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Inverted epi

Bolstering carrier capture in nitride quantum wells

Material needs

Rising bubbler sales entice multi-national materials company

Pyramid potential

Shaping LED creates a monolithic white source

Light extraction

Dielectric pillars draw more light

Plasma etching

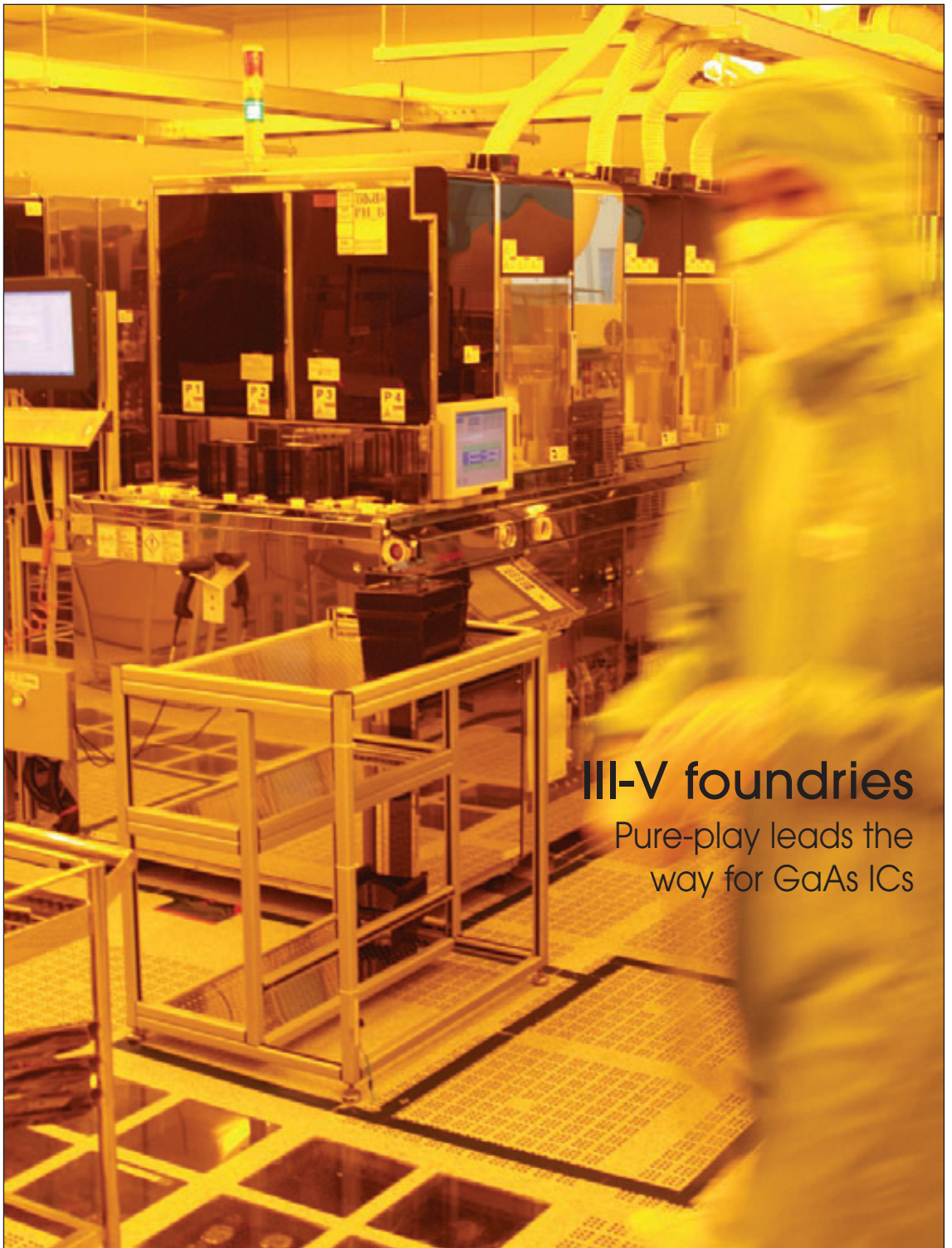
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Research review

Electron blocking layers have little impact in semi-polar green lasers



III-V foundries

Pure-play leads the way for GaAs ICs

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AIXTRON

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It's not what - it's how

Some arguments seem to go on forever. One of these that has already been debated over and over again concerns the most profitable way to manufacture GaAs ICs. Some claim that making everything in-house is the best way to go, while others believe that it is better to outsource. And there is a third camp that will champion a hybrid strategy, which combines the best bits of the first two approaches.

Whatever side you are on, you can point to the successes of several companies that have adopted one of these methods. And what that tells us is this: It ain't what you do, it's the way that you do it.

In this issue we take a close look at one of the firms that has underpinned the success of the outsourcing approach - WIN Semiconductors. This Taiwanese foundry, which I visited in early November, is the leading provider of GaAs ICs and could justifiably claim to be the TSMC of the GaAs world.

WIN has come a long way in a very short time. Founded in 1999, this GaAs foundry took until August 2006 to turn in its first monthly profit, but since then it has gone from strength to strength, ramping revenues at an annual growth rate of almost 50 percent.

Its success is partly down to the deep pockets of its patient investors, its broad portfolio of products and its competitive pricing, which partly stems from a relatively low wage bill. However, one should not underestimate the attractiveness of its manufacturing philosophy, which is to offer the world a pure-play foundry in GaAs. In other words, WIN only makes products for other companies, and there is never any conflict in the fab between internal production and making products for others.

This Taiwanese foundry is now heading into a new era: It's currently laying the foundations for GaN RF and power electronics products, and it is also developing a range of new services for its customers, such as copper bumping and plastic packaging.

But more exciting than any of these ventures, it will soon make its debut on the stock exchange. With such a promising program of new initiatives in the pipeline, the company promises to offer a good return to investors.

However, the global economy is still in turmoil, with the problems of the eurozone denting confidence the world over, so it will be interesting to see how willing investors are to pump cash into WIN in the current climate. The good news is that we'll not have to wait that long to find out.

Richard Stevenson PhD
Consultant Editor

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European project targets more efficiency for power electronics

LOW ENERGY consumption and high output powers are the core requirements for modern power converter systems. Power transistors are the elementary devices in electronic power converters transforming continuous and alternating current into the voltages used by systems. Such transistors can be found in almost every technical device.

Over the next three years, the EU project HiPoSwitch, which is coordinated by the Ferdinand-Braun-Institut (FBH), is focusing on novel GaN-based transistors. They are the key switching devices which shall ensure increased efficiency in future power converter systems and shall require less volume and weight along with enhanced performance. Usually, the efficiency of present systems is largely limited by the active components used. Nowadays, they are mostly based on silicon which has now advanced to the point that the material itself is basically at its limits.

SiC, on the other hand, is rather expensive and will thus prevent more widespread applications. With its superior material properties, GaN promises to be a suitable material for power switching. It is the basis for power switches operating at significantly higher frequencies without suffering from major switching losses. This is due to the drastically lower on-state

resistance of GaN power transistors, combined with considerably reduced in and output capacitances.

The joint project has a total budget of € 5.6 million and is being funded by the European Community who aim to provide nearly € 3.6 million.

Eight European project partners provide a portfolio of complementary competencies covering the complete value added chain, from research and development ((FBH ; Slovak Academy of Sciences, Institute of Electrical Engineering; Vienna University of Technology; University of Padua) to industrial application (Aixtron SE, Artesyn Austria GmbH & Co. KG, EpiGaN, Infineon Technologies Austria).

After project completion, GaN power transistors and 200 mm GaN-on-silicon substrates will be commercially available and marketed worldwide.

Throughout the project, normally-off GaN power transistors in vertical device architecture will be jointly developed by the German research institute FBH and Infineon. Processing will be carried out mainly on GaN-on-Si wafers provided by EpiGaN but also benchmarked against GaN-on-SiC epitaxial wafers delivered by FBH. This work package aims at rapidly



transferring the process modules from FBH to the high-volume process line at Infineon. Explorative concepts towards novel normally-off power transistors and devices operating.

In parallel to the device developments, the industrial partners concentrate on transferring the technology developed to a high-volume production environment: The Belgian company EpiGaN focuses on 200 mm GaN-on-Si epitaxy developments whereas the German corporation Aixtron sets the prerequisites for high-volume epitaxy by optimising the respective growth reactors.

Infineon Technologies Austria AG evaluates the developed transistor concepts and the GaN-on-Si wafers from EpiGaN in their process line. Artesyn Austria will finally demonstrate the capability of the newly developed technology by building a highly efficient kilowatt class inverter system to be implemented, for example, in new-generation base stations for mobile communications.

Mobile broadband device market to hit 525 million by 2016

THE UK market analyst Strategy Analytics is predicting that the Mobile Broadband Device market will claim a global installed base of over 525 million units by 2016. The report, "Mobile Broadband Devices: 5-Year Market Forecast for Embedded and External Modems," shows steady growth for external modems over the forecast period.

This expansion will be driven by device costs, more flexible tariffs, a shift to LTE and growth in mobile hotspots for multiple devices, such as tablets and other consumer electronics. Embedded modems, however, will experience slower growth due to the higher cost of embedding cellular capabilities and the

need for additional data services. "Strategy Analytics anticipates continued growth in mobile broadband devices as operators improve user segmentation, such as flexible plans and content bundling all underpinned by LTE," commented Andrew Brown, Director, Wireless Enterprise Strategies and author of the report.

"Mobile hotspots have been a highlight in this sector, typically enabling up to five devices at a time to connect anywhere on one data plan. The growth in the number and variety of Wi-Fi enabled devices, has considerably increased the value proposition of these mobile hotspot



devices," he added.

This Strategy Analytics report includes forecasts of shipments of mobile broadband devices, both embedded and external, as well as sizing of the installed base of mobile broadband devices. Also included in this report is further segmentation for embedded and external mobile WiMax devices.

Plasma-Therm welcomes order for VERSALINE system

PLASMA-THERM, a supplier of plasma process equipment, has sold another multi-chamber VERSALINE production system for etch and deposition to a leading North American wireless compound semiconductor manufacturer.

The process modules include an Inductively Coupled Plasma (ICP) etcher for additional capacity for advanced

backside GaAs via formation. A second module utilises Plasma Enhanced Chemical Vapour Deposition (PECVD) for highly controllable, low damage, low stress SiN deposition for demanding applications such as capacitors and passivation.

Each process chamber includes Plasma-Therm's EndPointWorks technology to ensure maximum via etch yield and real-time film thickness monitoring.

These orders compliment an installed base of Plasma-Therm VERSALINE and Versalock equipment at this site.

"Plasma-Therm has been an integral equipment supplier for wireless chip manufacturers for many years. Repeat orders based on a history of reliable, superior performance affirm our abilities to providing outstanding solutions to challenging compound semiconductor manufacturing issues," explains Ed Ostan, Senior VP of Marketing.

"Our wireless device manufacturing customers are attracted by the breadth and depth of our technology spanning etch and deposition processes and our collaborative efforts with customers to ensure maximum value."

Emcore's portable Terahertz spectrometer

EMCORE Corporation is launching the PB7200 portable frequency domain Terahertz (THz) spectrometer.

Demonstrated at the recent IRMMW-THz Conference in Houston, TX, the PB7200 is designed for THz researchers and application developers who need to study the properties of materials at THz frequencies with high resolution.

Key applications of this technology are explosives characterisation and detection and non-destructive material inspection.

The PB7200 is the first truly economical THz system that can sweep from 100 GHz to over 2.0 THz in a single rapid scan with high-frequency resolution. It employs precisely tuned, fibre-coupled, semiconductor lasers with highly advanced photomixers for signal generation and detection.

In addition, the PB7200 features sophisticated digital control hardware and software to provide a fully turnkey, portable THz spectrometer.

"The PB7200 represents a breakthrough in the field of THz technology because it offers outstanding performance at half the price of competing systems. It can support single frequency or broadband frequency range operation in specific spectral regions of interest with varying degrees of resolution. This versatility makes it a valuable tool for multiple applications," said Joseph Demers, Advanced Photonics Principal for Emcore.



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40 Gbit/s VCSELs combine speed and reliability

RESEARCHERS working on the European Commission funded Vertically Integrated Systems for Information Transfer (VISIT) programme have demonstrated high reliability Vertical Cavity Surface Emitting Laser (VCSEL) devices operating at data rates of up to 40 Gbit/s.

VISIT is an EU funded programme with the remit to focus on strategic, high-value photonic components and subsystems for scalable economic broadband access and local area networks.

The central objective of the VISIT programme, which started in October 2008, is the research, development, test and exploitation of system-enabling optical transmitters having a completely novel design and/or largely improved functionality as compared to current technology.

The directly modulated VCSEL devices, fabricated on material grown by IQE at its Cardiff facility, operate at 850nm, which is the current standard wavelength for optical fibre applications used in short-reach data communication and storage area networks.

The new technology increases data throughput by up to 400 times the speed of current copper Ethernet systems and four times that of the latest optical technologies. The VCSEL devices also demonstrated superb temperature stability



in the linear region of the light power versus current characteristic with a less than $25 \mu\text{W}/^\circ\text{C}$ change in emission power for operation below 6 mA at temperatures between 20 to 100°C .

The peak output power exceeded 8 mW for multi-mode operation and up to 4 mW for single mode operation, all with differential slope efficiencies exceeding 70% at up to 40°C .

Multi-mode VCSEL device operation was demonstrated at current densities well below $10 \text{ kA}/\text{cm}^2$, which is a critical factor in determining device reliability. This is expected to greatly improve with the further development of single-mode VCSELs. The VISIT team has also produced the first 40 Gbit/s packaged VCSELs, complete with an OM3 fibre pigtail and a high frequency electrical V-connector for ease of system-level optical link testing and development.

The prototype VCSEL devices fabricated using new device processing techniques and device geometries on wafers produced by IQE's optoelectronic facility in Cardiff, UK, operated reliably at 40 Gbit/s in initial tests, making them suitable for optical interconnectors as well as for optical fibre networks for high data rate applications such as data centres.

The next development stage under the VISIT programme will focus on final directly modulated VCSEL benchmarking and design and processing refinement including device designs for reliability and manufacturability. The VISIT team will also work on further improvements in the packaging and testing of optical transmitter subassemblies.

The VISIT Project is funded by the European Commission Framework 7 Programme with Project Officer Michael Hohenbichler.

The project is led by Dieter Bimberg of the Technical University of Berlin (Germany), and includes also the following project partners: IQE (UK), Intel, (Ireland), VI Systems GmbH (Germany), Chalmers University of Technology (Sweden), The University of Cambridge (UK), University College Cork via the Tyndall National Institute (Ireland), Riber S.A. (France) and the A.F. Ioffe Physical-Technical Institute of the Russian Academy of Sciences (Russia).

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Infrared power Topled raises the bar with 80 percent higher output

The new Power Topled with lens (SFH 4258S/4259S) from Osram Opto Semiconductors has an 80 percent higher optical output than the standard version of the infrared LED. This, says the firm, is despite the same surface area and the same current.

This boost comes from a special thin-film chip which, thanks to Nanostack technology, has not just one but two p-n junctions that are grown one on top of the other. The resultant increased range will have all benefit applications in the

security sector and in gesture recognition. The IR Power Topled with Nanostack technology chips provide high optical output and open up new design options – particularly in the security sector. More light from the same surface area will always be needed if space is tight, if a greater range is required or if light has to be distributed evenly over a greater area. This can be often achieved more flexibly with a large number of small LEDs than with a small number of large LEDs, and price also plays an important role here.

Apart from the Nanostack chip and the associated higher output the new infrared Power Topled is the same as the standard version and can therefore be used as a simple direct replacement. The package dimensions (footprint) remain the same so existing designs can continue to be used. Because of the series circuit the voltage is higher by about factor 2.



The infrared Power Topled produces an optical output of 80 mW from an operating current of 70 mA – around 80 percent higher than the standard model from the same current. The new LED emits at a wavelength of 850 nm and is therefore a good compromise between maximum spectral sensitivity for CCD and CMOS cameras and suppressed visibility for the human eye. It is available with beam angles of +/-15° (SFH 4258S) and +/-25° (SFH 4259S) from two different lens types.

The new LED is particularly useful for infrared illumination, especially in security systems. In CCTV applications the range can be increased significantly with the same number of LEDs. The main area of application in the consumer sector involves camera-based gaming as this is where high optical output has the greatest benefit.

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Breakthroughs in LED technology boost beam angle

Gem Hsin Electronics has made new advances in research and development of LED lighting products. The firm claims its latest developments enable wider beam angles than its competitors and unparalleled light uniformity. Combined, Gem Hsin's says these patented design achievements give its latest products a superiority that is unmatched in the LED industry. Gem Hsin has already started incorporating these cutting-edge research breakthroughs into their line of T5 / T8 LED Tube Lights.



these wider beam angles, provide unmatched natural LED light for home and office environments.

Gem Hsin's R&D team has also developed a new way to position LEDs into tube lights. Whereas other LED makers use a single row of LEDs in their tube lights, Gem Hsin is now implementing a design that increases uniformity and quality of light by using two, staggered rows of LEDs.

T8 LED tube light Gem Hsin's engineers, with their extensive backgrounds in cooling, have made significant breakthroughs in reducing the size of the heat-sinks needed in their LED products. Using laser-precision technology, extremely small holes are drilled beneath each LED, creating direct paths for heated air to escape to the heat-sink.

This improvement may appear minute but means that LEDs will stay cooler, improving efficiency and lifespan, and at the same time require less heat-sink mass for thermal optimisation. What's more, this design breakthrough enables Gem Hsin to offer lighting products that have much wider beam angles, up to 220 degrees, as compared to competitors who typically can only offer beam angles of 180 degrees. One of the major criticisms of LED light has been that it is too focused and unpleasant, but

Instead of uneven light with unsightly bright and dark areas, Gem Hsin's T8 LED Tube Lights produce, along their entire length, exactly the same high-quality, natural, soft light that consumers have been waiting for in an LED tube light. Both of these engineering accomplishments have already been recognised as unique inventions and granted patents in Japan and Taiwan. Furthermore, Gem Hsin has started incorporating them into their line of T5 / T8 LED Tube Lights that use 20% less energy than competing products and are available in two-foot-long, three-foot-long, four-foot-long, and eight-foot-long models, providing users with substantially lower operating costs.

First Solar to provide Alpine Solar project for NRG Energy

NRG Energy and First Solar, have signed an agreement for First Solar to provide engineering, procurement and construction (EPC) services for NRG's 66-MW (AC) Alpine solar project in Lancaster, California. First Solar will also provide operations and maintenance (O&M) services.

Electricity from the Alpine project will be sold under a 20-year power purchase agreement with Pacific Gas and Electric Company, helping California meet its ambitious renewable energy goals. Construction is expected to start before the end of 2011 and be completed in Q3 2012, creating an estimated 250 jobs over the course of construction. The project will use First Solar's advanced thin film CdTe photovoltaic (PV) modules.

The electricity generated by Alpine is enough to serve a yearly average of nearly 25,000 homes, and more than double that number at maximum capacity during peak hours of the day. The project is expected to offset approximately 1.5 million metric tonnes of greenhouse gases over 20 years, the equivalent of taking over 15,000 cars off the road annually.

"Less than two years ago, NRG and First Solar began our collaboration for our first solar plant at Blythe, which was the largest solar plant in California at the time. Alpine is three times that size, so we've really come a long way together in a short amount of time," said Tom Doyle, president of NRG's Solar and West Region.

"First Solar is excited to be working again with NRG," said Jim Lamon, First Solar Senior Vice President for EPC and O&M. "Our experience developing and building out our 2.7 gigawatt North American pipeline of utility-scale PV projects enables us to get our customers' projects rapidly completed and connected to the grid."

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World's most productive MOCVD reactor revealed by Aixtron

AFTER the successful introduction of CRIUS II-L, Aixtron SE is announcing the next milestone in terms of MOCVD reactor productivity.

The novel CRIUS II-XL configuration offers a reactor capacity as high as 19x4 inch, thus providing one of the world's highest throughputs and productivities. Additionally, Aixtron says its CRIUS II-XL provides best-in-class cost of ownership and footprint efficiency.

CRIUS-II-XL in 19 x 4 inch configuration CRIUS II-XL builds on the hardware setup of CRIUS II-L. "The only part that needs to be exchanged is the susceptor plate, which means that the larger capacity comes with virtually no extra cost", states Johannes Lindner, Aixtron's program manager for Close Coupled Showerhead (CCS) reactor technology. "This was one of the key design criteria in order to make the transition from CRIUS II-L to CRIUS II-XL as smooth as possible. Furthermore, only very minor process tuning factors need to be applied to transfer processes to CRIUS II-XL."

This latest version of the CRIUS reactor family is again a result of a detailed analysis of market requirements, in particular with respect to LED manufacturing cost. "There is a strong need for cost-efficient LED manufacturing,



and we know how much MOCVD can contribute to this cost reduction", says Rainer Beccard, Vice President of Marketing at Aixtron.

"Amongst many parameters, it is the reactor capacity which has the biggest impact on the total cost of ownership. Thus we have decided to design a 19x4 inch setup. This configuration has been extensively tested in Aixtron's application lab, making sure it provides perfect uniformity and yield together with its impressive capacity. The system is optimised for wafer sizes between 2 inch and 8 inch; changing from one wafer size to another requires a simple carrier plate exchange without further hardware or process adjustment."

CRIUS II-XL is the latest addition to Aixtron's CCS product line, which has proven to provide ultimate process stability and robust operation through many years.

Cree's Ruud Lighting to expand plant

Cree's Ruud Lighting subsidiary, based in Wisconsin, have begun a 208,000-square-foot expansion to its manufacturing facility. The M \$24.5 investment will focus on manufacturing and assembly of LED lighting and is expected to create 469 new full-time jobs over the next four years.

"Cree's recent acquisition of Ruud Lighting and its BetaLED products brought together two leading LED lighting companies under one roof," said Chuck Swoboda, chairman and CEO of Cree. "Last month this facility shipped its 500,000th LED luminaire."

The expansion will extend component and product storage capacity and house several new manufacturing lines for new

and existing Cree LED lighting products. In addition to the 208,000 square-foot facility, the investment will include equipment needed to expand the company's current manufacturing operations.

Most of the full-time jobs will be assembly positions, with other opportunities to follow along with expected growing demand for LED lighting products.

To help offset the company's \$24.5 million investment, Ruud Lighting will receive incentives related to local job creation from sources including the Wisconsin Economic Development Corporation, Racine County Economic Development Corporation and the Village of Sturtevant, totalling more than \$8 million.

SSE reaches Summit with investment

SUMMIT PARTNERS has completed a significant investment in Solid State Equipment (SSE), a manufacturer of single wafer wet processing equipment for the semiconductor industry. SSE will continue to focus on several high-growth segments of semiconductor manufacturing, including advanced packaging processes, mobile communications and mobile computing products, and LED devices. The investment was made in July, 2011.

Founded in 1965, SSE designs and manufactures capital equipment for leading semiconductor companies. The company provides outstanding products and services for the integrated circuit industry that can be configured to a specific customer's needs, while leveraging standard platforms and proprietary technology to drive efficiencies. SSE provides sales and technical support through its global network of direct and independent representatives.

Herman Itzkowitz, Solid State Equipment's President and CTO, said, "Summit Partners' investment is a vote of confidence in our business model and our leadership position in the industry. Summit Partners has provided us with the growth capital necessary to continue our track record of success in important growth segments of the semiconductor industry."

Added Rich Richardson, Solid State Equipment's Chairman, "Summit Partners' industry experience will be an invaluable resource as we enter our next stage of growth."

John Carroll, a Managing Director at Summit Partners who will join the Solid State Equipment Board of Directors, said, "Under the leadership of Rich and Herman, Solid State Equipment has established an exceptional track record through its proprietary technology and exceptional engineering capabilities. We are pleased to partner with Rich, Herman, and the management team to support the company's growth."

Expanding services in the pure-play market

WIN Semiconductors could easily rest on its laurels after grabbing the lion's share of the GaAs foundry business. But that's not the plan for this Taiwanese chip maker: Instead, it is expanding and refining its portfolio of GaAs technologies; it is preparing to introduce new GaN, packaging and copper bumping technologies; and it is getting ready to make its debut on the stock exchange. **Richard Stevenson reports.**

If you take a close look at some bridges you'll wonder why they were ever built. They are rarely used and their value can only be judged by the quality of the architecture – which may be good, or it may not. Other bridges, however, heave with dense traffic throughout day and night and their benefits are obvious to all.

It's the latter kind of bridge that you'll find at the headquarters of the Taiwanese GaAs foundry WIN Semiconductors, which in this case provides a link between the first phase of fab B and its extension. The seemingly endless toing and froing across this bridge reflects the pace of work throughout this colossal fab and its cousin, fab A. Both cleanrooms are always teeming with activity as scores of operators and engineers run vast numbers of wafers at high speeds through various processing and testing tools. The upshot of all this effort is the churning out of many, many wafers in quick time.

"We now have around 16,000 wafer starts per month," explains WIN's CEO, Yu-Chi Wang, who speaks excellent English that betrays many years spent in the US, first as a graduate student at Rutgers University, New Jersey, and then at Bell labs, where was involved with the design and process development of III-V devices for optical communication.

Under the guidance of Wang, who joined the company at its outset, this Taiwanese foundry is now making enough ICs to put it at the very forefront of the GaAs foundry business. According to Strategy Analytics of

Milton Keynes, England, WIN had 46 percent of the GaAs foundry market in 2010, up from 40 percent in 2009 and 38 percent in 2008. In comparison TriQuint, the company's biggest rival, has weakened its grip on this market - its share has fallen from around 40 percent in the late noughties to just 28 percent in 2010.

A little history

WIN has had a fast and eventful journey to the top. Founded in October 1999 amidst the ballooning of the internet bubble, it was one of eight Taiwanese firms with a dream of setting up a GaAs foundry that could mimic the country's incredibly successful silicon powerhouse, TSMC.

Back then many experts within the III-V industry were tipping a massive ramp in GaAs IC manufacture to fulfill demand for drivers for lasers and modulators, which would be deployed in the build-out of a new generation of optical networks.

Aided by the very deep pockets of two local investors, Dennis Chen and Kuo-I Yeh, WIN built a fab at the Hwaya Technology Park, which is located on the outskirts of the nation's capital city, Taipei. Into this space went the tools needed to process 6-inch GaAs epiwafers and manufacture millions and millions of ICs, plus equipment to test die for DC and RF characteristics prior to shipment. Within 18 months engineers had developed several technologies, including a 2 μm processes for making an InGaP HBT, and 0.15 μm,

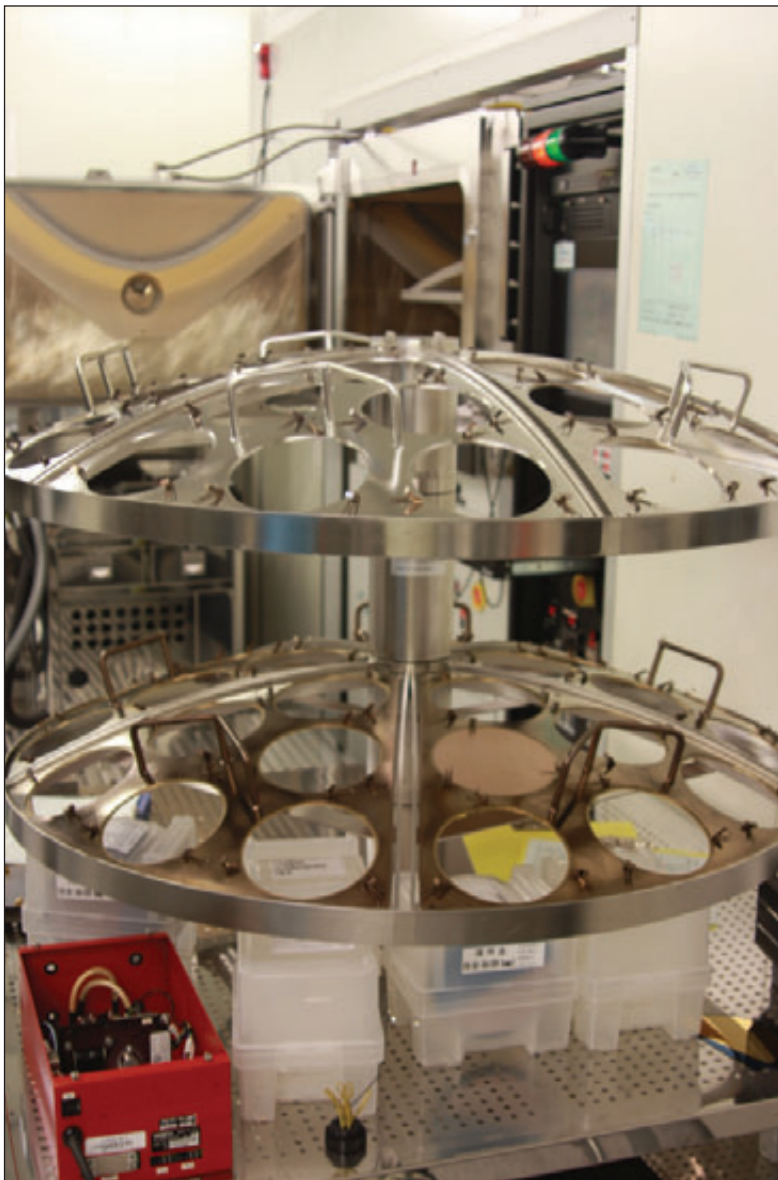


Photolithography of GaAs HBT and pHEMT wafers to form a range of ICs

0.25 μm and 0.5 μm processes for building pHEMTs. By 2003 these processes had been tuned for high-volume production and WIN was ready to start filling its order books. But by then the market was markedly differed from that of the late 1990s, where hype ruled over reality. Demand for optical components had now fallen through the floor, and although more and more GaAs was being used in handsets, the big fabs in this arena were still operating way below their full capacity.

Gold metallization of 30 GaAs 6-inch wafers in single tool

At this point Chen grabbed the reins, moving from a back-seat investor with a position on the board to chairman of WIN, where he took responsibility for the company's activities on a daily basis. This mode of operation continued for several years, until Chen appointed a CEO to take over the helm.



Getting through lean times

Although concerned by a lack of orders, Chen had no doubts whatsoever about the strengths of WIN's long-term prospects. To enable the company to survive through to those golden years when the GaAs IC business would take off, he brought in further investment. Some funding came from banks in Taiwan, and some from Chen and Yeh, the initial investors.

Chen also put a strategy in place to allow WIN to make the best use of this lean period. He believed that it would be foolish to expand the entire business at that time, but he did decide to increase R&D activity so that when the market improved WIN was ready to win business with a broad portfolio of HBT and pHEMT technologies. These could serve many markets, including cellular, satellite communications and point-to-point radio.

It's a strategy that has born good fruit. In 2004 the company starting making a small number of products for WLAN, and it followed up that success by entering the 2G cellular market. However, business was slow, and the company suffered from a few setbacks along the way, one of which it could do nothing about. In 2005 Taiwan's III-V industry grabbed the headlines for all the wrong reasons, when Procomp Informatics chairwoman, Sophie Yeh, was found guilty of embezzlement and handed a 14-year jail term. WIN had to explain to customers that Procomp was the exception rather than the rule in Taiwan's III-V industry, and convince everyone that if they placed their faith in this pure-play foundry, they would not be let down.

WIN also had to watch from the sidelines when one of its competitors in the GaAs foundry market, UK firm Filtronic, won a big supply contract with RFMD for pHEMT switches in 2005. (However, with hindsight, that contract did no favours for Filtronic. This firm became far too dependent on RFMD, who had the upper hand in this partnership and eventually bought the UK fab on very favourable terms.) During that time, however, WIN could console itself with a Japanese contract for pHEMT switches that enabled it to hone this particular technology.

By the middle of the last decade plummeting wafer costs had increased the difficulty for any foundry to turn a profit. While global GaAs revenue in 2006 was very similar to that in 2000, manufacturing volume, in terms of wafer output, had risen six-fold. In other words, even ignoring inflation, wafer prices in 2006 were one-sixth of that at the turn of the millennium. To succeed in such an environment companies would have to mix great technology with high levels of investment and a willingness to take substantial risk, all in return for selling products at relatively low prices.

It's a game that WIN excels at, and by 2006 it was starting to win significant business thanks to the rising demand for GaAs ICs. Many companies started to qualify their products with this Taiwanese foundry, including three big US firms, Skyworks, Avago and Anadigics, and WIN's revenue from then on has grown at a compound annual growth rate of almost 50 percent to hit \$210 million in 2010 – this year it will be even better. In comparison, the average revenue growth in this industry over the last six years is just 13 percent, according to Strategy Analytics.

WIN has also started to turn a profit: In August 2006 the company's income outstripped its expenditure for the first time, and since 2007 there has been a double-digit percentage increase in profit every year.

The success of WIN stands in stark contrast to the failings of other Taiwanese ventures that had plans to build GaAs fabs at the turn of the millennium. In many cases these fabs never got off the ground, and although Suntek bucked this trend, it subsequently failed due to the collapse of one of its parent companies, Procomp. Why has WIN managed to plough a different path and succeed on its own?

Deep-pocketed investors have certainly helped and the company has good people in key positions that are helping to drive up yields, trim cycle times and ultimately enable the company to price its products very competitively. But arguably the real key to WIN's success is the pure-play nature of its foundry – it does not make its own products or perform its own circuit design. "Therefore we do not compete with our customers in the same market," explains Wang.

GaAs ICs for Wi-fi account for one-fifth of WIN's revenue and a similar proportion comes from a collection of niche markets, such as high-frequency point-point radios, satellite communications, and fibre optic components. But the lion's share – the remaining 60 percent of sales – is associated with handsets. Cell phones can feature a pHEMT circuit for switching and house several power amplifiers, all built from HBTs, to deliver signal gain at various frequencies. In this sector more than two-thirds of the company's revenue comes from the manufacture of HBTs, which can be produced with yields in excess of 98 percent.

WIN will soon release a fourth generation of its HBT technology, and it is already developing a successor to that, which will support production of a new generation of power amplifiers delivering multi-mode, multi-band technology. "You have to support GSM and UMTS at the same time," says Wang. To succeed, amplifiers must combine a very small footprint with excellence in three

Deep-pocketed investors have certainly helped, and the company has good people in key positions that are helping to drive up yields, trim cycle times and ultimately enable the company to price its products very competitively. But arguably the real key to WIN's success is the pure-play nature of its foundry – it does not make its own products or perform its own circuit design. In other words, it does not compete with its customers in the same market

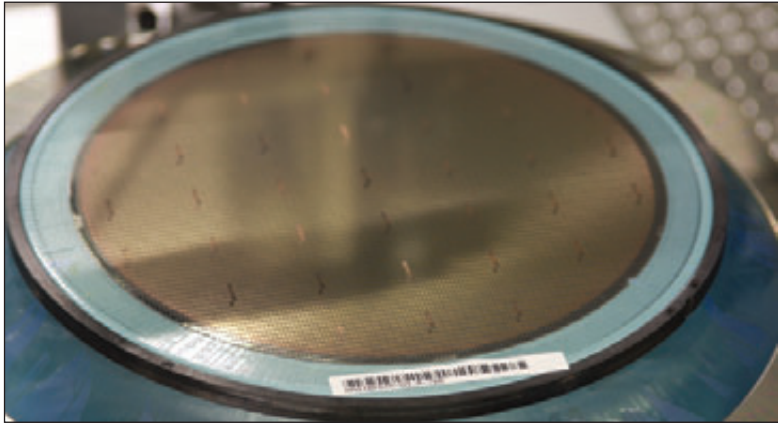
areas: They must be rugged enough under an extreme load mismatch condition to meet the demand of GSM; they must have a high enough linearity for UMTS, which is a requirement for WCDMA; and their power efficiency must be very high. WIN is tackling all these challenges, and Wang says that it is making good progress.

Switching HBTs

During the last few years, many leading GaAs manufacturers have developed circuits incorporating more complex devices, known as either BiFETs or BiHEMTs, which unite an amplifier with a switch. WIN has not been left behind - it has its own variant of this technology that is known as the H²W process. This has been used by several customers to make products for wireless markets.



Optical inspection of 6-inch GaAs wafers in fab B



Die from the 6-inch wafer

“Some of our customers had product releases using the BiHEMT for WiMAX applications that were extremely successful and were qualified by the biggest WiMAX company,” says Wang. Although sales of WiMAX products have subsequently faded, the underlying technology is strong, and some of WIN’s other customers are designing next-generation power amplifiers with the H²W process.

WIN is continuing to refine its BiHEMT technology and it is now on the verge of releasing a new H²W process. “The problem of BiHEMTs is that they are made using a very complicated, very long process,” says Wang. “We have simplified the process and made the device performance better.”

The company is also looking to expand its range of technologies so that it can grow its business. Over the coming months and years WIN will introduce GaN processes, first on SiC substrates and then on silicon. In addition, it will launch packaging services and a copper bumping technology that replaces wire bonding.

“GaN is a technology with great potential,” says Wang, who points out that this material can make devices for high-frequency microwave applications and cable TV, and it can also yield switches for improving the performance of power grids and converting the DC output from solar cells into an AC form.

One of the strengths of WIN’s copper bumping technology, which is applicable to ICs made with both its HBT and pHEMT processes, is that it can significantly reduce in the overall footprint of the

amplifier by elimination of wire bonds. This is not the only benefit, however – the emitter, the hottest spot on the HBT, operates at a far lower temperature due to superior heat dissipation that stems from a ten-fold increase in the thickness of the copper.

This increases the efficiency of the HBT, improving its linearity thanks to a reduction in channel temperature. One upshot of this is that these devices can be packed closer together because they are running cooler.

What’s more, it is possible to eliminate backside processing with copper bumping, which in turn trims processing costs. Yield also goes up because there is no longer a need to control the length of the wire bond. “With packaging technology, it’s not our goal to go for high volume. We are not trying to do a packaging service for cellular power amplifiers,” says Wang. He believes that it would be very challenging for WIN to try to compete on cost with large packaging houses, and a better approach is to concentrate on providing a fast turnaround for customers’ packaged prototypes, so that they can be evaluated quickly and help to reduce time to market.



Right: A vast army of tools test production die. For a premium, customers can have every single die of theirs tested - the other option is to have a carefully selected proportion of these chips examined prior to shipment

Although packaging and copper bumping services will help to swell WIN's coffers, sales will continue to be dominated by shipments of GaAs ICs for handsets, which Wang tips to rise for several years to come. He believes that the turmoil in financial markets will not have a big impact on smartphone sales, which will increase by 50 percent from 2010 to 2011, and then go up another 40 percent and 30 percent in 2012 and 2013, respectively. "The next wave will be the entry-level smartphone, which will replace the 2G feature phone and further increasing GaAs demand."

Looking further ahead, Wang expects the launch of LTE and 4G handsets to start in two years' time. These next-generation smartphones could combine GaAs HBTs with switches based on silicon-on-insulator technology. "That's why, for our switch, we are focussing on how to make our performance better, insertion loss much lower, and the die size much smaller – even going to a third dimension."

A buoyant smartphone market will help to drive up WIN's orders and enable the company to get closer to its current output capacity of 20,000 wafers per month.

As it gets closer to that figure, it will be able to install more equipment in fab B, taking that capacity higher, and further down the line – maybe in the next three-to-five years – it will increase capacity once again by migrating to 200 mm wafers.

In tandem with these efforts, WIN will continue to develop its GaN products, plus its copper bumping and packaging technologies. To partly fund these activities, WIN is generating cash through its launch on the Taiwan GreTai Securities Market. It's going to be a busy time for this pure-play foundry, which already could lay claim to be the TSMC of the GaAs world.

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WIN's headquarters at Hwaya Technology Park on the outskirts of Taipei has two fabs with a combined capacity of 20,000 wafers per month



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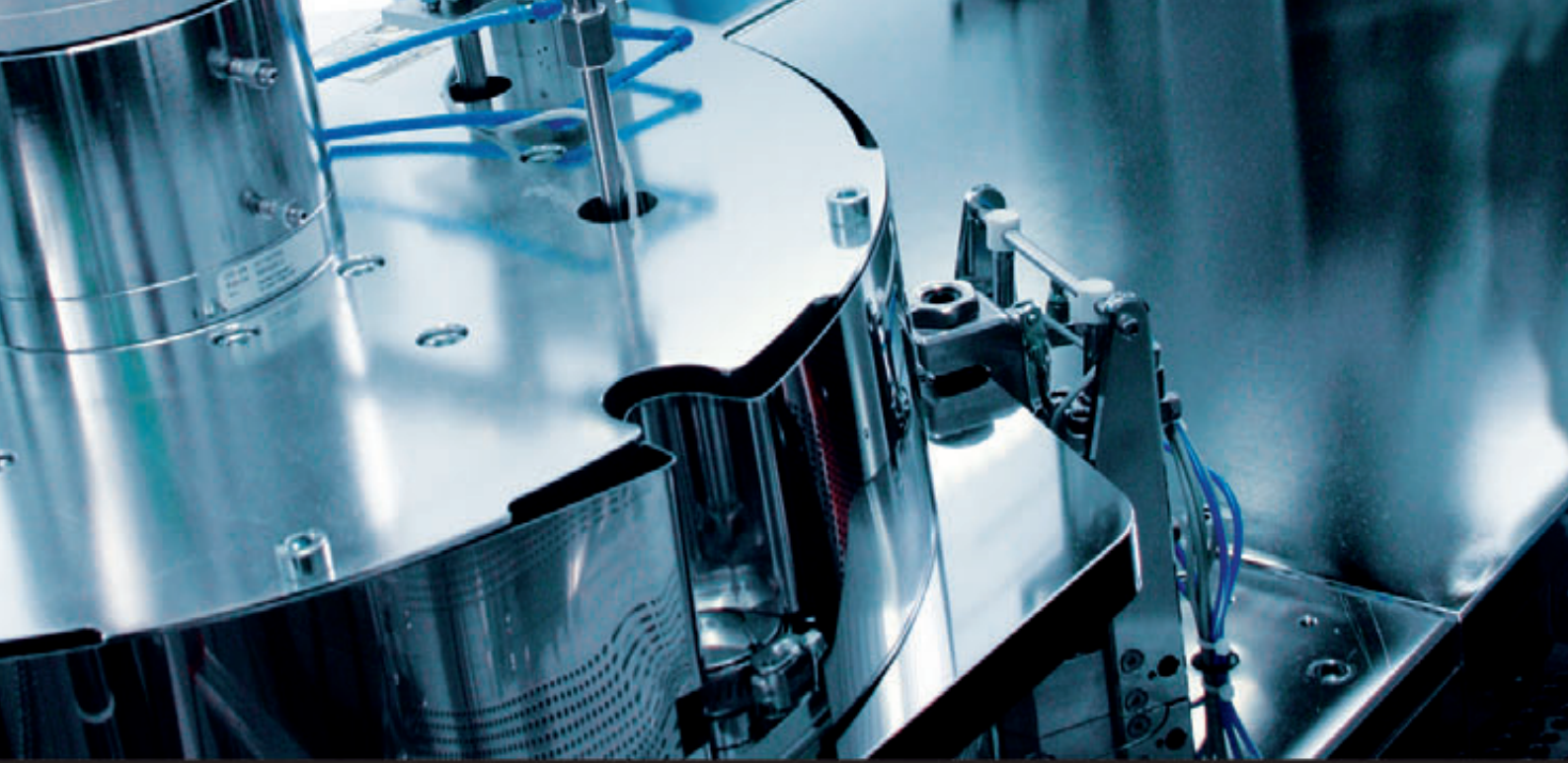


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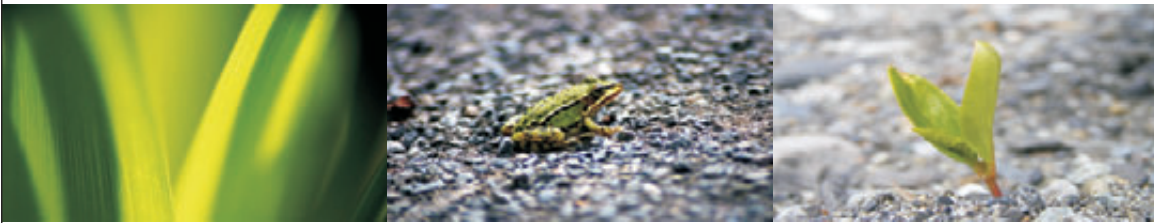
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Inverted epitaxy boosts LED efficiency

Light generation in traditional LEDs is hampered by poor hole doping and an internal electric field that suck carriers out of the active region. The solution: Begin device growth with the p-type layers, because this bolsters carrier capture in the quantum wells and unlocks the door to polarization-induced hole doping, says Crosslight's Z.Q. Li.

LEDs only deliver strong performance when they have high internal quantum efficiency – a high ratio of photons generated to carriers injected. However, ensuring that this is the case in nitride LEDs operating over a wide current range is very challenging because in this class of device the internal quantum efficiency tends to plummet as the drive current is cranked up.

Uncertainty surrounds the cause of this efficiency decline that goes by the name of droop. Its origin is the subject of fierce debate, because understanding what

causes it will help to spur the fabrication of droop-busting LED architectures that can underpin a solid-state lighting revolution. At present, some groups are attributing the decline in internal quantum efficiency to various Auger mechanisms, while others are blaming defect recombination or a leakage current. However, no one is disputing that the inclusion of an AlGaIn electron-blocking layer (EBL) substantially improves the performance of GaN LEDs.

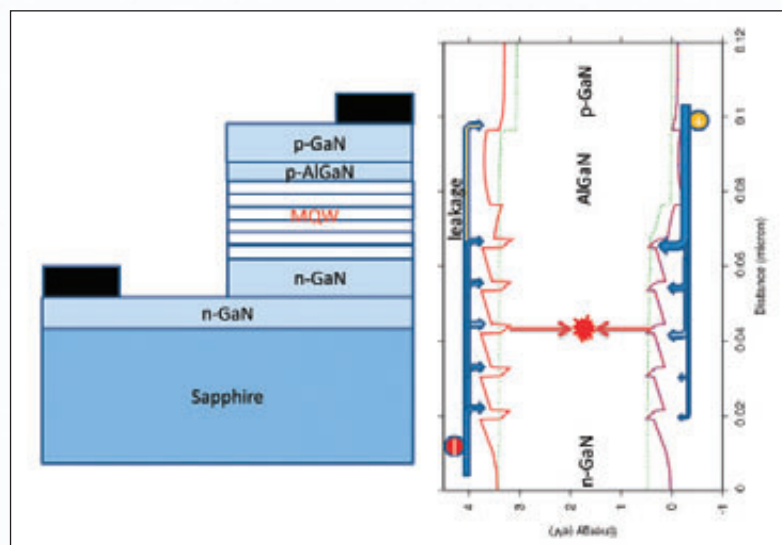


Figure 1. A traditional 'p-side up' nitride LED and a corresponding electron band diagram showing the carrier injection and recombination. Electrons are travelling upwards to the quantum-wells and holes downwards. Electrons with small effective mass cause current leakage while holes with big effective mass result in non-uniform hole density in quantum wells. Thus the internal quantum efficiency is low

One way to understand the benefits of the EBL is to first see how it works in a typical LED structure (see Figure 1). In this particular device, just like any other LED, efficiency is maximised by injecting as many electron and holes as possible into the quantum wells (QWs) and enabling incredibly efficient recombination in that trench. However, because electrons have a smaller effective mass and a higher mobility than holes, there is high likelihood that they cross the QW region and reach the p-doped region, rather than recombining to emit light in the QW. This current leakage does not generate any useful photons, and most of the recombination outside the QW is non-radiative.

To prevent electrons escaping over the QW region, engineers can insert a p-type $\text{Al}_x\text{Ga}_{1-x}\text{N}$ EBL to impede the progress of these carriers: The larger band gap of $\text{Al}_x\text{Ga}_{1-x}\text{N}$ acts as a road-block to electrons travelling outside the QW region. However, in nitride materials holes are about ten times heavier than electrons, and their mobility is roughly 20-30 times lower. Consequently, holes rarely cross the MQW region, leading to non-uniform distributions of hole density in the QWs and ultimately a low internal quantum efficiency.



Our efforts reveal that increases in the aluminium composition and thickness of the EBL can block electrons more effectively. But there's a catch - these measures impede hole transport, and the upshot is a degradation in LED efficiency

Improvements in this key figure of merit are possible by optimising the thickness, doping density and aluminium composition of the EBL. Exposing the perfect combination by experimental efforts would be very costly and time-consuming, and a modelling-based effort has far more appeal. Such an approach is possible using numerical tools that we have developed at Crosslight Software, which is located in Burnaby, British Columbia, Canada. Our software, which has been used by many academic and industrial researchers to design the active region and passive layers of LEDs, determines the carrier transport and optical generation in these devices using multi-dimensional finite-element analysis. All salient features for nitride semiconductors are catered for, including polarization charge at heterojunctions and the influence of different crystal orientations on QW properties.

The core of the LED – the multi-quantum well, EBL and contact layer – is usually designed with one-dimensional simulations; two- and three-dimensional simulations tend to be employed for uncovering and understanding issues related to packaging, such as thermal effects, current spreading and optical extraction. We have simulated LED performance for a range of devices with different AlGaIn EBLs. These efforts reveal that increases in the aluminium composition and the thickness of the EBL can block electrons more effectively. But there's a catch – these measures impede

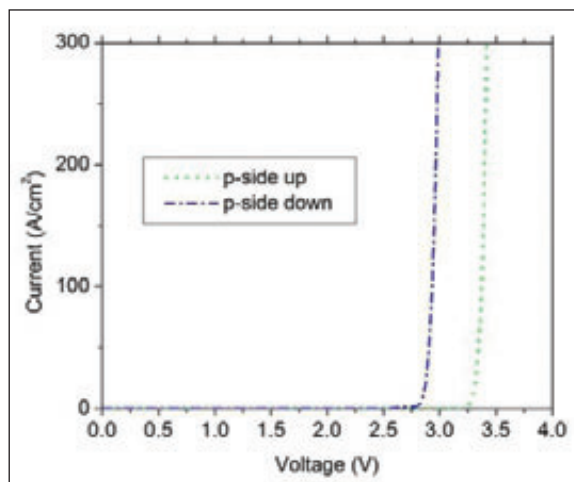


Figure 3. Voltage and current relations for a p-side up and p-side down LED device

hole transport, and the upshot is a degradation in LED efficiency. One theoretical solution to this problem is to ramp up the p-type doping density of EBL, a step that effectively increases the barrier for electrons and lowers that for holes. This is impractical, however, because it is difficult to obtain very high p-doping concentrations in GaN-based materials. The energy level for the commonly used acceptor dopant, magnesium, is very deep – at room temperature only about 1 percent is ionized and contributing to the hole density. Adding substantial amounts of magnesium into the structure is very difficult, and even if this were possible, it would degrade the device.

Debdeep Jena and co-workers from the University of Notre Dame, Indiana, have uncovered a possible way to overcome this hole doping issue. They have shown that an AlGaIn layer with a properly graded aluminium composition can induce hole doping due to the intrinsic polarization of these materials. This technique promises to circumvent many of the difficulties associated with magnesium doping because polarization-induced hole doping is not thermally activated.

Inverting the epi

Traditionally, LEDs are fabricated by growing an n-doped region on top of the substrate and adding QWs, an EBL and a p-doped region (see Figure 1). This configuration has a major downside: The electric field that stems from interface polarization charges between the quantum barrier and the well sucks the carriers out of this region, hampering efficient carrier capture in the well and leading to a high leakage current.

We have shown that a novel, p-side down LED architecture

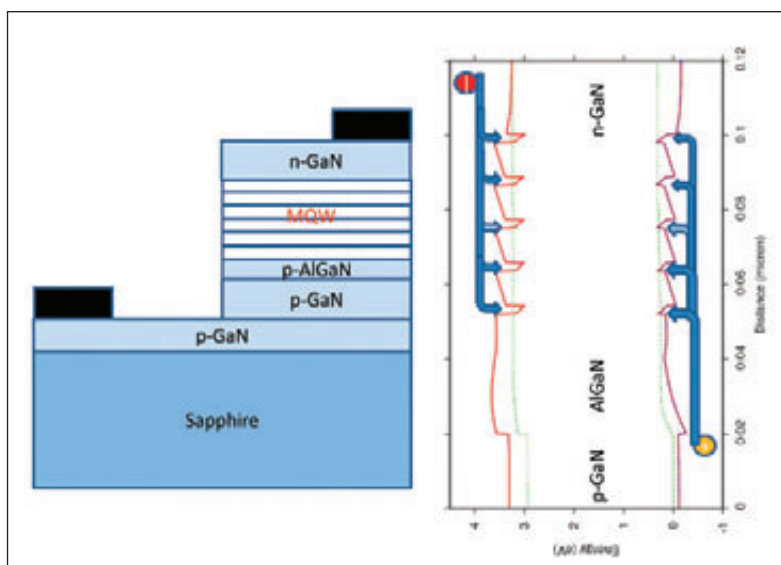


Figure 2. A novel, p-side down nitride LED that promises higher output powers and a lower forward voltage. An EBL layer with aluminium composition graded from 10 to 15 percent induces hole density in this layer. Note the direction of carrier injection is reversed, which helps quantum-wells to capture electrons and generate photons

can address this issue. Such a device, which features a p-type doped region adjacent to the substrate and an n-type region on top, operates with reversed current injection compared to the conventional structure (See Figure 2 for details of this LED's bandstructure).

This design has two benefits: Carrier capture is now more favoured than their escape, thanks to a switch in the direction of current flow; and hole injection is improved without resorting to excessively high levels of magnesium doping, because by putting the EBL layer at the bottom of the structure, it can be graded in a way that enables polarization-induced doping to increase hole density. Our simulations show that this inverted architecture enables a hike in the LED's output power, as well as a cut in its forward voltage.

Unfortunately, realizing such gains in real devices is not trivial. Growing high-quality p-side down devices is tricky due to diffusion of magnesium impurities, which are the most common p-type dopants associated with MOCVD. It should also be noted that many of the techniques for producing p-side down devices, such as lift-off, will not deliver the results promised by our simulations, because they flip the entire crystal upside down – this fails to reverse the direction of the current

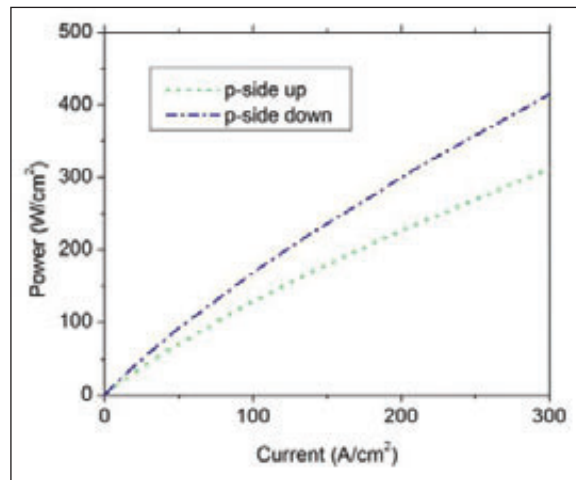


Figure 4. Power and current relations for p-side up and p-side down LED device

injection with respect to the growth orientation of the crystal. Nevertheless, given the rapid improvements of epitaxial technology in nitride compounds, we are optimistic that high-quality p-side down devices will make their debut in the next few years.

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Further reading

J. Simon et al.
Science **327**
60 (2010)
Z.Q. Li et al.
J. J. Appl. Phys. **50**
080212(2011)

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Albemarle amplifies the bubbler brigade

As a supplier of metal organic raw materials to companies providing MOCVD precursors, Albemarle had been quietly serving our industry for many years. Now the multi-national chemicals specialist is coming into full view by launching its PureGrowth line, a move designed to fulfil the hike in demand for materials for LED manufacturing. **Richard Stevenson quizzes Albemarle's Vice President, Performance Catalyst Solutions, Amy Motto, and the company Business Development Manager, Electronic Materials, Al Knight, about this venture.**

Q Why does the III-V industry need another supplier of metal organic precursors?

AM We got into this because the market pulled us. There was a huge shortage in the market in 2009 and 2010. Chipmakers could not get enough high-purity products to keep their plants running. We were getting calls from companies making LED chips begging us as a leading organo-metallic supplier to jump into this market.

We were very familiar with these materials because we have such a long history here – we've actually been supplying most of the high-purity metal-organic producers with organo-metallic precursors. But until fairly recently it was never a business that we were interested in jumping into because it was very small volume.

When we started looking at growth data we felt that there were only three major producers at that time. They were not announcing capacity as fast as the market needed. So we thought that this was a naturally step for us, given our global footprint, our background in organo-metallics and the experience we have in high-purity products in other product lines.

Q What have you done to underpin your launch of metal organic bubblers?

AM I would say two things: We've added significant staffing and significant capital. We've hired some experts in the industry and we have really staffed up our sales team and our R&D team to make sure that we enter this market quickly, appropriately and get off the ground.

We have also invested a significant amount of capital since 2010 to make sure that we do this correctly: That we have all the right analytical tools; all the right packaging tools; and the right manufacturing assets to make sure that we have the best-quality, best repeatability process on the market.

We don't plan for any additional staffing, but we do continue to foresee some significant capital being spent over the next few years.

Q How do the challenges of supplying metal organics compare to those faced by an LED chipmaker?

AM I think it is a little bit more straightforward for LED manufacturers, because they buy turn-key manufacturing facilities. They do need experienced engineers and



Amy Motto is Albemarle's Vice President, Performance Catalyst Solutions



Albemarle's bubblers are initially available in 1.2 litre and 4 litre sizes, but there are plans in place to increase this range soon

operators to run them, but they can manage that. For a high-purity metal-organic supplier, it's not so straightforward. There are patents out on how to make the product; there are difficult handling issues with these types of pyrophoric materials; and a high purity cleanroom and high-quality analytical measurements need to be put in place. It's also much more complicated from a manufacturing perspective.

Q Have you set up any supply contracts with chipmakers already?

AM We have qualified many customers, especially on trimethylgallium, which is the main demand product. We have also qualified some on triethylgallium, which is a kind of second tier product, and we are continuing to push for more qualifications.

Q How wide is the range of metal organic precursors that you are offering?

AM The plan for that is to have ultra high purity TMG, TEG, TMI, TMA and Cp2Mg (dicyclopentadienyl magnesium) in the portfolio under the PureGrowth line. We plan to have all of those done and fully commercialised by the end of first quarter 2012. We are on track to do that. We will phase them in over time and we are right on schedule.

Q Our industry is a global one. Are you able to supply materials across the world?

AM That's Albemarle's strength. We have a long history in organo-metallic supply and we have supplied organo-metallics to pretty much every polymer producer in the world. We are talking about nice places, strange places, everywhere. We have more than 20 people located all around the world focused in this area. We've dedicated some additional sales people in key regions such as

Korea, Taiwan, Japan and China. We also have warehousing; we have logistics squared away; and we know how to handle dangerous goods. We built that platform for the high-purity metal organics. We are producing these products in Baton Rouge, Louisiana, and we have plans to also produce them in our facility in Yeosu, Korea.

Q If a customer places an order with you, how long will they wait for a delivery?

AM We plan to have local stock in every major consuming region in the world, so we expect to have a week's turnaround time – the time we get an order to the time we deliver. If it's an order for something fancy, you'll have to give us more time to put it in place.

Q Chipmakers need a guaranteed supply of materials. Why can they depend on you for material year in, year out?

AM We're in this for the long haul and we are committed to expanding in the right areas of the world as needed.

Albemarle is a speciality chemicals maker, and we focus a lot on quality and on customer relationships. We are not going to enter a market because we feel like it today. When we make a decision to do something we are committed to it, and we want to deliver high quality products and offer the best customer and technical service. We have that reputation in all of the areas that we are involved in.

We are also committed to expansion. We are well aware that the electronics industry may have new requirements for materials. They may slightly change what the material is – they may drastically change what the material is. We know that it might not be TMG required for the next 40 years; it may be something else. We are committed to staying with the industry, continuing to innovate with customers and innovate ourselves.

Q Your rivals have increased the range of bubbler sizes over the last few years. What sizes of bubbler are you offering?

AK In the interests of getting materials to the market in a timely manner, we concentrated on the popular sizes: the 1.2 and the 4 litre bubbler. But we have designs and are in the process of building larger bubblers for customers that request this. We are also looking at bulk refill options in the near future.

Q Are you offering chipmakers any incentives to sample your products?

AK The reception that we have had in the market



Five different materials feature in the PureGrowth portfolio: TMG, TEG, TMI, TMA and Cp2Mg

place has been very positive. For a large part, incentives have not been necessary to convince the chipmakers to try our products. They all seem very excited about having a new supplier in the market, and beyond the occasional free sample to run qualifications nothing else has been necessary.

Q Prices of some materials, such as indium, are highly volatile. Will these strong fluctuations in price be passed on to the customer?

AM We have a lot of experience with expensive metals with volatile pricing, like molybdenum and rare earths. We understand how to buy those in the most cost-effective manner. We also understand how to reduce the utilization of some of those materials so that we can offer a better price to the customers. But at the end of the day, we are not going to lose margin or profitability.

Q Impurities drive down device performance. How pure are the materials you supply?

AM We've certainly got the 'six-nines' purity that is required today. But we believe that [impurity specifications] are going to be more and more strict, so we are not just stopping at what one customer wants. We are continuing to drive to have the best performing product in the market. We have really ramped up our analytical efforts. We know how to detect extremely low impurities, and we are going to keep monitoring that and driving it down and improving our process.

Q How do you determine the quality of your material in your metal organic bubblers?

AK So far, every batch of TMG and TEG that we produce has been sent to a third party to grow a thin film of GaAs. We've conducted a Hall test on these thin films, looking at the mobility as well as the background doping. This ensures that it will be successful in MOCVD applications.

In conjunction with that we do analytical testing using ICPMS [inductively coupled plasma-mass spectroscopy], which has a very low detection limit, and also proton NMR for the oxygen impurities.

Q Trimethylindium has a reputation as a difficult source to work with, partly due to variations in 'pick-up' concentrations. How stable is the trimethylindium gas flow produced by your source?

AK In parallel with the scale up of the chemistry for TMI [that we are doing right now], we have a couple of designs for bubblers to give good stability as well as good utilisation. We plan on conducting tests with those bubblers using an Epison [in-line gas concentration

monitor] to determine the pick-up rate and utilization. Once we fix a design for that bubbler we will start building.

Q There are safety issues associated with handling metal organics. How do you help the customer in this regard?

AM That's really where our strength lies. In all of our organo-metallic business that we supply today we're doing safety shows, training operators, training engineers and carrying out a significant product stewardship program. We are surprised that there is not more of a demand for that in the LED market.

Q The LED business will be your primary market. Will you also be going after other parts of the compound semiconductor industry?

AM Our aim is to be the leading high-purity or regular-purity organo-metallic supplier to the electronics industry. So wherever there is a need for an organo-metallic, at whatever type of quality, we would like to be there and supply.

Q Some academics have MOCVD tools. Can you cater for their relatively modest needs, in terms of material volumes?

AK Yes. Students eventually become customers in the commercial world, and if they have experience with our materials, our quality and our service, then we will look at that as an investment in the future. So we have a capability and can supply smaller bubblers down to 150 ml, which is typically used for a lot of research in institutions.

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Albemarle's core strengths

Albemarle is a multi-national chemicals manufacturer with an annual turnover of \$3 billion. It is headquartered in Baton Rouge, Louisiana, and it is organized into three divisions: catalysts, polymer solutions and fine chemicals. Metal-organics precursor manufacturer takes place in the catalyst group because organo-metallics are widely used for the production of polymer catalysts. Albemarle has been producing organo-metallics since the 1950s, and it claims to lead the world leader in this market, in terms of manufacturing volume, experience and production facilities. The company's polymer solutions division is active in electronics and supplies flame-retardants to PV makers, cell phone makers and computer makers. The company's third division, its fine chemicals group, focuses on pharmaceutical and agricultural chemicals. However, they also make precursors for the OLED market and some products for the electronics sector.

Pyramids pave the way to monolithic white LEDs

There is now little headroom left to improve the efficacy of the conventional white LED. But major gains in efficiency are possible by replacing the traditional combination of a blue chip and yellow phosphor with a monolithic, multiple wavelength source. One great way to do this is to work with nano-scale pyramids, say **Samsung's Taek Kim, Joosung Kim and Moonseung Yang.**

LEDs will utterly dominate the display backlighting market in the next year or so. This has spurred LED chip manufacturers to hunt for new, lucrative applications, and by far the biggest of these is general illumination. Producers of LEDs are already starting to tap into this market, but they will only make significant inroads when they can substantially cut the cost per lumen of this emitter, a goal that can be fulfilled through increases in luminous efficacy.

This revolution in lighting will be driven by white LEDs, which combine a blue-emitting chip with a phosphor that is pumped with blue light and emits yellow. In this device, the luminous efficacy of the white emission resulting from colour mixing is limited – even if the efficiency of the blue LED and the phosphor are very high, there is still an unavoidable energy loss due to the difference between the energy of the photons used to pump the phosphor and the energy of those emitted. Using a

phosphor also has a practical downside – coating this material onto the LED chip adds to manufacturing costs.

The ultimate approach is a monolithic white LED that emits multiple spectra, such as blue and yellow or the three primary colours. However, fabricating such a device is challenging due to the plummeting efficiencies of InGaN blue LEDs at longer wavelengths and the rapid fall-off in the efficiency of red InGaP LEDs at shorter wavelengths. Acting together, these weaknesses lead to an absence of efficient green and yellow emitters – the so-called 'green-gap' – and they hamper the realisation of a monolithic white LED.

At Samsung Advanced Institute of Technology (SAIT) we have been developing a novel, alternative LED architecture for addressing the green gap and enabling the fabrication of monolithic white LEDs. Our technology is based on nano-scale pyramids.

In the labs of leading chipmakers the luminous efficacy of the best white LEDs can exceed 200 lm/W. At a drive current of 350 mA, the US firm Cree holds the efficacy record with a 231 lm/W device. Further gains in efficacy will undoubtedly follow, but there is not much headroom left because the maximum theoretical efficacy for a phosphor-converting white LED is 263 lm/W.

One factor restricting efficacy to this theoretical maximum is the Stokes shift energy loss. This is about 20 percent for blue pumping of yellow phosphors, and the loss is even higher when blue light is used to excite longer wavelength phosphors, such as orange ones, which are needed to form the warm-white light that is desired by the residential lighting market. The combination of colours used to create a white-light source also places a limit on efficacy. The human eye is most sensitive in the green, and the absence of this colour in a conventional white LED has a big impact on this source's efficacy. Compounding the issue, the broad emission spectrum associated with a phosphor produces photons at wavelengths where the human eye is unresponsive. And making matters even worse, the proportion of invisible photons gets more severe in warm white.

Eliminating wavelength conversion gets around these issues and increases the theoretical maximum efficacy to more than 400 lm/W. But building such a device is tricky because it requires the fabrication of a single chip that not only produces polychromatic wavelengths, but also delivers efficient green, yellow and possibly even red emission.

Why phosphor-free?

An affordable, high-quality LED light bulb is the holy grail of solid-state lighting. This type of luminaire with good colour quality and very high efficacy is already available today, but the cost is far too high for many consumers.

Scaling-up chip manufacturing is the obvious way to cut costs, with large size silicon wafers offering the best returns. We have developed a technology for this and have recently fabricated blue LEDs delivering 510 mW at a 350 mA drive current on 4-inch and 8-inch silicon substrates. But when it comes to reducing the cost of ownership, it is more effective to increase luminous efficacy than trim manufacturing costs. That's because this efficacy-centred approach delivers three separate benefits: A cut in the cost per lumen at the chip level, a reduction in packaging cost for the luminaire, and a fall in electrical usage.

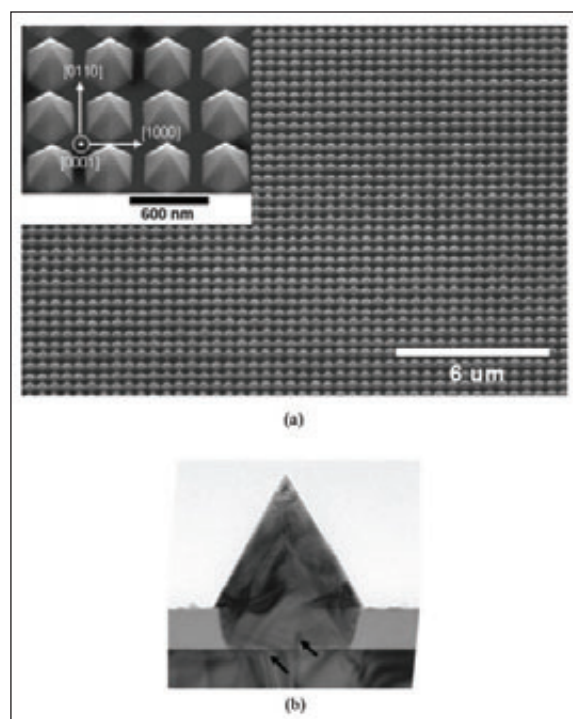
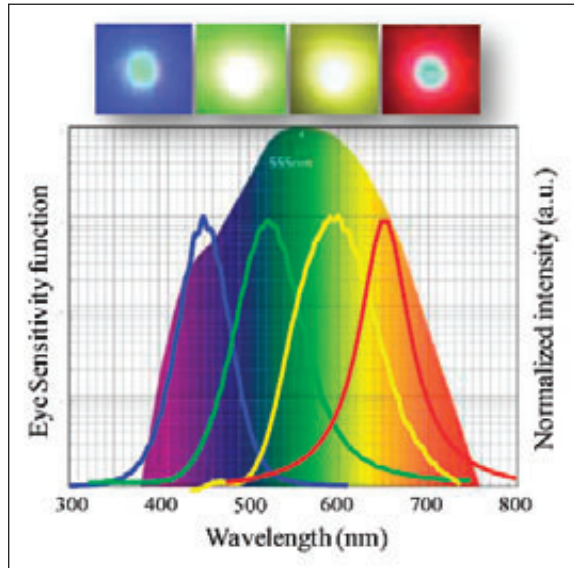
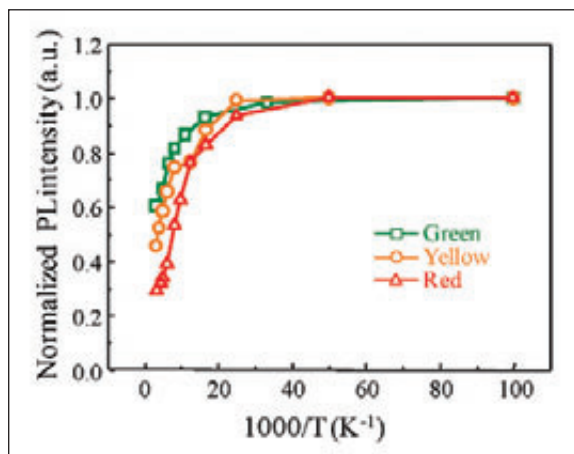


Figure 1. (a) SEM images of a nano-pyramid array. Inset shows crystallographic directions. (b) Cross sectional TEM shows threading dislocations terminating before they can propagate into the InGaN layer

Figure 2. (a) (Top) PL spectra from InGaN on planar (blue) and nano-pyramids (green, yellow and red). Eye sensitivity function is overlapped for reference.



(b) (Below) Temperature dependence of the integrated PL intensity for green, yellow, and red InGaN on nano-pyramids. The intensities are normalized to their values at 10 K



Barriers to monolithic white LEDs

The green gap in nitride LEDs stems from a combination of poor crystal quality of indium-rich InGaN and the polar characteristics of III-Nitrides on the *c*-plane. Macroscopic polarization occurs in this material, giving rise to a piezoelectric field perpendicular to the plane of the quantum well. This field pulls apart electrons and holes in the well, leading to a decline in the radiative recombination rate (called quantum-confined Stark effect).

As the wavelength increases, this efficiency reduction becomes more severe. A hike in indium content is needed to reach these longer wavelengths, and this also increases strain in the quantum well, leading to higher piezoelectric fields that hamper radiative recombination. On top of this, the larger strain and lower growth temperature required to incorporate more indium deteriorate emission efficiency, due to the generation of many non-radiative recombination

centres, such as point and line defects. One extensively studied, experimentally proven technique for side-stepping the piezoelectric fields is to turn to GaN grown on semi-polar or non-polar substrates. These can be made from either sapphire or GaN. However, stacking faults plague epitaxial non-polar and semi-polar films grown on sapphire, and free-standing GaN substrates of any orientation are too expensive to be used for making LEDs. One promising alternative that is under investigation by many groups, including National Taiwan University, is to reduce the electric field through strain control, such as pre-straining of the multi quantum wells (MQWs).

A more radical idea that has great potential is to build LEDs from InGaN nanostructures. Emission from the blue right through to the red has already been demonstrated with such structures, which have received much attention thanks to their promise to close the green gap and realise polychromatic white LEDs. Strengths of the nanostructures include facets for semi-polar and non-polar GaN growth, enhanced light extraction, and the promise of increased crystal quality, thanks to reduced strain that stems from their small features.

We have used this class of structure – specifically nanoscale pyramids with InGaN layers – to produce epilayers delivering very efficient green, yellow and red emission. In addition, we have fabricated a monolithic LED that produces white light through colour mixing from different quantum wells.

Closing the green gap

To produce structures with efficient green to red emission we have used MOCVD to grow InGaN/GaN MQWs or a double heterostructure (DH) on nano-size GaN hexagonal pyramids. These are formed via selective growth on patterned *c*-plane GaN templates featuring circular openings in a 100 nm-thick SiN film.

After patterning the wafer, we form un-intentionally doped GaN hexagonal pyramids with a proprietary growth process. This growth step concludes with the addition of three InGaN QWs with GaN barriers or an InGaN/GaN DH structure, with the growth condition for the ternary layer carefully selected to control emission wavelength and efficiency. The SiN films are not removed after growth.

The six facets of these arrayed pyramid structures are clearly visible in scanning electron microscopy and transmission electron microscopy (TEM) images (see Figure 1). According to high-resolution X-ray diffraction, all of these facets are semipolar $\{11\bar{2}2\}$ planes. One of the benefits of this approach is that the threading dislocations are terminated before propagating into the InGaN layer – see the cross-sectional TEM image in

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From backlighting TVs to empowering mobile devices and harnessing the sun's energy, compound semiconductor chips are playing an ever increasing role in modern life. This is set to continue, but who had the biggest breakthroughs over the last 12 months? Which pioneering companies from around the globe created the best opportunities for the compound semiconductor industry?

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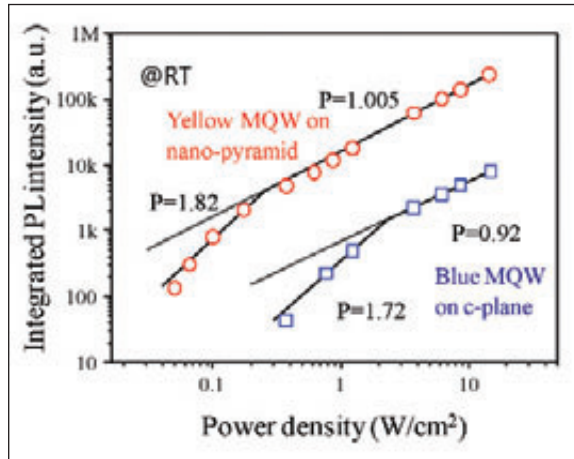


Figure 3. Integrated PL intensity as a function of power density for yellow InGaN MQWs on nano-pyramids and blue InGaN MQW on a c-plane substrate. Light intensity (L) is proportional to I^P , where I is the carrier density and P is power index. If $P = 1$, radiative recombination is dominant and if $P > 1$, Shockley-Read-Hall recombination is dominant

Figure 1 (b). This dislocation filtering that occurs when carrying out selective-area growth through nano-scale openings arises due to the thermal mismatch between GaN and the dielectric mask.

We are able to produce a wide range of colours with efficient emission using our nano-pyramid structure. Photoluminescence (PL) measurements reveal green, yellow and red emission (see Figure 2 a), with corresponding internal quantum efficiencies of 61 percent, 45 percent and 29 percent, respectively, according to Arrhenius plots of the normalized integrated PL intensity over a 10 to 300 K temperature range (see Figure 2b).

To identify the origin of this high efficiency, we excite the yellow MQW on nano-pyramids and compare its emission with that produced by another structure – a blue MQW grown on the c-plane of another wafer. PL spectra generated by pumping both structures at a range of energies uncovers a linear relationship between excitation power and PL intensity that kicks in at lower incident powers in the yellow-emitting structure, indicating that this one has fewer defects than the blue MQW (see Figure 3).

We have determined the strength of the piezoelectric field through low-temperature measurements of the shift in the emission peak as a function of excitation power density (see Figure 4). Photo-generated carriers screen the piezoelectric field, so it is possible to estimate the field strength from blue shifts in the emission peak with

excitation power. Again, we compare the yellow and blue-emitting structures: A blue shift of 29 meV occurs in the blue MQW when the excitation power is increased from 1 to 10 mW, indicating the presence of the piezoelectric field; in comparison, the blue shift in the yellow quantum well is negligible.

To reveal whether this strongly suppressed piezoelectric field in our yellow emitting pyramids stems from the semi-polar plane or results from strain relaxation in these nanostructures we scaled this structure, building equivalent pyramids with a bottom diameter of about 2 μm . In this case the blue shift was 47 meV.

This is a relatively small shift for emission centred around 570 nm, indicating significant influence from the semi-polar growth plane (In comparison, variations in excitation power of one order of magnitude have been reported to produce a 143 meV blue shift in MQW structures emitting at 500 nm).

However, the blue shift associated with the micron-sized pyramids is still far, far larger than that occurring in its nano-scale cousin. Our conclusion: Growth of MQWs on {1122} facets of nano-size pyramids effectively suppresses the piezoelectric field via the semi-polar growth plane and strain relaxation.

Building a white source

One of the benefits of using selectively grown InGaN is that its composition can be varied through changes in both the growth condition and the type of selective growth employed. This has very important implications: The wavelength of an InGaN layer on nano-pyramids is different from that on a planar substrate, and it is

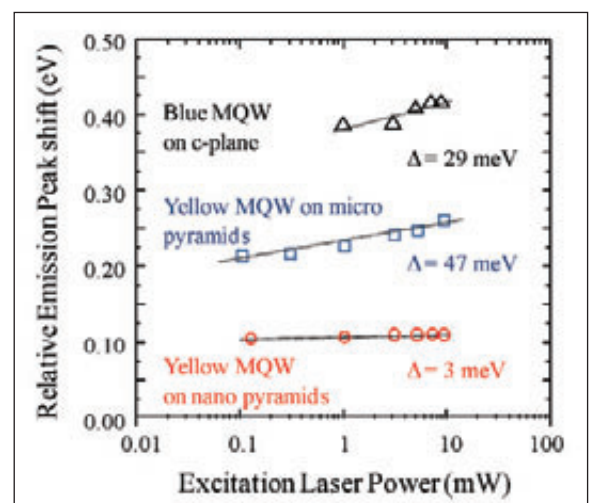


Figure 4. Emission peak shifts for three different structures as a function of injection power. Due to their difference in emission wavelength, relative peak shifts are compared

consequently possible to realise multiple wavelength emission. We have grown an InGaN MQW on a nano-patterned structure that has regions with $20\ \mu\text{m} \times 20\ \mu\text{m}$ openings for planar growth. Micro-PL measurements reveal that the resultant epistructure produces white PL emission via colour mixing of blue light from the planar area and yellow emission from the nano-pyramids (see Figure 5).

The longer wavelength that results from a higher indium composition in the MQWs in the nanopyramids is not due to simply different planes for deposition. Instead, it is caused by enhanced presence of indium species, which undergo lateral vapour diffusion and surface migration from the dielectric mask to the GaN pyramids.

In fact, we have found that when we grow an InGaN MQW after removing the SiN layer, the emission peak from the pyramids shortens by 15 nm. We have also learnt that it is possible to control the emission wavelength from the MQWs on the nano-pyramids by adjusting the separation of these pyramids.

Through variations in selective epitaxial patterns we have made multiple wavelengths LEDs (see Figure 6, which shows blue, cyan, yellow, and white LEDs from the same substrate). The white variant combines yellow emission from InGaN MQWs on nano-pyramids and blue emission from micron-sized planar areas.

The forward voltage for this device at 20 mA is 3.69 V, which is higher than ideal due to the high resistivity in the p-contact layer on the nano-structures. However, the turn-on voltage is lower than that for a blue LED, thanks to the lower bandgap of the yellow MQW. The colour temperature for this LED is 7100 K, but lower values are possible by adjusting the area ratio between the nano-pyramids and planar area.

Our efforts highlight the tremendous potential of LEDs built from nano-pyramid arrays, which can deliver high luminescence efficiency over a very wide spectral range thanks to the combination of reduced defects, relaxed strain and a suppressed piezoelectric field.

Challenges still remain, however, and one of the biggest is realising uniform current flow in the InGaN layer – today it crowds through the shortest current paths due to the three-dimensional geometry of the structure. Although the crowding is not as bad as it would be in nanorods, uniform current injection is essential for high-power LEDs. We will work to overcome this issue, and also try to develop higher p-type doping on the {1122} plane, a step that is needed to lower the LED's operating voltage.

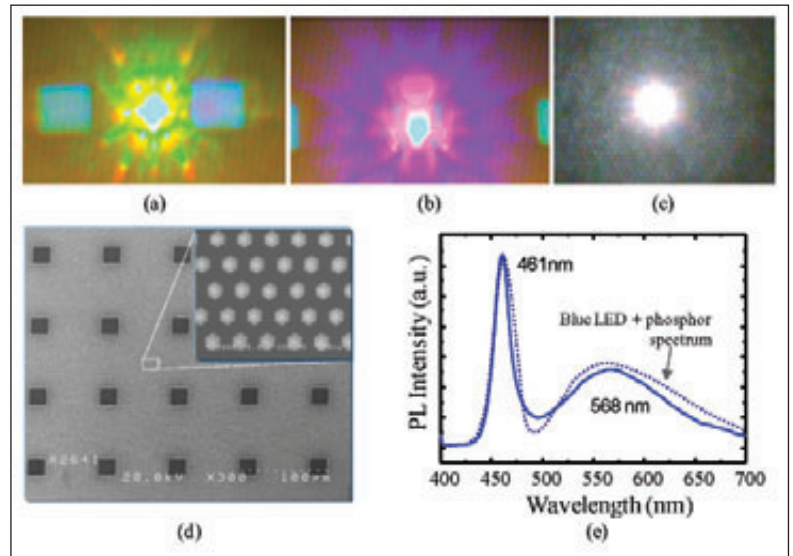


Figure 5. Micro PL images of nano-pyramids (a) and the micro planar area (b). The macroscopic PL images, which were acquired with a beam diameter of $5\ \mu\text{m}$, show white emission composed of blue and yellow peaks (c). SEM image of a white emission structure (d). Black squares are micron-sized planar areas, and the inset shows a nano-pyramid array. (e) PL spectrum of (d) structure. For a comparison, a spectrum of a phosphor-converting white LED is shown as a dotted line

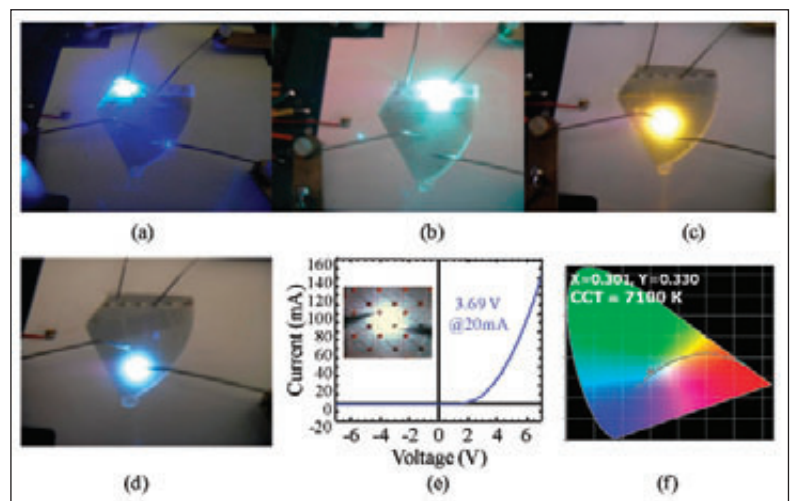
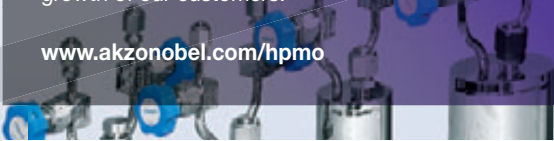


Figure 6. Blue (a), cyan (b), yellow (c) and white (d) LEDs from the same substrate. The blue LED structure is grown on a planar c-plane; cyan and yellow LED structures were grown on nano-pyramids; and the white LED was grown on planar and nano-pyramid hybrid patterns. (e) I-V curve of a white LED. (f) Colour temperature of a white LED

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Dielectric pillars aid light extraction

Poor light extraction holds back LED performance. But this can be avoided by inserting a patterned dielectric stack on top of the device, an approach that has the added bonus of controlling the far-field emission pattern, says **Ahmed Noemaun from Rensselaer Polytechnic Institute.**

In an ideal world, every photon that is generated within an LED will exit this device and provide useful illumination. But in practice this doesn't happen – some photons are trapped inside the chip due to total internal reflection at the surface boundary, while others are lost to absorption that can occur at metal contacts.

To increase LED extraction efficiency, engineers have improved device design with techniques such as surface texturing, shaping the chip geometry, patterning the sapphire substrate and inserting photonic crystal structures. If these modifications were not applied, blue LEDs would have a minimal light-extraction efficiency of around 25 percent, and the corresponding figure for their UV cousins would be no more than a few percent.

Fabricating sub-micron patterns by lithography is elaborate and expensive, factors that limit the application of photonic crystals and sapphire-substrate patterning for LEDs. Controlling these processes is also difficult, and can deteriorate the device's internal efficiency and its electrical properties.

A simplistic, cost-effective approach to extracting the optical modes trapped inside the LED chip is surface roughening. Conceptually, this approach is very simple: Some of the light is extracted through sharp, pointed features on the surface, and that which remains is reflected and diffused, reducing the chance that it will be permanently trapped inside the semiconductor chip. Several techniques can be used to roughen the LED surface, including crystallographic wet chemical etching of the nitrogen-face of GaN. However, these methods tend to be specific to the LED semiconductor material or its surface-plane orientation and cannot be applied uniformly to all LEDs. In addition, these techniques offer little control over the features of the roughened surface, preventing any modification to the LED's far-field light emission pattern.

At Rensselaer Polytechnic Institute we have pioneered a new approach to boosting light extraction that is not limited to any LED semiconductor material or its

orientation. This technology, which can also tailor the far-field emission pattern, involves the addition of graded-refractive-index (GRIN) patterns to the top surface of the LED (see Figure 1). Without this modification, most of the light that strikes the planar top surface of an LED is reflected – only a small proportion is incident at an angle that falls within the 'escape cone' and can exit the device. With our approach, output power is increased through the insertion of a dielectric pillar with a curved circumference that acts as an additional surface for light extraction.

Thanks to this addition, the light escape region has now increased, because it encompasses both the original escape cone of the top layer and the escape cone on the sidewall of the pillar. That's not the only benefit of this approach, however: If the pillar is composed of GRIN layers, light entering the pillar refracts at each layer boundary, eventually striking the sidewall at near-

Figure 1: A carefully designed graded-index pillar with five dielectric layers can extract trapped optical modes occurring inside the LED semiconductor

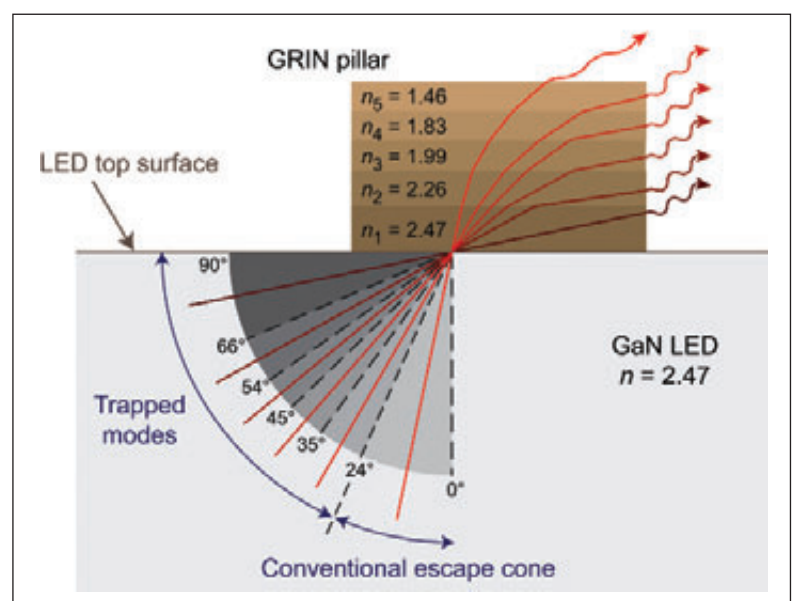
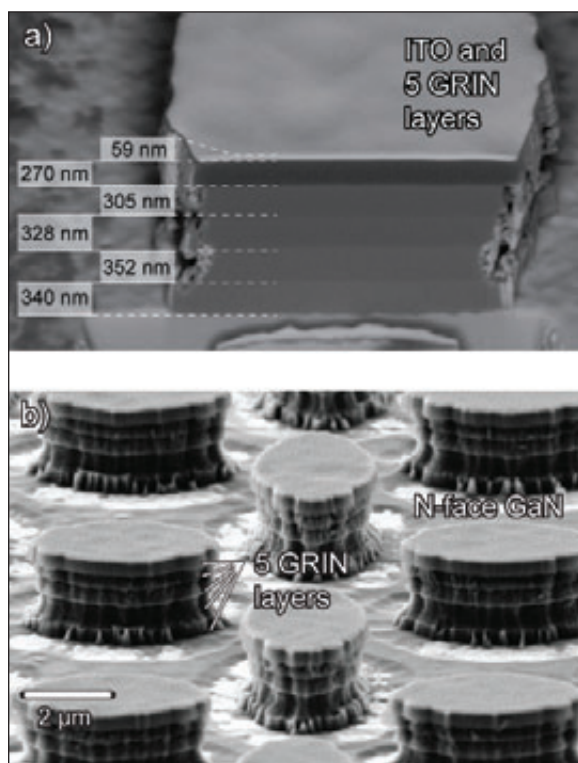


Figure 2: (a) Scanning electron microscopy image (SEM) reveals a stack of GRIN layers made up of TiO_2 and SiO_2 with an indium tin oxide layer on top.



(b) An SEM image of an array of GRIN pillars

normal angles of incidence. Consequently, all the trapped optical modes can be extracted out of the LED chip through appropriate design of the refractive index and height of the layers forming the GRIN stack.

Eliminating light trapping due to total internal reflection is possible by selecting the refractive indices of the layers so that the critical angle at the boundary of consecutive layers is complimentary to the critical angle of the sidewall-air interface. Note that the bottom layer must be chosen to have a refractive index closest to that of the top of the LED chip to ensure no coupling loss at this interface. Each layer in the GRIN stack extracts light incident on the layer's surface at a specific range of incident angles.

For example, in our structure the first layer, which has a refractive index of 2.47, extracts light striking the top of the LED chip between 66° and 90° . In comparison, the second layer, which has a refractive index of 2.26, enables light extraction for emission incident between 54° and 66° .

With our approach it is possible to prevent light from bouncing back into the semiconductor without striking the sidewall through careful design of the height-over-width ratio of the individual layers that form the pillar. These constructions are arranged in an array to form a GRIN pattern, and choosing the spacing of these pillars is a delicate balancing act. If they are too far apart, not enough light enters the pillars and gains in LED extraction efficiency are modest; but put them too close together, and a significant proportion of the light exiting one pillar enters its neighbour, rather than leaving the device.

Putting theory into practice

To produce pillars that can extract all the optical modes of the LED, it is essential to work with a pair of transparent materials with vastly different refractive indices. To this end, we employ the high-refractive-index material TiO_2 in conjunction with a low-refractive-index partner, SiO_2 . Films of these oxides can form a composite dielectric layer with any desired refractive index from 1.46 to 2.47 – its value just depends on the ratio of the two materials.

In our case, we use sputter deposition to form a GRIN stack containing five layers with different refractive indices, each of which was formed by carefully selecting the powers applied to the SiO_2 and TiO_2 targets. We add a thin indium tin oxide (ITO) layer onto this stack that acts as a hard mask for the subsequent dry etch (See Figure 2 (a)).

GRIN patterns are defined in the LED wafers by a combination of contact lithography and an inductively coupled-plasma (ICP) dry etch. (The ITO is dry etched under a CH_4 , H_2 and Cl_2 environment to pattern the hard mask, before the GRIN layers are etched under CHF_3). The sidewalls of the pillars that are formed can extract all the trapped optical modes because they are smooth, vertical and contain minimal residues such as particles (see Figure 2(b) for an example).

We have put our LED design to the test by fabricating GRIN patterns on the planar top surface of thin-film GaInN/GaN blue LEDs. This modification increased light output power by 131 percent and boosted the light extraction efficiency to around 70 percent. Performance is influenced by the type of pillar employed, and we have found that LEDs with diamond-shaped GRIN pillars are brighter than those made from cylindrical pillars. The reason: Light entering cylindrical pillars can be trapped inside these structures, and bounce around their edges in whispering gallery modes, a frailty that does not afflict diamond-shaped structures.

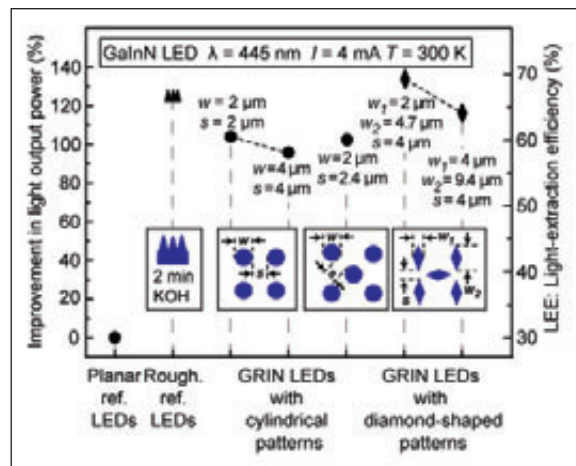


Figure 3: LEDs with GRIN structures can deliver superior light output compared to a planar reference LED and a roughened reference LED

One of the major differences between our LED and more conventional designs is that the peak emission intensity is no longer along the surface-normal of the device's top surface. Instead, due to light leaving the device through the sidewalls of the GRIN patterns, peak emission intensity from the LED is off the surface-normal between 25° and 55°. The far-field emission pattern of GRIN LEDs has bi-lobes (similar to bunny ears!), rather than the Lambertian pattern produced by typical LEDs (see Figure 4). However, peak emission intensity can be shifted towards the surface-normal by modifying the slope of the GRIN pillars with a short-buffered oxide etch (see Figure 5).

This fine-tuning of the emission pattern with a simple additional step at the end of the fabrication process introduces a design flexibility, which is an incredibly valuable feature that is available only with our approach.

Our work is in its infancy, and we are now searching for the perfect combination of size, shape, arrangement and filling factor of the GRIN pillars to yield maximum LED light extraction. This quest is employing ray tracing simulations to ascertain the best combination of circular, rectangular, and rhomboid stacks and the optimum placement to determine the parameters of a 'perfect' GRIN pattern.

The problem that we are grappling with is, in fact, similar to that faced by a restaurant owner who wants to seat as many people as possible in his diner. If they put more tables in the room, they can seat more people – and in our case, by increasing the fill factor of the GRIN pillars, we can increase light extraction. But if the tables are too close, the guests don't have enough room to sit; and if we put our pillars too close together, light leaving one pillar enters its neighbour. Every restaurant must also cater for a range of people and consider special needs. Translated into our LED design, light emitted close to a sidewall-surface normal requires extra spacing between pillars to prevent emission from re-entering the neighbouring pillar.

A very promising aspect of our approach is that it is a 'one size fits all' technology because it can be uniformly applied on all LEDs, including various material systems and different orientations. It is not because of modifications to the LED chip by the GRIN process: Only the deposited dielectric materials are etched, and the GRIN patterns should have no impact on the internal efficiency, forward voltage, or leakage current of the device.

We believe that our GRIN technology can be 'game changer', thanks to its potential to enable devices to combine incredibly high light extraction efficiencies with an emission profile that can be tuned to match the target application. For example, the designers of LCD panels with direct-lit back-lighting want LEDs with oblique

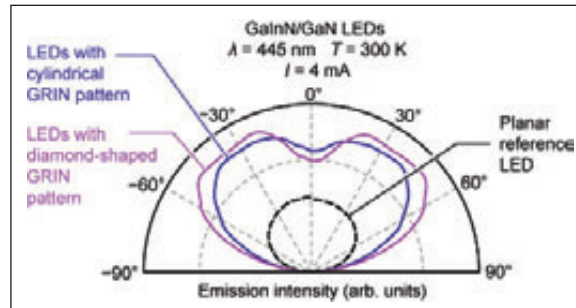


Figure 4: Far-field emission pattern of LEDs coated with GRIN patterns and reference LEDs with a planar top surface

emission, a condition that should be possible with our GRIN technology. Another promise of our GRIN LEDs is the opportunity to eliminate secondary optics, such as lenses and mirrors, thanks to the inherent control over the far-field emission pattern. We hope to exploit this opportunity, plus the other benefits of incorporating GRIN structures in the LED, over the next few years.

● Efforts at realizing high light-extraction efficiency LEDs with GRIN patterns are being pursued by Ahmed Noemaun, Frank Mont and Ming Ma from Rensselaer Polytechnic Institute. The group is jointly lead by Jaehee Cho and E. Fred Schubert, and includes collaboration with Gi Bum Kim and Cheolsoo Sone from Samsung LED Company.

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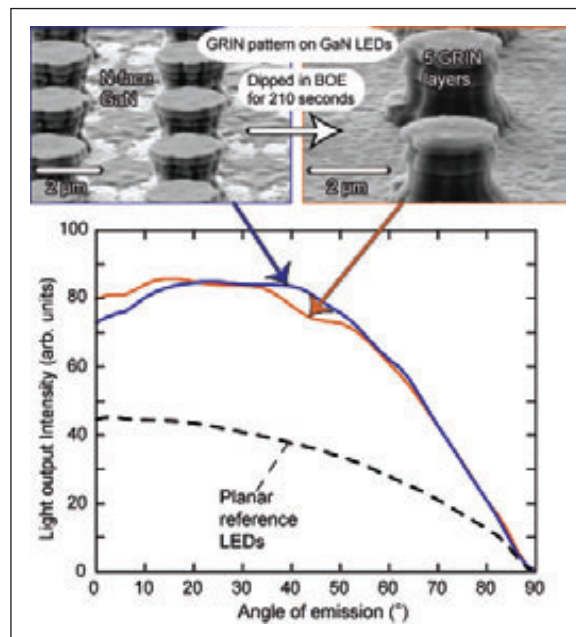
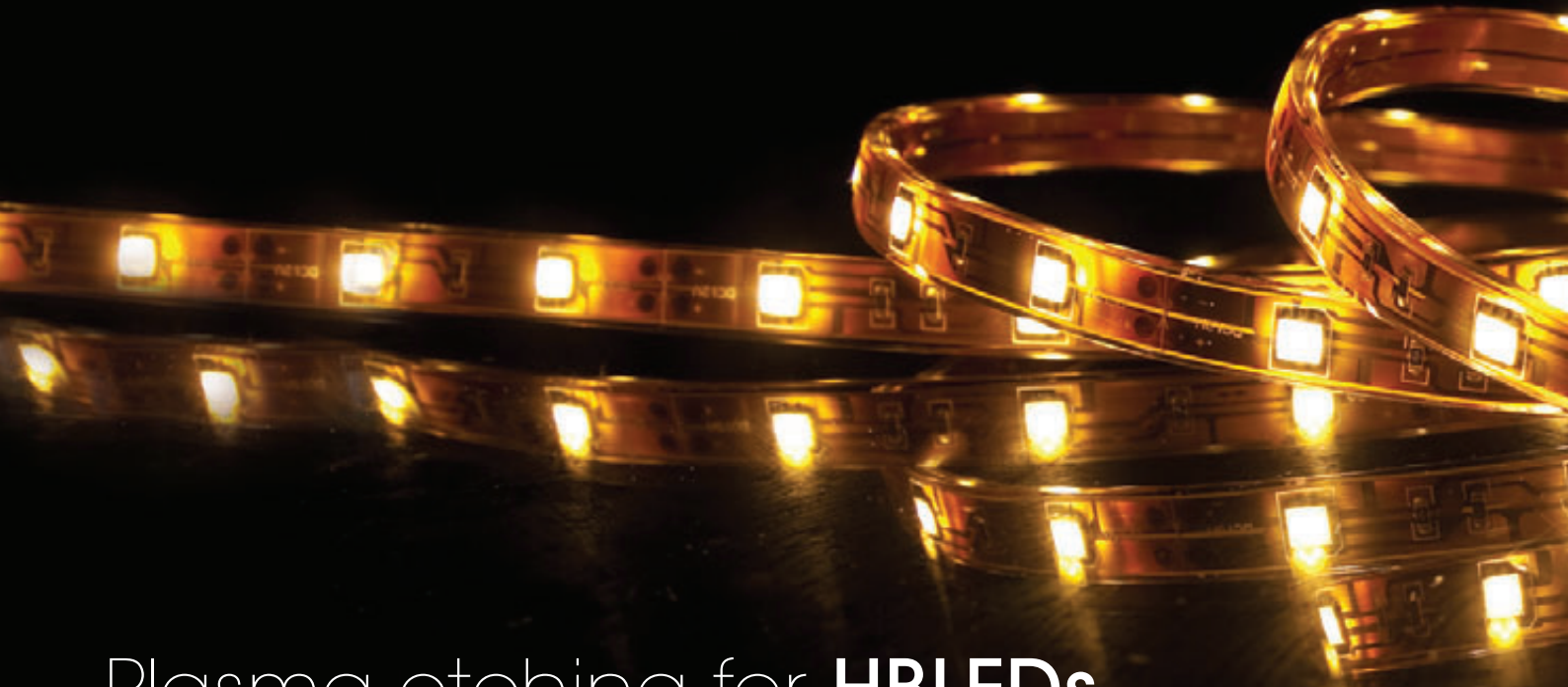


Figure 5: Modifying the slope to the GRIN pillars helps to fine tune the far-field emission pattern of the LEDs

Further Reading

A. N. Noemaun et al. *Journal of Applied Physics* **110** 054510 (2011)
A. N. Noemaun et al. *Journal of Vacuum Science and Technology A* **29** 051302 (2011)
J. K. Kim et al. *Applied Physics Letters* **93** 221111 (2008)



Plasma etching for **HBLEDs**

The goal of every HBLED manufacturer is more light for less money. With strong competition and numerous technology hurdles it is vital that all manufacturing steps are pushed. **Mark Dineen, Product Manager (HBLED) at Oxford Instruments Plasma Technology** discusses how optimised plasma etching offers several ways to improve device output and reduce costs providing a double windfall.

I have never thought of myself as a veteran, but with over 15 years working on HBLEDs I guess that makes me one. When I first started out, plasma etching was used as a tool to etch down through the p-type layer into the n-type in order to make a contact. Since then we have seen several new applications that mean plasma etching is even more important.

Patterned Sapphire Substrates

Sapphire, at the moment, is still the substrate of choice for growing HBLED structures. However, there are two problems with growing on Sapphire: it is not a perfect lattice match and light extraction is reduced by having two parallel reflecting surfaces. In order to improve both these issues from 2005 onwards companies have been



etching patterns into the sapphire prior to growth. This can give a >98% improvement on light extraction from the finished device.

Sapphire is a very stable material, with a melting point of 2054°C that consequently makes it difficult to plasma etch. However Photoresist (PR) which is used to achieve the very specific pattern definition has an upper temperature limit before it degrades, typically 150°C.

PR is the mask of choice for this process as the ultimate 'dome' shape is reliant on all the mask being removed on completion, and the shape is closely linked to the relative etch rates of the sapphire and mask. PR is also preferred as it simplifies the manufacturing flow and reduces the overall Cost per Lumen. In order to etch the material, combinations of Cl₂, BCl₃ and Ar are commonly used with higher etch rates achieved at higher plasma source powers. However this increases

Figure 1:
Typical dome
PSS feature

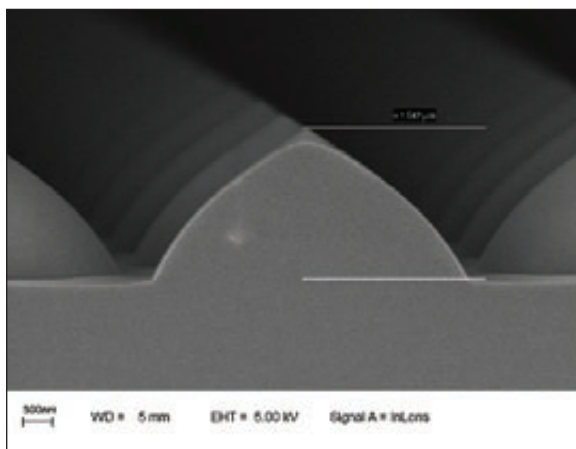
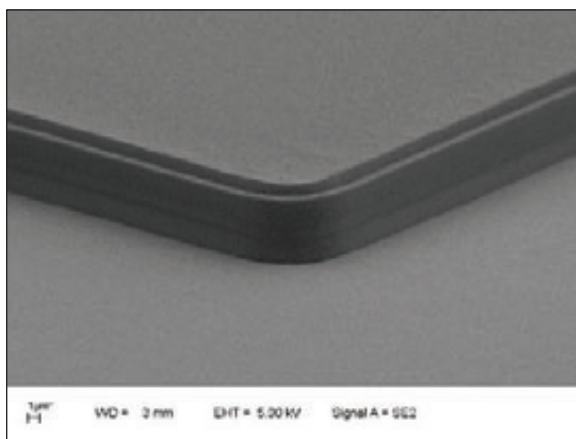


Figure 2:
Shallow GaN
etch for
device
contact PR
remains on
the sample



the heat load on the sample therefore, to use PR as a mask and maintain a high etch rate, it is necessary to actively cool the wafer sample.

The silicon industry is accustomed to clamping single wafers to a temperature-controlled table, and introducing a heat transfer medium, normally helium, between the table and the wafer. 'Helium backside cooling' has become the standard method for single wafer temperature control. HBLED manufacturing currently uses batches of smaller substrates, passed into the etch tool on a carrier plate. For Patterned Sapphire Substrate (PSS) etching, HBLED devices are still mostly manufactured on 2" or 4" wafers, therefore to significantly reduce costs it is desirable to process as many wafers in one run as possible.

Etching large numbers of wafers with a PR mask requires good temperature control of each wafer, and this requires an understanding of how to transfer the heat from the plasma away from the samples to the cooled electrode. Helium backside cooling is the key, and understanding how to enable this for every wafer ensures success. Batch sizes for this technique are up to 20 x 2" with etch rates between 50nm/min and 100nm/min depending on the PR mask and PSS shape requirements.

GaN Etching

The chemical stability and high bond strength, its melting point, (2500°C) and bond energy (8.9eV/atom), associated with GaN also make it highly resistant to wet etching in either acid or alkali based etchants. To date, the lack of a suitable wet etch for processing has resulted in much interest in developing dry etch processes suitable for HBLED production, with the same necessity to etch large numbers of wafers in a single batch. Plasma etch batch sizes have increased from 4 x 2" wafers in the late nineties up to 55 x 2" or 3 x 8" today, the question now is how big can the batch size go before it becomes unattractive. This is mitigated as the wafer sizes migrate upwards from 2" to 4" and then 6". The main areas of GaN etching are:

Shallow contact etch

When etching down to a contact layer it is vital that minimal plasma damage is caused to the semiconductor otherwise an increase in contact resistance can occur. Careful optimisation of the etch process is required to maximise throughput while maintaining device performance. Smooth surfaces typically indicate a high quality etch as shown in Figure 2.

Unoptimised etch processing can lead to threading dislocations in the GaN etching preferentially leading to a pitted surface and increase in contact resistance. Again PR is the mask of choice for this step as it is the most simple process regime. The use of PR leads to a reduction in powers used due to the temperature limitations with typical batch etch rates upto 150nm/min reported.

Deep isolation etch

Etch rate is key to this process as depths of up to 7μm can be required. The function of this step is to etch down the underlying sapphire substrate in between the active devices. As sapphire is electrically non-conducting this isolates the devices before physical separation. The key challenges with this etch step are heat removal if a PR mask is used, as high etch rates

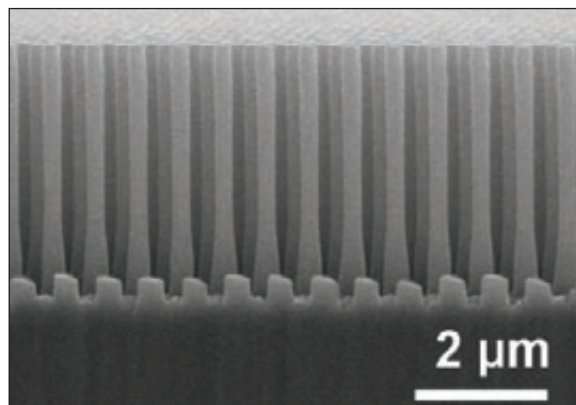


Figure 3: Deep, high aspect ratio GaN etch
SEM image from Philip Shields, University of Bath



Figure 4: PlasmaPro NGP1000 etch system

are achieved with high plasma densities. This translates as a clamping issue for single wafers and is typically approached using an electrostatic clamp. A dielectric hard mask can be used and this opens the possibility of high etch rate batch processing where uniformity across the batch dictates the yield.

Photonic crystal patterning

By patterning the light emitting surface of the HBLED with a quasi-crystalline array known as a photonic crystal it is possible to improve light extraction. An extreme demonstration of this is shown in Figure 3 where a 600nm feature has been etched 4 μ m deep giving a >6:1 high aspect ratio structure. Here the challenges are maintaining the vertical profile in the etch feature in order to ensure the optical performance of the photonic crystal.

Equipment

In order to achieve the high etch rates and low damage requirements the industry has developed several high density plasma sources: Inductively Couple Plasma (ICP); Transformer Coupled Plasma (TCP); High Density Plasma (HDP). All technologies offer a driven table on which the sample sits and a separate plasma source which enables high plasma densities without an increase in the DC Bias seen by the sample. DC Bias has been shown to increase plasma damage to sensitive surfaces so this is an essential system characteristic. The PlasmaPro NGP1000 etch system, designed for GaN, AlGaInP and Sapphire etch, offers batch sizes up to 55 x 2", 13 x 4", 5 x 6" or 3 x 8", yielding market leading volumes of wafers/month. The HDP Etch plasma source achieves comparable plasma densities to ICP sources, maintaining the benefits of high etch rates and low damage. Other key technologies required for etching batches are: a knowledge and control of plasma uniformity over large areas and the capability to control the sample temperature of multiple wafers under aggressive plasma conditions.

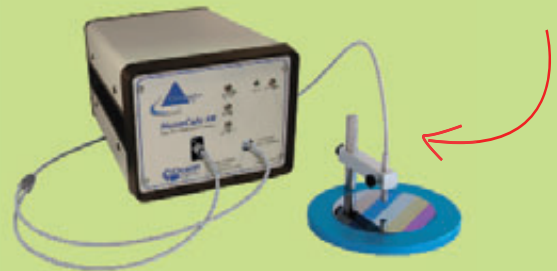
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Optimism reigns in solar circles

Insights into the future growth of the solar market, development of a large scale PV production line from a university research laboratory project and technologies to boost cell efficiency all featured at the recent Advances in Photovoltaics conference hosted by the Institute of Physics in London. **Zoe Barber reports.**

Despite turbulent times for investors in solar power, the picture that emerged at the one-day Advances in Photovoltaics gathering was of a buoyant, optimistic industry, with technology performing ahead of predictions on many counts. Although there is continued pressure for increased efficiencies and reduced costs, it was noted that there is great potential to deliver on these fronts: In addition to further economies of scale due to ramping up of volume production, there are many exciting possibilities for future technologies, and many parameters to tune.

As well as discussion of the market and the position of PV against other power sources, there were reports on technological achievements, and intriguing pointers to the potential for really significant advances. Delegates also learned about the demands for characterisation

methods and the problems in making true comparisons between different device performance.

The meeting kicked-off with a presentation from Martin Green, the internationally renowned academic from the University of New South Wales. Green set the scene with an overview of current market trends, a summary of where the exploitation of PV technology has got to, and where we can expect it to go.

During the last decade, PV's position within the growing low-carbon technology market has gone from one of virtual insignificance to a significant contributor. Green illustrated that wind energy has been growing strongly, but PV is catching up and will probably overtake it in the next decade. In Australia, this has been encouraged by arguably overgenerous feed-in

tariffs, leading to a large uptake of domestic-based PV modules. These are typically 3 kWp systems that provide homeowners with around half their required power usage. In Sydney about 8 percent of homes have these fitted.

Green pointed out that large arrays are also being deployed around the globe, with up-take relatively high in the US and Germany. These are set to compete with wholesale conventional power generation some time soon. Goals for PV uptake vary greatly from country to country, given variable climates, but the overall figure for Europe is a 12 percent PV power contribution by 2020. In the UK, the aim is to deploy 2 GW by the end of this decade.

The cost required to make PV continues to fall. Green says that there's been a pretty consistent 20 percent 'learning rate' since the late 1970s – in other words, a doubling in production has led to about a 20 percent drop in cost. This trend is expected to continue. Falling production costs have enabled PV to now get very close to grid parity in some parts of the world, but there's still some way to go before this technology hits wholesale price. A proper evaluation of the value provided by PV must not just consider generation costs, but also power demand cycles: Green illustrated this point with a plot of daily power demand in Germany, and the potential contribution from different technologies. Here PV can flatten out the peaks in demand in the middle of the day – it is having significant impact on this already.

In Japan there has been significant investment in hydro-storage technology to make use of the nuclear output, which has to be continuous. A similar approach could be applied to handling the PV input to the grid, flattening out the daily PV input cycle.

Green also discussed PV technology, beginning by offering his take on the competition between first-generation silicon-wafer cells and second-generation rivals based on thin films. He argued that those who had written-off silicon-wafer devices for economic reasons have ignored the huge potential for manufacturing cost reductions – much of this development has, until now, been in Asia, and may have been missed.

Green explained that the increased competition in the market place has spurred silicon wafer manufacturers to develop new, cheaper products based upon 'quasi-monocrystalline' silicon ingots, which are being produced in larger and larger sizes. A spin-off benefit of the size increase is the ability to produce a higher proportion of high-quality, oriented grain growth in the centre of the ingot, using a centrally placed seed crystal combined with directional solidification. There's scope for further advances here, plus a strong driver to do it, since the silicon wafer is about half the total cell cost.

To highlight the tremendous advances made by the



silicon PV industry, Green showed the gains in achievable efficiency and the extent of cost reduction since the emergence of the silicon p-n junction 'black cell' in 1974. Improvements to date have come from refinements to passivation and rear contacts, along with developments associated with surface texturing. In the near term, one of the biggest opportunities to trim costs is to find alternatives for the role of silver.

Light trapping technology came up several times during the day – in Green's talk he explained that optimised rear-surface scattering can increase the optical thickness of a cell to about 40 or 50 times its geometric thickness. An efficiency of 25 percent could result without the need to resort to any new technologies.

Green also described some of the advantages associated with moving to thin film technology: Less materials usage, large manufacturing capabilities with integrated module fabrication, and improvements to aesthetics and ruggedness. According to him, chalcogenides – and, further ahead, dye-sensitised and organic cells – offer great potential, as well as capabilities for flexible devices. He showed delegates a plot of efficiency versus cost per unit area, which revealed reductions in cost for thin film technology, offset by some drop in efficiency. However, it's still early days.

In Green's opinion, there are many different technologies that can be used to form third-generation cells, and he believes that it's not clear which of these is the frontrunner. He pointed out that one contender is stacked cells with different bandgaps that can access the whole solar spectrum – predictions are for 49 percent efficiency in three-cell stacks, going up to 58 percent in a six-cell stack. Efforts within Green's group include research into stacked silicon-based technology, with bandgap manipulation using quantum confinement in silicon dots having diameters of just 2-5 nm. Another

CdTe-solar cell manufacturer Abound Solar won a 1.5 MW contract in Polpenazze Del Garda, Italy

goal for this team is the optimisation of epitaxial germanium-on-silicon substrates for stacked junction growth. And they are also working on the development of hot carrier cells, in which slower thermal relaxation at the band edge is controlled by manipulation of the lattice's phononic properties, again using quantum dots.

Thinning silicon to cut costs

Cigang Xu from Oxford Instruments talked about the trend for reducing the quantity of silicon in devices by simply thinning wafers to 100-150 μm whilst maintaining their thermal and ultraviolet stability and passivation properties. He described the progress made in a European-funded project focused on developing aluminium oxide deposition for the rear side of cells using plasma-enhanced CVD (a technique that offers clear routes to industrial scale-up). This process has great potential for precise growth control: Precursor supply (trimethyl aluminium and nitrous oxide), RF power, pressure, flow rates, and temperature are all available parameters that can be used for optimisation, whilst monitoring plasma conditions. According to Xu, ultimately it's necessary to find an appropriate balance between growth rates, precursor usage, uniformity, and film properties.

Transfer of a research project in thin-film devices at Colorado State University to the production line were described by Kurt Barth of Abound Solar. The result is a rugged CdTe PV module that is now being fabricated on a commercial scale. A first-generation tool was built in 2009, and just 19 months later the first modules were coming off the production line. Barth revealed that manufacturability has been a key driver at all stages of development. He said that the resultant product is robust, utilising a unique encapsulation design with an edge seal enclosing internal dessicators. This results in impressive long-term performance, with tests revealing that devices maintained high performance at 85 °C and 85 percent humidity for well in excess of the 1000 hours required for certification.

At Abound automated cell manufacture takes about two-and-a-half hours from start to finish. Glass is loaded and a laser scribes grooves into this substrate, before a proprietary method based on thermal sublimation

deposits a CdTe-based film. Metal sputtering to add back contacts follows, and finally the cell is encapsulated.

According to Barth, Abound will be producing 70,000 modules per month by Fall 2012. Production yield already exceeds 80 percent and total area efficiency is up to 10 percent – further improvements are expected through fine tuning of thickness and processing. The Colorado-based CdTe outfit also has plans to ramp its manufacturing capacity. Construction of a second production line with 65 MW capacity is underway and a third is planned that should lead to a 170 MW capacity by 2012. A new facility with 10 lines is also in the pipeline, and Barth says this should enable Abound to expand its manufacturing capacity to 1500 MW by 2014.

Another speaker talking about commercial drivers for cost reduction and improved capability was Stuart Irvine, who is the Director of the Centre for Solar energy Research at Optic Technium and an academic at Glyndwr University. According to Irvine, although thin-film technology actually offers only a slight cost reduction compared to silicon at this stage, it has great potential to become far cheaper. That's because thin-film technology is relatively new, so it is only now growing in maturity, with high-volume manufacture leading to economies of scale. Irvine argued that it's still a close race between these PV rivals, and he predicted that thin-film technology would represent about a quarter of the PV market by 2013.

Irvine went on to point out some of the materials challenges for thin-film PV: An increased conversion efficiency; reductions in the cost and amount of semiconductor material used; and the development of cheaper, lower-energy processing methods, with high throughput. He also pointed out that there are issues of durability and product lifetime. One option for trimming costs is to use ultra-thin films. However, models of the costing breakdown that have been produced by the UK PV Supergen consortium illustrate that the relatively small materials component of total production costs doesn't justify this switch right now. The situation could change, however, given the uncertainty surrounding future materials prices – tellurium prices are critical.

Another topic discussed by Irvine was CdS deposition on windows by atmospheric pressure MOCVD at growth temperatures of 200-450 °C. This involved the addition of zinc to increase transmission. He and his co-workers are also looking at device efficiency at various film thicknesses and trying to determine how thin a film can be whilst maintaining its properties. It's not simply absorption that must be considered, explained Irvine – there are other effects to take into account in cells that are just a few microns across. To thoroughly investigate this topic, the team have turned to micro-light beam induced current mapping, a technique that can nicely illustrate issues relating to uniformity and pin-holes, with

The fast-food outlet Burger King is installing CdTe-based photovoltaics systems



different wavelengths highlighting different effects. Irvine summarised current work for the team, including enhancing absorption with light capture through scattering, optimisation of back reflectors and the addition of super-absorber material to replace CdTe. Here iron pyrite is undergoing trials: Nominally FeS₂, but it is notoriously difficult to control stoichiometry. Future work will also look at combining organics and inorganics in hybrid devices to extend the wavelength range.

Nano-structuring silicon

A long-standing heavyweight within the solar industry is Sharp. Matthias Kauer represented this company, providing an overview of research into PV, which is a key technology for the company and one that has been contributing a growing fraction of product sales since 1959.

According to Kauer, solar cell products and PV sales are particularly important in Europe, using both silicon and thin-film technologies. He says that Sharp places an emphasis on local production for local consumption, and can live up to this mantra thanks to manufacturing at sites such as the Sharp plant in Wrexham, UK, which ships 500 MW of PV cells based on crystalline silicon per annum. Further ventures are planned in Europe, such as the setting up of a silicon thin-film cell manufacturing facility in Italy. In Sakai, Japan, thin-film solar cell fabrication is going on alongside a major LCD facility where there are economies of scale, and overlap in the use of glass supplies.

Looking forward, Kauer said that cost reduction rates indicate that solar technology should hit grid parity in about five-to-ten years. He believes that once this happens, PV will expand into new markets, such as electric vehicles and 'town' power generation.

Sharp's R&D takes place in Oxford, UK, with a range of areas and products. Activities include the development of a proof of concept of a novel, nanostructured thin-film silicon solar cell. This features a very high aspect ratio light trapping 'moth-eye' surface as a substrate for subsequent film growth – specifically 1.5 µm pillars with a 0.5 µm spacing.

Another interest being pursued by Sharp is that of multi-junction solar cells based on a stack of lattice-matched III-V materials. These are currently being fabricated by MBE. Kauer pointed out that there's a 'missing' material with a bandgap around 1 eV that needs to fit into the stack: Ge/X/GaAs/GaInP. He said that the solution to X might be InGaAsN.

Sam Stranks from Oxford University, UK, described the development of a PV composite 'blend'. This was based on single-walled carbon-nanotubes, typically 1 µm long and 1 nm in diameter, wrapped in a single layer of the polymer P3HT and dispersed in a matrix. Stranks admitted that efficiencies are currently low, but pointed out that there are plenty of possibilities for optimisation

of the blend that could lead to long-lived charge separation. Potential levers include the density, spacing, size and directionality of the nanotubes. He revealed that he and his co-workers are now using time resolved photoluminescence studies to characterise the structures.

Delegates were also briefed on efforts concerning cost and efficiency gains uncovered by fabrication studies at Loughborough University, UK, including optimisation of groove shape for buried contacts by laser ablation (for concentrator PV devices). This is achieved by tuning laser power, stage speed, energy, pulse rate and duration. Characterisation is via coherence correlation interferometry, a fast, large-area method.

The requirement for a fast, cheap, in-line method for surface scattering studies was illustrated by work at the Laboratoire de Physique des Interfaces et Couches Minces, Palaiseau. They are using Mueller polarimetry for monitoring surface texture optimisation to control light management in devices.

Finally, Ralph Gottschalg from Loughborough University gave an entertaining and extremely informative talk on the problems of testing cells and modules in order to make true comparisons and gain trustworthy data. Earlier in the day delegates had been made aware of the need for robust testing regimes and effective comparators. Gottschalg picked up the story, warning delegates that the situation is a minefield! Although researchers may assume that testing by placing two cells alongside each other will give a true comparison, this is not the case for all sorts of reasons – including ground reflection, wind speed, and pigeons! Given all these issues, it might seem that the best way forward is to revert to 'laboratory conditions'. But there are many downsides with that approach, warned Gottschalg.

The biggest of these is that the lab cannot replicate the conditions in the field. Round-robin results performed in a series of high-quality European laboratories gave frighteningly large variations in results (+/-3 percent), and agreements were worse with varying irradiance. The description of the current attempts to develop international standards – requiring standard conditions, standardised data for module behaviour, agreed methods for modelling energy yield, and standardised reporting – raised many smiles.

As if all this information were not enough for this one-day gathering, there was a lively and varied poster show to take in as well. Presentations illustrated fabrication, structure, characterisation, and modelling of PV cells and devices, as well as some novel applications. The next meeting is planned for early Fall 2012, by which time we can expect significant progress and further exciting developments.

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Corning simplifies semi-polar green lasers

Semi-polar lasers don't need electron-blocking layers to deliver high output powers in the green

REMOVING the electron-blocking layer (EBL) has little impact on the performance of green semi-polar lasers, according to experimental efforts by researchers at Corning. This US team has shown that even when the EBL is omitted, semi-polar lasers can still have good injection efficiencies and deliver in a relatively similar performance over a wide temperature range.

These beneficial characteristics strengthen the case that the semi-polar green laser is the best candidate for providing a single-chip green source for various 'RGB' displays, including pico-projectors.

Lead-author Dmitry Sizov argues that the team's findings should not raise any eyebrows, given that EBLs are rarely used in semiconductor systems that are free from polarization fields. "Semi-polar structures with reduced polarization fields are closer to those systems, which may be part of the reason why the EBL is not critical," says Sizov. He and his co-workers also believe that the carrier injection mechanism in semi-polar laser-diodes differs from those in their conventional cousins.

Removing the EBL from semi-polar lasers



Corning's semi-polar lasers deliver a 60 mW continuous-wave output at 519 nm

could make the semi-polar lasers more attractive, because it enables the devices to combine superior injection architectures with lower operating voltages.

Corning's engineers exposed the lack of importance of the EBL by comparing the performance of 11 semi-polar devices with ridge widths of 1.0 μm , 1.5 μm and 2.0 μm and emission wavelengths ranging from 508 nm to 522 nm. Four of these MOCVD-grown lasers had an $\text{Al}_{0.28}\text{Ga}_{0.78}\text{N}$ EBL positioned 10 nm above the top-most QW; the other seven were EBL-free

devices.

Driven in pulsed mode, all of these lasers show no significant change in slope efficiency with temperature, indicating that variations in design had little impact on injection efficiency.

Temperature insensitivity, which was determined by values for the 'characteristic temperature of lasing threshold', T_0 , did not depend on the inclusion or absence of the EBL. However, the value of T_0 for all these lasers, which ranged from 161 K to 246K, is significantly higher than the typical value for conventional green laser diodes. The team attributes the superior temperature insensitivity of the semi-polar laser to intrinsic quantum well properties, such as a higher recombination rate. The team's most impressive EBL-free laser emits at 519.4 nm and delivers a CW output of 60 mW at 10 °C, falling to 35 mW at 60 °C.

Sizov and his co-workers plan to continue working on the development of novel approaches for creating efficient laser devices, including GaN-based lasers.

D. Sizov *et al.* *Appl. Phys. Express* 4 102103 (2011)

Flipping 60 GHz transistors

InGaAs HEMTs form two-stage gain blocks delivering 9 dB of gain while consuming just 20 mW

A TEAM of Taiwanese engineers has used flip-chip packaging to build an InGaAs HEMT delivering up to 6.5 dB of gain at 60 GHz.

The researchers argue that one of the strengths of flip-chip technology is its simplicity: The circuit needs no passive components, such as metal-insulator-metal capacitors and thin-film resistors.

"The main advantage of this approach is the inclusion of matching circuits on the carrier for flip-chip packaging. This provides a cost effective solution for seamless integration of the device onto the circuit," claims team-member Edward Chang from Yuan Ze University.

Silicon CMOS can also yield circuits operating at 60 GHz, which can find deployment in wireless personal area networks, wireless high-definition

multimedia interfaces and wireless docking stations. However, III-Vs have the upper hand in several key areas: A lower noise figure, lower DC power consumption and superior linearity.

Construction of 60 GHz devices began with MBE growth of HEMT epistructures featuring a 15 nm-thick $\text{In}_{0.6}\text{Ga}_{0.4}\text{As}$ channel. Epiwafers were thinned to 100 μm and diced into die that were screened for DC and RF characteristics. Good die were then bonded to sapphire substrates, which were coated with a thin film of metal that had been processed to create transmission lines.

Flip-chip packaging made no impact on the DC performance of the InGaAs HEMT, which has a drain-source current of 350 mA/mm and a transconductance of 600 mS/mm at a drain-source voltage

of 0.5 V. Minimal parasitic effects at interconnections lead to a 0.7 dB reduction in the maximum achievable gain to 6.5 dB.

Two-stage gain blocks were also built with the team's flip-chip approach. At 60 GHz these devices delivered 9 dB of small signal gain when drawing just 20 mW.

Cheng claims that the simplicity and low-cost of the process makes the flip-chip approach suitable for high-volume manufacturing: "It's based on the very mature PCB printing technology."

The team is aiming to make its process even cheaper with flip-chip-on-board technology that replaces substrates with organic dielectrics.

C.-Y Chiang *et al.* *Appl. Phys. Express* 4 104105 (2011)

Antimonides aid infrared detection

The pairing of InGaAs and GaAsSb combine to create detectors with efficiencies exceeding incumbent designs

RESEARCHERS at the University of Virginia are developing incredibly versatile, infrared photodetectors based on quantum wells made from InGaAs and GaAsSb.

These devices operate at room temperature and span the spectral range from 800 nm to 2.8 μm , making them suitable for a wide variety of applications that include telecommunications, night vision, tumor sensing and gas monitoring and detection. "There are other detectors that can detect fairly well in this wavelength regime but they either need cooling or have a low fabrication yield", says Jinrong Yuan.

Yuan points out that one interesting and beneficial feature of the InGaAs/GaAsSb system is its type II structure, which dictates that optical transitions are indirect and occur between adjacent layers. The effective bandgap is consequently narrower than bulk InGaAs, enabling detection at longer wavelengths.

It is possible to stretch the detection of bulk InGaAs to 2.5 μm by straining the ternary layer, but this step introduces defects, increases dark current, and ultimately demands detector cooling. The type II structures pioneered by researchers at the University of Virginia, however, are lattice-matched.

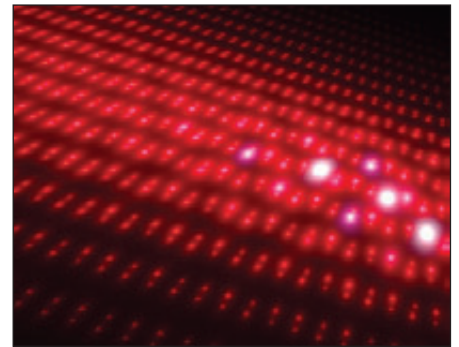
This team has recently fabricated detectors with an absorption region made from 100 alternating layers of 7 nm-thick $\text{In}_{0.53}\text{Ga}_{0.47}\text{As}$ and 5-nm thick $\text{Ga}_{0.5}\text{As}_{0.5}\text{Sb}$.

Performance of this MBE-grown device has been compared to that of a conventional InGaAs detector, which was also made by the researchers. Dark current in the type II detector is more than two orders of magnitude higher due to defects at the interfaces in the quantum well region and a higher density of thermal carriers, which results from the smaller effective bandgap.

Measurements by the engineers revealed that the efficiency of the more novel detector exceeded that of its bulk cousin, delivering quantum efficiencies of 80.2 percent and 57.8 percent at 1064 nm and 1550 nm, respectively.

The team's next goal is to improve the quantum efficiency of its device over its entire range of 800 nm to 2.8 μm .

J. Yuan *et al.* *Electron. Lett* **47** 1144 (2011)




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Strained Layer & Quantum Well
Multi-junction CPV cells

Abolishing unwanted fields in nitride solar cells

Growth on a-plane sapphire enables nitride cells to deliver record-breaking short-circuit current densities

THE performance of conventional nitride solar cells are held back by piezoelectric fields that oppose built-in electric fields and hamper carrier ejection out of the active region. But it is possible to negate these piezoelectric fields and increase efficiency by making nitride photovoltaic on the non-polar a-plane, according to a Japanese research team from Meijo University and Nagoya University.

Wide bandgap non-polar devices have the potential to span a vast spectral range are yet to deliver high efficiencies – the team's latest a-plane nitride cells convert just 1.6 percent of the sun's radiation into electricity, compared to 2.9 percent for variants grown on the c-plane. But far higher efficiencies on non-polar planes will follow through improvements in crystal quality, which should be possible by switching the substrate from r-plane sapphire to bulk GaN.

Non-polar nitride solar cells were fabricated by placing an r-plane sapphire substrate into an MOCVD reactor, thermally cleaning its surface in a hydrogen atmosphere at 1100 °C and depositing a stack of nitride films: First a 150 nm layer of AlN and then a 500 nm film of Al_{0.5}Ga_{0.5}N, a 1.2 μm-thick layer of

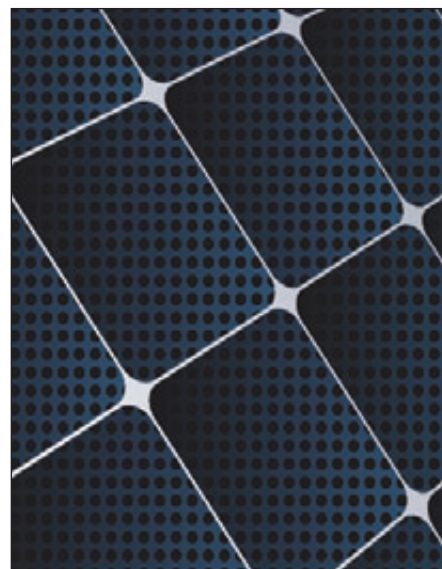
undoped GaN, an n-doped 2.5 μm layer of GaN, a superlattice active region and a 100 nm-thick, p-type GaN cap. The active region comprised 30 periods of 3 nm-thick Ga_{0.85}In_{0.15}N and 1 nm-thick GaN.

Reactive ion etching defined mesa areas in the substrate, and electron beam evaporation added n-type and p-type contacts to the devices, which have dimensions of 350 μm by 350 μm.

External quantum efficiency peaked at 62 percent at 400 nm. This corresponds to an internal quantum efficiency of 94 percent, assuming transmissivity of 67 percent for the Ni/Au electrode. The open-circuit voltage, short-circuit current density and fill factor for the cell were 0.9 V, 4.8 mA/cm² and 57 percent.

The team claims that its device sets a new benchmark for the short-circuit current density for a nitride cell. This record-breaking current may stem from the longer wavelength of the absorption edge or the reduction in internal electric field.

Open circuit voltage is lower than what would be expected from the bandgap of the InGaN active layer. Team member Hiroshi Amano says that this could be due to a defect-related leakage pass or a low



shunt resistance. The non-polar device has a very high level of defects: Densities of threading dislocations and stacking faults are $1 \times 10^{10} \text{ cm}^{-2}$ and $1 \times 10^5 \text{ cm}^{-1}$, respectively. The team plans to address this by producing devices on a high-quality a-plane GaN substrate, which should improve material quality and boost cell performance.

T. Nakao *et al.* *Appl. Phys Express* 4 101001 (2011)

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11-035

Direct integration of III-V lasers on silicon

Compared to their previous work which demonstrated pulsed laser operation, the French IES group have incorporated in the laser a layer which has a dual function as an etch-stop and an ohmic contact layer.

RESEARCHERS from the University of Montpellier and CNRS (France) have realised the direct epitaxial integration of a III-V semiconductor laser diode on a silicon substrate.

The diode fabricated by the nanoMIR group of Institut d'Electronique du Sud (IES) operates under continuous wave (cw) above 30 °C. It emits several mW of output power at a 2 μm wavelength.

IES says this work represents a breakthrough towards the direct integration of III-V semiconductor materials and devices (transistors, lasers, LEDs, photodetectors) on a silicon platform. This, they point out, is a pre-requisite to emerging applications such as III-V CMOS logic, photonic integrated circuits, on-chip optical communications and system-on-chip/system-in-package integrated sensors.

There is currently a lot of research in progress aimed at integrating III-V semiconductor alloys and devices on silicon in order to combine their extraordinary intrinsic properties with very advanced silicon technology.

Although remarkable advancements have been made in the last couple of years with die bonding of InP-based devices, it remains unclear whether this technique can be used on a large scale.

In contrast, heterogeneous epitaxy allows large-scale fabrication and direct integration, but it has proven difficult due to the combination of large lattice-, thermal-, and polarity mismatches. The work of IES demonstrates that GaSb-based compounds are good candidates to solve these problems.

Epitaxial structures were produced by MBE on a tilted (001)-oriented silicon substrate. In contrast to other III-V/Si systems, under appropriate growth conditions, strain relaxation in the GaSb/Si system is known to occur by formation of defects which remain confined close to the GaSb/Si interface. This allows the realization of good quality heterostructures without resorting to thick or composite buffer layers.



Compared to their previous work that demonstrated pulsed laser operation, the IES group enhanced the laser by adding a layer with a dual role: An etch-stop layer and an ohmic contact layer.

The chips were then processed with a "top-top" contact configuration which avoids driving the current through the defective GaSb/Si interface.

A turn-on voltage of 0.8 eV was measured

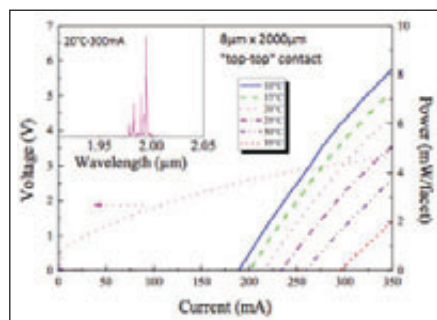


Figure: CW L-I-V characteristics of a "top-top" LD. Right axis: Output power vs injected current for different temperatures. Left axis: Voltage-current curve at 20°C. The inset shows the lasing spectrum taken at 20°C under 300 mA cw injection.

at 20 °C very close to the active zone bandgap of 0.6 eV. Several milliwatts of output power under cw operation were measured with uncoated facets. CW operation was achieved up to 35 °C limited by the experimental setup.

The wavelength of these laser diodes is 2 μm . However the IES group has previously demonstrated emission with antimonide-based lasers in the entire range from 1.5 μm up to 3.3 μm . They point out that the present results can thus be extended to this spectral zone. Further work will focus on this aspect as well as on reducing the optical losses, which remain high compared to homoepitaxial lasers.

Reboul et al *Appl. Phys. Lett.* **99** 121113 (2011)

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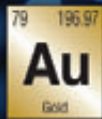
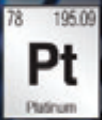
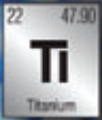
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LEDs

Kyma executive gives invited talk for LED manufacturers

The talk outlined the best way to grow aluminium nitride on patterned sapphire substrate (PSS) for the fabrication of high quality gallium nitride LEDs.

Kyma Technologies, a supplier of crystalline AlN and GaN and related products and services, participated in an invitation only workshop held in Taipei, Taiwan last week.

The workshop was focused on recent developments related to PSS technology for nitride semiconductor LED manufacturing.

At the workshop, Edward Preble, Kyma's Chief Technology Officer and Vice President of Business Development, gave an invited talk entitled "Plasma Vapour Deposition of Nano-Columnar (PVDNC) AlN on PSS for fabrication of high quality GaN LEDs."

In his talk he discussed the use of the PVDNC crystal growth process to produce nano-columnar structures on top of the micro-structured features already present on a PSS substrate, and the observed benefits by LED manufacturers.

"I am thankful to the organisers, especially Natsuko Aota-san and Hideo Aida-san at Namiki Precision Jewel Company, for inviting me to this meeting," commented Preble. "I really enjoyed the open exchange of ideas on how to better capitalise on the many opportunities that are available to enhance the properties of sapphire substrates in support of better LED performance and reduced LED manufacturing costs."

PSS substrates have become increasingly important in GaN LED manufacturing. Only a few years ago most GaN LEDs were made using flat sapphire; today up to 30% utilise PSS and the trend is expected to continue such that PSS may be more important than flat sapphire by 2015.

There are several different methods, including both wet and dry etching, for making PSS, and the detailed microstructures being used and investigated are manifold. LED manufacturers

and research scientists report several different benefits and those benefits seem to vary from group to group. Reported benefits include a lower defect density in the GaN buffer, higher thermal conductivity of the device heterostructures, and greater light extraction efficiency.

Kyma's PVDNC process has been used to deposit high quality AlN on both flat and PSS sapphire, as well as on flat silicon, as a nucleation layer for improved GaN buffer layers. Kyma has not tried PVDNC AlN on patterned silicon and encourages interested parties to contact the company for discussion.

Kyma says that the market for nitride semiconductor devices is estimated to be \$9B in 2011 and is expected to reach \$90B over the long term, including \$60B in visible lighting applications and \$30B in power electronics applications.

Everlight fights back against Nichia in LED combat

The firm is retaliating against Nichia's recent claims by filing a lawsuit in the Tokyo District Court; Everlight is seeking damages and demands that Nichia stops spreading false allegations.

After Everlight won a victory over Nichia for the patent administrative litigation (Patent No. 089036) in the Taiwan Supreme Administrative Court in October 2011, the Taiwan Supreme Court this November ruled in favour of Everlight again in the civil infringement case on Nichia's patent in issue.

Everlight says this finalises all cases regarding this patent and that since Nichia has affected fair competitive market mechanisms by filing patent infringement lawsuits and announcing press releases, Everlight decided to fight back.

On 1st December 2011, Everlight brought a new lawsuit in the Tokyo District Court demanding that Nichia stops spreading false allegations and is seeking an award for damages.

In 2006, Nichia brought the patent infringement lawsuit against Everlight in Taiwan and sought damages of TWD 80 million (US \$ 2.65 million).

Everlight fought back aggressively by invalidating Nichia's patent in issue in the Taiwan Intellectual Property Office (TIPO) the same year. Last July the Intellectual Property Court held in the civil lawsuit that the patent is invalid and that there are no legal grounds for the claim of TWD 80 million in damages.

In March 2011 the IP Court in the administrative procedure further ordered the TIPO to revoke Nichia's patent in issue. Nichia appealed, yet in October the Taiwan Supreme Administrative Court affirmed the IP Court's decision, upholding that Nichia's patent is invalid and granting victory to Everlight. Soon after this, in November the Taiwan Supreme Court dismissed Nichia's appeal in the civil infringement lawsuit, and Everlight won final victory over Nichia in both administrative and civil actions.

Everlight has since brought an unfair competition lawsuit in the Tokyo District Court (on 1st Dec 2011) and sought an order compelling Nichia to stop issuing press releases alleging baseless patent infringements in an attempt to affect Everlight's goodwill.

Nichia have repeatedly proclaimed that LED manufacturers and distributors should respect its patent rights, and according to Everlight, Nichia says on its website that Chinese, Korean and Taiwanese manufacturers' recent behaviour of disregarding patent rights in the Japanese market has grown "intolerable".

However, Everlight says that the validity of the patents Nichia used to claim infringement over Everlight's products is questionable. As such, the firm decided, after many years of litigation against Nichia, to strike back to fully protect the interests of its customers and shareholders and to continue to bring patent invalidation lawsuits against Nichia in multiple countries.

Through the endeavours of the whole LED industry all over the world, LED technology has become the most energy-efficient, environmental-friendly, and health-oriented products now, and LED makers can manufacture and sell a range of LED products through fair market mechanisms.

Everlight says it consistently takes intellectual property rights seriously and has reached several

mutually beneficial cross-license and patent license agreements with other companies in the industry. However, the firm says that when facing unfair competition, it will strike back when appropriate and take strong moves to protect the interests of its customers and clients.

Soraa secures \$88 million in funding

Funding by Khosla Ventures and NEA will help to develop and commercialise blue and green lasers grown on non-polar and semi-polar gallium nitride substrates.

Soraa, a developer of laser diodes for consumer, biomedical, defence, and industrial applications, has closed on \$88.6 million in fresh capital, according to a SEC regulatory filing.

The funding for the Fremont, California-based laser start-up has come from Khosla Ventures and NEA. Soraa lists its director and NEA general partner Ravi Viswanathan on the new filing.

Soraa, which was founded by the UCSB academics Shuji Nakamura, Steve DenBaars, and Jim Speck, is developing lasers on semi-polar and non-polar GaN substrates.

The benefits that these new planes deliver, in terms of device performance and architecture, will be discussed during a talk given by James W. Raring, VP Laser Engineering of Soraa, at the CS Europe Conference 2012. At this meeting in Frankfurt he will be presenting a talk entitled "*III-Nitride Lasers Based on Nonpolar/Semipolar Substrates*".

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

Bridgelux in Forbes' most promising 100 list

The developer and manufacturer of LED lighting technologies and products was ranked 58th on

the list of 100 privately-held American companies selected from 22 industries.

Bridgelux, has been named in Forbes' prestigious list of America's Most Promising Companies (AMPC).

Bridgelux was ranked 58th on the list of 100 privately-held companies selected from 22 industries for their innovative business models and strong management teams. Forbes noted that Bridgelux revenue grew 168% from 2008 – 2010.

"We are extremely honoured to be selected by Forbes for this influential list of high-growth, high-potential companies," said Bill Watkins, Bridgelux's chief executive officer. "Our technology breakthroughs and innovative product designs have helped drive rapid adoption of our industry-leading array architecture in the general illumination market. We are excited about the prospects of continued rapid growth in the years ahead as mass adoption of solid state lighting accelerates."

Forbes' list of America's Most Promising Companies features 100 privately held companies with compelling business models, strong management teams, notable customers, strategic partners and precious investment capital.

"Sizing up younger, privately held companies is hard: Their fortunes can change very quickly and there's a dearth of public data," says Forbes Executive Editor Brett Nelson. "We took a more comprehensive approach to evaluate their health and potential."

Seoul Semi and Philips bury the hatchet on LED technology

The terms of the cross-license agreement will not be disclosed.

Seoul Semiconductor and Royal Philips Electronics have agreed to settle their pending legal cases and to enter into a cross-license agreement covering patents relating to specific LED technology areas.

Under this arrangement, each party gains access to a substantial part of the other party's patent

portfolios for various LED level technologies.

"As cross-license agreement details are usually kept confidential, we have agreed not to disclose any of the terms," says John Bae, vice-president of Seoul Semiconductor.

"We will continue to focus our attention towards innovative LED technology and driving adoption through quality and value." By entering into this cross-license agreement with Philips, Seoul Semiconductor anticipates expanding its flexibility.

Separately, Seoul Semiconductor has recently introduced Acrich2, the latest versions of its highly successful AC-driven Acriche family. "We are very excited about our Acriche family of products and especially Acrich2, which was introduced in October 2011. Acrich2 eliminates many of the technical barriers associated with traditional high-voltage and AC-driven LED solutions," says John Bae.

Seoul Semiconductor also holds patent agreements regarding LED technology with many leading LED manufacturers.

Cree LMH2 LED modules raise the bar for efficacy and quality

The next-generation LED module family features TrueWhite technology and are claimed to provide an industry-leading Colour Rendering Index (CRI) greater than 90.

Cree has announced the commercial availability of the new LMH2 LED module family, designed to speed time-to-market for high-quality LED luminaires.



The barrier-breaking LMH2 is the only LED

module delivering 80-lumens-per-watt system efficacy combined with CRI greater than 90. The modules feature Cree TrueWhite Technology, a revolutionary way to generate white light with LEDs. The modules deliver high efficiency with beautiful light characteristics and colour accuracy while maintaining colour consistency over the life of the product.

The compact, two-piece module allows maximum design flexibility—uniquely enabling manufacturers to incorporate their luminaire design into the thermal management system and potentially eliminating the need, and cost, of secondary thermal management. By separating the light source and power supply, Cree gives luminaire designers a broad range of options for mounting, wiring and reflector design.

Optimised for more than downlights and spots, the LMH2 makes Cree TrueWhite Technology easily available in many lighting applications, including wall sconces, pendant lights, ceiling fans and many other common fixtures in residential, retail, museums, hospitality and restaurant environments.

“At Cree we uniquely understand what lighting OEMs need to bring LED fixtures to market. The new Cree LMH2 modules make the benefits of Cree TrueWhite Technology affordable and widely available,” said Mike Watson, senior director of marketing, Cree LED components. “Only Cree enables our customers with the latest LED modules that combine 80 LPW efficacy with 90+ CRI.”

The LMH2 is available at 850 and 1250 lumens and in colour temperatures of 2700 K, 3000 K, 3500 K and 4000 K with more than 90 CRI. Designed for 50,000 hours of operation and dimmable to five percent, the LMH2 comes with Cree’s new industry-leading five-and-a-half year warranty.

The LMH2 is also UL-recognised and complies with multiple international regulatory and safety standards. Fixture makers seeking ENERGY STAR qualification will have access to specification and performance data, including LM-80 reports, which can speed regulatory approvals.

Sample and production quantities are available with standard lead times from both Cree and Cree module distributors.

Arima Changzhi orders 6 Aixtron systems

The JV LED manufacturing company involving Changzhi High Tech Industry Investment, China, and Arima Optoelectronics from Taiwan aims to boost HB LED capacity

The joint venture has placed an order for three 42 x 2-inch wafer configuration AIX 2800G4 HT MOCVD systems as well as three 11 x 4-inch wafer configuration AIX 2800G4 HT MOCVD systems.

All reactors have been installed and commissioned by a local Aixtron service support team and will be used for the production of High Brightness (HB) LEDs. Chen, General Manager of Changzhi High Tech, expressed his satisfaction with progress so far, “We have been very actively preparing our epitaxy process development and production of LED for HB LED wafers and chips.»

He continued, « Underpinning this strategic plan will continue to be the equipment we receive from Aixtron, the world’s leading supplier of MOCVD equipment for the production of LEDs. Through our long-standing ISCAS (Institute of Semiconductors of Chinese Academy of Sciences, Beijing) collaborations and more recently with Arima Changzhi, they have impressively shown us how easy it is to achieve outstanding results in a very short time.”

Bastian Marheineke, Vice President Sales at Aixtron, comments, “Repeat orders are particularly important to us and we will be with our customer every step of the way. As usual, we will ensure the highest performance and best utilisation of Aixtron equipment. We know how crucial these six reactors are to them and are pleased to work closely with their highly knowledgeable staff to a smooth and rapid ramp to full production.”

GaN nanowires have a bright future

Gallium nitride nanowires grown by PML scientists may only be a few tenths of a micron in diameter, but they promise a very wide range of applications, from new LEDs and diode lasers to ultra-small

resonators, chemical sensors, and highly sensitive atomic probe tips.

In the two decades since GaN was first employed in a commercially viable LED, ushering in a dazzling future for low-power lighting and high-power transistors, the III-V semiconductor has been produced and investigated numerous ways, in both thin-film and nanowire form.

At PML's Quantum Electronics and Photonics Division in Boulder, Colorado, much of the recent effort has been devoted to growing and characterising extremely high-quality GaN nanowires – “some of the best, if not the best, in the world,” says Norman Sanford, co-leader of the Semiconductor Metrology for Energy Conversion project.

GaN emits light when holes and electrons recombine at a junction created by doping the crystal to create p-type and n-type regions. These layers are formed by a variety of deposition methods, typically on a sapphire or SiC substrate. Conventional methods produce crystals with relatively high defect densities. Unfortunately, defects in the lattice limit light emission, introduce signal noise, and lead to early device failure.

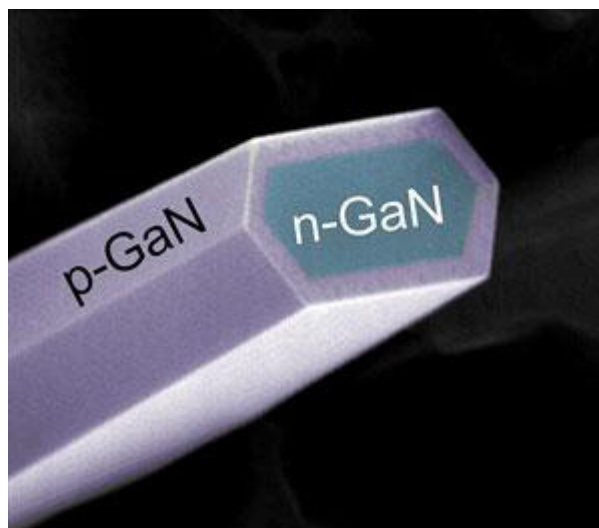
The Boulder team, by contrast, grows virtually defect-free hexagonal GaN nanowires very slowly from a silicon base. Their MBE deposition method allows the nanowires to form spontaneously without the use of catalyst particles. Although catalyst particles are widely used for nanowire growth, they leave behind trace impurities that can degrade GaN. It takes two to three days for the structures to reach a length around 10 microns (about one-tenth the thickness of a human hair), but the wait pays off because the crystal structure is very nearly perfect.



Optically pumped GaN nanowire laser shown glowing orange. The actual laser output is UV

(≈370 nm) and invisible to the unaided eye. The length of the lasing nanowire is roughly 10 microns and the diameter is roughly 200 nm. The metal probe tip at the top of the image is used to examine proximity effects on the lasing properties of the nanowire. Other (non-lasing) nanowires are also seen in the image.

Among other advantages, flawless crystals produce more light. «Now, for the first time, the electroluminescence from a single GaN nanowire LED is sufficiently bright that we can measure its spectrum and track the spectrum with drive current to see evidence of heating,» says project co-leader Kris Bertness. «There are no other examples of electroluminescence spectra from a single MBE-grown GaN nanowire in the literature.



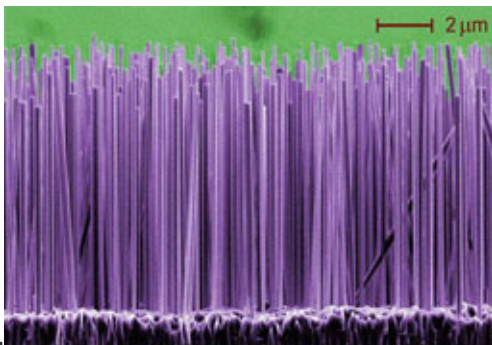
Structure of an n-type GaN nanowire grown by MBE and coated in a thin-shell of p-type GaN grown by halide vapor phase epitaxy. (Credit: Aric Sanders and Albert Davydov/MML)

GaN and its related alloy system (including semiconductors containing indium and aluminium) form the basis of the rapidly expanding solid state lighting industry. It could move faster, experts believe, if industry could develop an economical method to grow low-defect-density material.

“Conventional GaN-based LEDs grown on cost-effective but non-lattice-matched substrates (such as sapphire) suffer from unavoidable strain and defects which compromise efficiency,” Sanford says. “Additionally, light extraction from conventional planar (flat) LED structures is impeded by total internal reflection resulting in wasted

photons which are trapped in the device rather than radiating outward as useful light.”

GaN nanowire LED technology offers significant improvements since the wires grow essentially free of strain and defects and should thus enable fundamentally more efficient devices. What’s more, the morphology provided by a “forest” of densely arrayed nanowire LEDs offers improvements in the light-extraction efficiency of these structures compared with their planar counterparts.



A «forest» of nanowires

Testing and measuring those and other properties, however, poses significant challenges. “P-type GaN is difficult to grow by any common growth method,” Bertness says. “And what turns out to be very hard is making good electrical contacts to the nanowire, because it is not flat, and its thickness is larger than most of the metal films used to contact planar films.

“This 3D geometry encourages void formation and trapping of chemical impurities near the contacts, both of which degrade the contact, sometimes to the point of being unusable. This is an area we are actively investigating.”

The team is looking at ways to grow nanowires in regular arrays, with careful control of the spacing and dimensions of each individual wire. Recently they found that by creating a grid-like pattern of openings on the order of 200 nanometres wide in a SiN “mask layer” placed over the substrate, they could achieve selective growth of highly regular wires. The ability to produce ordered patterns of uniform GaN devices, Bertness says, “is essential for reliable manufacturing.”

GaN is not only a light source. It also has multiple uses in different fields. “Another nice thing about GaN is that it’s insensitive to high temperatures,”

says Robert Hickernell, leader of the Optoelectronic Manufacturing Group, which includes the Semiconductor Metrology project. “That’s an advantage for high electrical power applications.” The Group is also studying nanowire field effect transistors (FETs) to accurately measure carrier transport properties. “And we’ve got GaN nanowire FETs that are some of the best research devices in the world.”

In addition, GaN nanowires are mechanically robust. Very robust: Four years ago, a PML-University of Colorado collaboration made headlines by producing nanowires with extraordinarily high quality factors that make them potentially excellent oscillators. “In the distant future,” Hickernell says, “they might be used in cell phone applications as micro-resonators.”

The combination of high mechanical quality factor and tiny mass also makes them capable of detecting masses in the sub-attogram range. PML collaborators at the University of Colorado are confident that they can extrapolate the present experiments to roughly 0.01 attograms, or 10 zeptograms sensitivity. (For comparison, the mass of a virus is on the order of 1 attogram, or 10

Earlier this year, Bertness, Sanford and CU collaborators used GaN’s native piezoresistance to measure frequency response in nanowires stretched across a 10 micron gap. The results showed that the devices had “immediate utility in high-resolution mass and force sensing applications,” the researchers wrote in their published report.

The team thinks it is possible to make “a new class of electrically-addressable multifunction scanning-probe tools,” Bertness explains. “For example, conventional NSOM relies on a scanning optical tip with an aperture diameter in range of 10 to 100 nanometres which is formed at the tapered end of a passive optical fibre. Those tips are mechanically and chemically fragile and have a very short service life – hours to days. On the other hand, GaN nanowire based NSOM tools can potentially offer electrically-addressable multifunction operation that combines optical emission, optical detection, AFM and RF-AFM functionality.”

Finally, GaN nanowires are also well suited for use in chemical, biological, and gas sensing. Ongoing

collaborative work between the team and NIST's Material Measurement Laboratory is producing interesting results with GaN nanowires used in tandem with nanoclusters of TiO

New wet process for LEDs on patterned sapphire boosts efficiency

Switching from a dry process to wet lowers capital and manufacturing costs, scalability, and better throughput for gallium nitride and indium gallium nitride LEDs.

MicroTech has developed a wet process station for the etching of PSS (Patterned Sapphire Substrate) wafers used to increase light extraction and efficiency in high brightness LEDs.

The wet station can improve manufacturing throughput, a major stumbling block to making LEDs price competitive with fluorescent lighting.

As LED manufacturers look to decrease costs, the use of PSS becomes more important. The average light output power is reported to be up to 37% larger on a PSS than a standard sapphire wafer. The use of patterned sapphire substrates reduces the dislocation density in the GaN layer and enhances the light extraction efficiency from the LED chip.

Traditional dry etching on PSS produces highly efficient, very bright light but throughput is slow and scalability is impacted as wafer sizes increase. Typically, more dry etch tools are needed to keep throughput up as wafer size increases.

In the wet etch process in the MicroTech system, GaN or InGaN coated wafers are submerged in the etch tank with a mixture of etching and buffering agents. Prior to submersion, an SiO₂ mask is patterned using plasma enhanced chemical vapor deposition. A lithography step exposes the desired pattern to etch. The sapphire etch process takes place between 260°C and 300°C. This ultra high temperature etches the wafers exponentially more quickly than the standard 150-180°C process and therefore, speeds throughput.

Independent customer evaluations show a

significant improvement in light extraction and efficiency in the substrates and a considerable cost savings, even if polishing work is performed on the wafers after etch to increase efficiencies. Development work is also being done to improve the dome shapes created on the wafers with a chemical mechanical polishing process. New non-cone shapes are also under development.

Recently MicroTech announced the delivery of a similar concept process station to the solar industry that delivers high throughput and lower cost-of-ownership benefits by moving from a dry CVD process to an efficient, production-proven, environmentally friendly wet process.

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on "The Market for LEDs in Lighting".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status

and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN

Semiconductors

Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Soraa Inc.

Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for

RF and power compound semiconductor devices
- Dr Thomas Uhrmann, Business Development
Manager, EV Group (EVG)

ISET ships non-vacuum CIGS modules

The company reverses industry trends by exporting PV modules to Asia.

International Solar Electric Technology, Inc. (ISET), a manufacturer of printed thin-film CIGS solar panels, has shipped full-sized modules to initial customers in South Korea from its pilot production facility in Los Angeles. Initial products were designed and assembled to meet the specifications of distributed power markets as ISET targets growth in an underserved industry segment.

The CIGS modules will supply off-grid electricity for green LED lighting applications in agricultural, industrial, and transportation markets. ISET raised just under \$18 million to develop a pilot facility in Southern California capable of manufacturing CIGS modules from bare glass to final module assembly.

ISET says it is the first PV company to ship monolithically-integrated CIGS products based on a printed ink process. ISET's CEO and President Vijay K. Kapur identified this milestone as "the product of thinking globally and competitively," pointing out that "global competition has pushed prices to a level which we had anticipated from the start. For that reason, I am extremely proud that we have begun to export American-made PV products based on ISET's manufacturing platform which can be truly cost competitive."

The company's first shipments follow closely upon recent announcements of efficiency and yield milestones in preparation for expansion to volume manufacturing.

Osram LEDs combine maximum flexibility with minimal size

The firm says its latest Oslon Square LEDs make even better use of light.

Osram Opto Semiconductors new LED, the Oslon Square, opens up a wide range of possible uses, including designer luminaires for the home or office, retrofits and street lights.

The LED is available in many different versions with different colour temperatures. It can be operated with different currents, making it extremely versatile. Its reflective package makes even better use of the light and increases system efficiency in all versions.



High efficiency: the reflective package of Oslon Square makes use even of the light emitted at the side between the chip and the lens.

The Oslon Square can be used in a wide range of applications, from cool designer luminaires to bright street lights. And there is no need to change the manufacturing process for the lamps because this new LED has all the right credentials for widespread use – it is small, powerful and capable of operating on different currents. This one LED can therefore be used for manufacturing different products for different target markets.

Like the Oslon SSL, the Square measures only 3 x 3 mm, has a low thermal resistance of 4 to 3.8 K/W and is accommodated in a robust package which is suitable for outdoor use. Particularly worthy of mention is the high system efficiency that can be achieved with this versatile LED. The LED chip is enclosed by a reflective package that reflects light emitted at the side or at the back so that this light is

usable. Light that is reflected back to the LED within a system – for example from a diffuser – can also be used in this way.

The Oslon Square EC is suitable for indoor applications in which a high quality of light is needed, for example in offices. With a colour temperature of 3000 K it provides a warm white light and also offers high colour stability over a wide viewing angle (120°). The CRI is at least 80. If the lighting needs to be particularly uniform a “fine-bin” order can be placed for this LED. At an operating current of 700 mA it achieves an efficiency of above 90 lm/W and a luminous flux of 200 lm and more. At 350 mA its efficiency passes the 100 lm/W mark.

The EC version is also suitable for retrofits. Thanks to its small dimensions of 3 x 3 mm it can be closely clustered and, like all the LEDs in this series, it benefits from its reflective package, both individually and within a system.

The Oslon Square PC and UW are designed for outdoor applications, for example in street lighting. They can be operated on currents of 200 mA to 1.5 A, making them interesting for other applications such as downlights and spotlights. The LEDs produce a neutral white to cold white light with colour temperatures of 4000 K and 6000 K. And at 130 lm/W from 350 mA they are even more efficient than the warm white version. With a CRI of at least 70 (4000 K) and 65 (6000 K) these LEDs combine good quality of light with high efficiency.

Ivo Ivanovski, Product Manager for the Oslon Square series at Osram Opto Semiconductors, summarised the benefits of the new LED as follows, “Every application places different demands on lighting, and with the Oslon Square we are providing a platform for tailor-made solutions. The LED is available in different colour temperatures with different CRIs and can be operated with different currents.”

“By the end of the year we will have added further color temperatures to the portfolio. In addition to product features, we are offering logistical concepts with the Oslon Square that will make it easier for customers to develop luminaires,” concluded Ivanovski.

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, “Compound Semiconductor Markets: Current Status and Future Prospects”.

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Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : “CS Europe 2012: Markets and III-V CMOS Conference”

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems

Technology Office

- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

- III-V on 200 mm Si for VLSI - Richard Hill, Sematech

- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : "CS Europe 2012: LEDs, lasers, PV and electronics Conference"

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

- Ammono's ammonothermal method to make GaN substrates - Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors

- Scalable "on-silicon" solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers - Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.

- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

- Perspective of an LED Manufacturer - Iain Black,

Philips Lumileds Lighting Company

- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU

- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

- GaN the enabler for true SDR- Professor Rik Jos, NXP

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- Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, EpiGaN

- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

- Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Kyma expands AlN template manufacturing capacity

The firm's aluminium nitride based templates act as a replacement for bare and patterned sapphire substrates by manufacturers of blue, green, and white LEDs.

Kyma Technologies has expanded its AlN template manufacturing capacity for both sapphire and silicon based AlN template products.

Kyma's AlN templates are manufactured using its patented plasma vapour deposition of nanocolumns (PVDNC) technology, which provides LED manufacturers with throughput, cost, and performance benefits.

The expansion of Kyma's AIN PVDNC template manufacturing capacity is based on successful customer qualification of products fabricated in its newest high volume PVDNC reactor, the commissioning of which was announced by the company earlier this year.

LED customer feedback indicates significant improvements in LED brightness, reverse voltage, and electrostatic discharge yield. Similar benefits have been previously verified using Kyma's lower volume manufacturing tools which the company has used since it was founded in 1998.

Kyma has also qualified the tool for production of PVDNC AIN on silicon wafers. Several customers report improved device properties for both RF and power switching applications.

Kyma says qualification of this new tool was not a small task and that its design is totally new compared to earlier designs, with key design changes targeting improved tool uptime, shorter process cycle time, and better process repeatability and uniformity.

"We are pleased to qualify our new reactor for both sapphire and silicon based PVDNC AIN template products," said Heather Splawn, Kyma's Chief Operating Officer. "Doing so represents not only a significant boost to our manufacturing capacity; it also validates our improved tool design approach which should prove beneficial for our continued expansion plans going forward."

Kyma believes that the market for nitride semiconductor devices is estimated to be \$9B in 2011 and is expected to reach \$90B over the long term, including \$60B in visible lighting applications and \$30B in power electronics applications.

LED street lights to be installed in Taiwan

President Ma Ying-jeou said today that Taiwan is using LED traffic lights throughout the country and will install LED street lights and indoor lights in public buildings in the near future

Ma made the remarks at the inaugural ceremony of Genesis Photonics Inc.'s new plant at the Southern Taiwan Science Park in Tainan City. Ma said green technology is one of the Cabinet's six key development industries. Efforts to develop the industry have turned Taiwan into the world's biggest LED lighting and molding suppliers, he said, adding that the newly-built plant is set to create some 300 jobs. He continued by saying that Taiwan trails only Singapore in the use of LED traffic lights, and that the next step is to utilize LEDs in street lights and indoor lighting devices. David Chung, president of Genesis Photonics Inc., said the company is confident about the future of the LED industry. Despite the faltering global economic situation, which has resulted in a large stockpile of LEDs, the company will overcome the challenge by focusing on technological upgrades. Chung went on to say the company's new plant will feature Taiwan's first production lines for 6-inch epitaxial wafers. A center of innovation will also be established at the plant for the training of research and development talent in the field of solid-state lighting technology.

Fairchild's AlGaAs infrared LED optically coupled to a phototransistor

Industrial applications present reliability challenges to designers as a result of the high temperature and tight spaces commonly found in power supplies, motor controls and consumer applications such as chargers and adapters.

To combat these reliability challenges, system design engineers need an optocoupler, which allows for more design margins and has stable parameters in high temperature environments.

To meet this need, Fairchild Semiconductor a global supplier of high-performance power and

mobile semiconductor solutions, developed the FODM8801, part of the OptoHiT™ series of high temperature phototransistor optocouplers. These devices use Fairchild's proprietary OPTOPLANAR® coplanar packaging technology to achieve high noise immunity and reliable isolation at high operating temperatures.

The FODM8801 consists of an aluminum gallium arsenide (AlGaAs) infrared light emitting diode optically coupled to a phototransistor. The device provides a guaranteed Current Transfer Ratio (CTR) for both saturated and non-saturated modes of operation and switching specifications over the extended operating temperature range (-40°C to +125°C) for greater design flexibility.

The device offers excellent CTR linearity at high temperature and operates at a very low input current (IF). The FODM8801 is packaged in a compact, half-pitch, mini-flat, 4-pin package (1.27mm lead pitch), saving board space and providing more design flexibility, allowing for overall reductions in system cost.

Additionally, the FODM8801 provides high isolation voltage for increased reliability in lead-free environments. Devices in the OptoHiT series are ideally suited for industrial applications, including power supplies, motor controls and consumer applications, which include chargers and adapters.

The FODM8801 is part of Fairchild's comprehensive portfolio of high performance optocouplers that offer leading-edge noise immunity resulting from its proprietary OPTOPLANAR coplanar packaging technology. The OPTOPLANAR technology ensures safe insulation thickness of more than 0.4 millimeters in attaining reliable high voltage isolation, and provides >5mm creepage and clearance distance, certified by UL1577 and DIN_ EN/IEC60747-5-2 standards.

www.fairchildsemi.com.

MOCVD shipments see first year-over-year decline in 2.5 years

A growing oversupply of LEDs and expiring

subsidies in China have contributed to the reduction. On the upside, shipments for GaN-on-silicon reactors saw an upsurge.

IMS Research released the MOCVD chapters of its 300-page "Quarterly LED Supply and Demand Report" in November 2011 which revealed significant changes in MOCVD market share and the MOCVD market outlook.

MOCVD shipments for all applications fell Q/Q and Y/Y to 170 units. It was the first Y/Y decline in at least 2.5 years.

The decline can be attributed to depressed utilisation in the GaN LED space along with a growing oversupply in LEDs, tight credit, facility readiness and expiring subsidies in China. A bright spot was rising shipments of MOCVD systems for GaN on silicon.

MOCVD revenues were down sequentially for the 3rd consecutive quarter and Y/Y for the first quarter in at least 2 years, falling to \$340 million.

Veeco led in total MOCVD unit and revenues for the first time, earning a 63% share of tool shipped, shown in Figure 1, and 65% share of revenues. Aixtron's share fell from 50% to 34% in units and 52% to 32% of revenues.

Veeco did benefit from the recognition of previously shipped MaxBright reactors to the GaN LED market. However, if those were excluded, Veeco still would have enjoyed a commanding 56% to 40% unit share advantage indicative of the acceptance of this new platform and Aixtron's customer delays

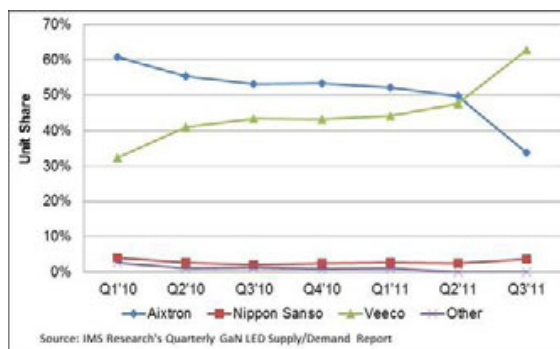


Figure 1: Total MOCVD Unit Share

GaN is the dominant application for MOCVD tools which are used to produce blue/green LEDs.

In Q3'11, GaN MOCVD tools accounted for 90% of the total MOCVD market with shipments of 152 units, down 18% Q/Q and 34% Y/Y. It was the lowest total since Q1'10. If previously shipped but unrecognised reactors from Veeco weren't included, shipments would have been the lowest since Q4'09.

What's more, GaN MOCVD revenues were down sequentially for the 3rd consecutive quarter, falling 21% Q/Q and 37% Y/Y to \$308 million.

China earned its highest share to date at 82% of unit shipments. No other region had a double-digit share. India took its first MOCVD system for GaN in at least 3 years.

Eleven of the top 13 customers in Q3'11 installed tools in China. Elec-Tech was the #1 customer in Q3'11 followed by Epilight and Tongfang Opto.

By region, Veeco led in China for the 4th consecutive quarter and also led in Taiwan for the first time.

Two inch systems once again dominated due to China's dominance, earning an 87% share of tools installed in Q3'11. Including all of Epistar's majority owned subsidiaries in China, Epistar had the highest number of merchant MOCVD systems installed followed by Samsung LED and San'an tied for #2.

As a result of the Q3'11 weakness, reduced guidance from MOCVD manufacturers and discussions with LED manufacturers, we have reduced our 2011 forecast to < 700 tools, a 9% reduction vs. the most recent forecast.

This quarter, IMS Research provided LED manufacturers' optimistic, base and pessimistic forecasts for 2012 GaN MOCVD installations, producing an interesting range. The base forecast is now less than 400 tools, a 43% reduction from 2011. However, the firm still sees 2012 as the 3rd best year ever for GaN MOCVD installations due to additional players entering from China, the existence of multi-year MOCVD subsidy agreements between certain Chinese provinces and local MOCVD suppliers and existing players buying new, more cost effective tools with wider process windows to go after new markets.

China is expected to account for a 71% share of

the 2012 market, down from 77% in 2011. Taiwan's share is expected to rise from 12% to 13% with Korea's share rising from 6% to 8%.

MOCVD supplier share is forecasted for 2012 based on interviews with LED manufacturers.

The market research firm also expects to see 4" and 6" installations surge as companies prepare for the growth in lighting market demand.

According to IMS Research SVP Ross Young, "The remainder of the Q4'11 issue of our Quarterly GaN LED Supply and Demand Report will be distributed shortly and will include updated forecasts for lighting demand given China's recent incandescent ban announcement and the latest backlighting results and forecasts factoring in new, low cost direct LED backlights introduced into developing markets. We will also be updating our forecasts through 2016 for packaged LED revenues, LED supply, LED and MOCVD supply/demand and sapphire supply, demand and pricing. As we have heard from many of our subscribers, this report continues to be the most comprehensive and valuable quarterly report on the LED industry."

Hualei Opto receives further Aixtron MOCVD reactors

Very satisfied with the Aixtron CCS technology used in Phase 1 of its gallium nitride HB LED program, Hualei will continue to choose Aixtron systems for its next expansion phases.

Xiang Nang Hualei Optoelectronics of Hunan Province, China, has ordered eight new Aixtron MOCVD reactors to boost capacity for GaN HB LEDs.

The order includes six CRIUS II reactors in a 55x2-inch wafer configuration and two AIX G5 HT 56x2-inch wafer configuration systems. A local Aixtron service team has installed and commissioned the new systems in Hualei Optoelectronics' state-of-the-art facility in Chenzhou, China.

Previously in 2009, Hualei Optoelectronics placed Aixtron's largest ever single order for MOCVD systems from China at that time with multiple CRIUS MOCVD systems.

A spokesperson from Hualei Optoelectronics comments, "The acquisition of further Aixtron MOCVD reactors represents another step in our shift away from an earlier reliance on heavy industry towards high-tech. Entering the high brightness LED business was our strategic target and by working closely with Aixtron, Hualei has achieved its goals quickly and efficiently. Hualei is completely satisfied with the Aixtron Close Coupled Showerhead technology we used in Phase 1 of our GaN HB LED program and that is why we will continue to choose Aixtron systems for our next expansion phases. The professional and responsive service we receive from the local Aixtron team will further guarantee our success."

Bastian Marheineke, Vice President Sales at Aixtron, adds, "Aixtron was the first company to install a commercial MOCVD reactor in China and since then we have enjoyed excellent relations with the leading institutes and companies. So it is with great pleasure that we announce this repeat order from Hualei. It not only reaffirms the on-going enthusiasm for investment in new technology in China but also reflects the continued trust in Aixtron based process technology and support."

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be "An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program."

Defining the next steps for the Compound Semiconductor Industry

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix of quality speakers making it the must attend industry event for 2012.

The CS Europe 2012 Conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

Please register at www.cseurope.net and remember to book your delegate place now as

numbers will be limited.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/ Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-Vs on 200 mm Si for VLSI - Richard Hill, Sematech
- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : "CS Europe 2012: LEDs, lasers, PV and electronics Conference"

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow
- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree
- Ammonio's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonio S.A.
- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable «on-silicon» solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.
- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.
- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company
- The CPV Market following its acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU
- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR - Professor Rik Jos, NXP
- Holistic Approach to MOCVD vacuum & Abatement - Mike Czerniak, EdwardsVacuum Ltd.
- Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning
- Large diameter GaN-on-Si epiwafers for

power electronics - Dr Mariane Germain, EpiGaN

- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor
- Damage - free Deposition on LED devices – Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd
- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

CdSe/ZnS QD-LEDs turn troublesome molecules to their advantage

Nestling quantum dots in an insulating egg-crate structure enables optimisation for quantum-dot LEDs according to researchers in the U.S.

Researchers at the Harvard School of Engineering and Applied Sciences (SEAS) have demonstrated a robust new architecture for quantum-dot LEDs (QD-LEDs).

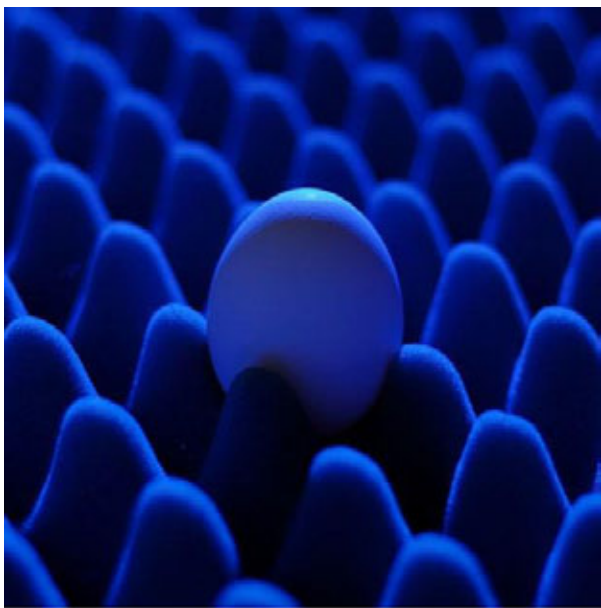
Quantum dots are very tiny crystals that glow with bright, rich colours when stimulated by an electric current. QD-LEDs are expected to find applications in television and computer screens, general light sources, and lasers.

Previous work in the field had been complicated by organic molecules called ligands that dangle from the surface of the quantum dots. The ligands play an essential role in quantum dot formation, but they can cause functional problems later on.

Thanks to an inventive change in technique devised by the Harvard team, the once-troublesome ligands can now be used to build a more versatile QD-LED structure. The new single-layer design, can withstand the use of chemical treatments to optimise the device's performance for diverse

applications.

“With quantum dots, the chemical environment that’s optimal for growth is usually not the environment that’s optimal for function,” says co-principal investigator Venkatesh Narayanamurti, Benjamin Peirce Professor of Technology and Public Policy at SEAS.



Harvard researchers have demonstrated a new design for LEDs by nestling quantum dots in an insulating structure that resembles an egg crate. (Stock image courtesy of Flickr user Cliff Muller.)

The quantum dots, each only 6 nanometres in diameter, are grown in a solution that glows strikingly under a black light.

The solution of quantum dots can be deposited onto the surface of the electrodes using a range of techniques, but according to applied physicist Edward Likovich, lead author of a paper describing the research, “That’s when it gets complicated.”

“The core of the dots is a perfect lattice of semiconductor material, but on the exterior it’s a lot messier,” he says. “The dots are coated with ligands, long organic chains that are necessary for precise synthesis of the dots in solution. But once you deposit the quantum dots onto the electrode surface, these same ligands make many of the typical device processing steps very difficult.”

The ligands can interfere with current conduction, and attempts to modify them can cause the quantum dots to fuse together, destroying the properties that make them useful. Organic molecules can also degrade over time when exposed to UV rays.

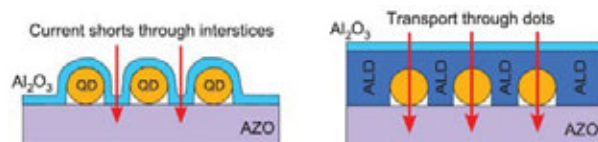
Researchers would like to be able to use those ligands to produce the quantum dots in solution, while minimising the negative impact of the ligands on current conduction.

“The QD technologies that have been developed so far are these big, thick, multilayer devices,” says co-author Rafael Jaramillo, a Ziff Environmental Fellow at the Harvard University Centre for the Environment. Jaramillo works in the lab of Shriram Ramanathan, Associate Professor of Materials Science at SEAS.

“Until now, those multiple layers have been essential for producing enough light, but they don’t allow much control over current conduction or flexibility in terms of chemical treatments. A thin, monolayer film of quantum dots is of tremendous interest in this field, because it enables so many new applications.”

The new QD-LED resembles a sandwich, with a single active layer of quantum dots nestled in insulation and trapped between two ceramic electrodes. To create light, current must be funnelled through the quantum dots, but the dots also have to be kept apart from one another in order to function.

In an early design, the path of least resistance was between the quantum dots, so the electric current bypassed the dots and produced no light.



In an early design (left), the path of least resistance was between the quantum dots, so the current bypassed the dots and produced no light. Using the atomic layer deposition (ALD) technique (right), researchers were able to funnel current directly through the dots, creating a fully functional, single-layered QD-LED. (Image courtesy of Edward Likovich.)

Abandoning the traditional evaporation technique they had been using to apply insulation to the device, the researchers instead used atomic layer deposition (ALD)—a technique that involves jets of water. ALD takes advantage of the water-resistant ligands on the quantum dots, so when the aluminium oxide insulation is applied to the surface, it selectively fills the gaps between the dots, producing a flat surface on the top.

The new structure allows more effective control over the flow of electrical current.

“Exploiting these hydrophobic ligands allowed us to insulate the interstices between the quantum dots, essentially creating a structure that acts as an egg crate for quantum dots,” says co-author Kasey Russell, a postdoctoral fellow at SEAS. “The benefit is that we can funnel current directly through the quantum dots despite having only a single layer of them, and because we have that single layer, we can apply new chemical treatments to it, moving forward.”

Through Harvard’s Office of Technology Development, Likovich and his colleagues have applied for a provisional patent on the device. Beyond the possible applications in computer and TV displays, lights, and lasers, the technology could one day be used in field-effect transistors or solar cells.

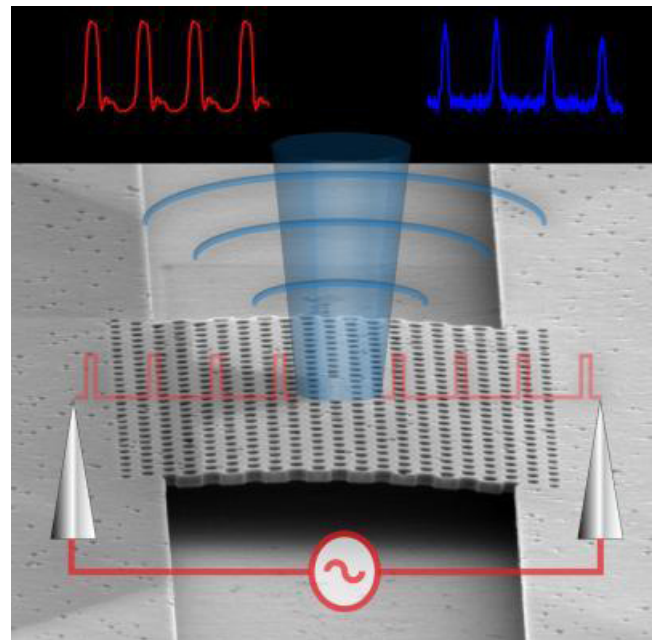
The research was supported by the Harvard University Centre for the Environment; the Nanoscale Science and Engineering Centre at Harvard, which is funded by the National Science Foundation (NSF); and the use of facilities at the Harvard University Centre for Nanoscale Systems, a member of the NSF-supported National Nanotechnology Infrastructure Network.

Further details of this work are described in the paper, “High-Current-Density Monolayer CdSe/ZnS Quantum Dot Light-Emitting Devices with Oxide Electrodes,” by Likovich *et al*, *Advanced Materials*, Vol 23, Issue 39, pages 4521–4525, DOI: 10.1002/adma.201101782.

LED chips to take on lasers in computer transmission

The nanoscale devices which incorporate small islands of indium arsenide, are claimed to be ultrafast and a thousand times more energy efficient than laser-based devices.

A team at Stanford’s School of Engineering has demonstrated an ultrafast nanoscale LED that it says is orders of magnitude lower in power consumption than today’s laser-based systems and able to transmit data at 10 billion bits per second. The researchers say it is a major step forward in providing a practical ultrafast, low-power light sources for on-chip computer data transmission.



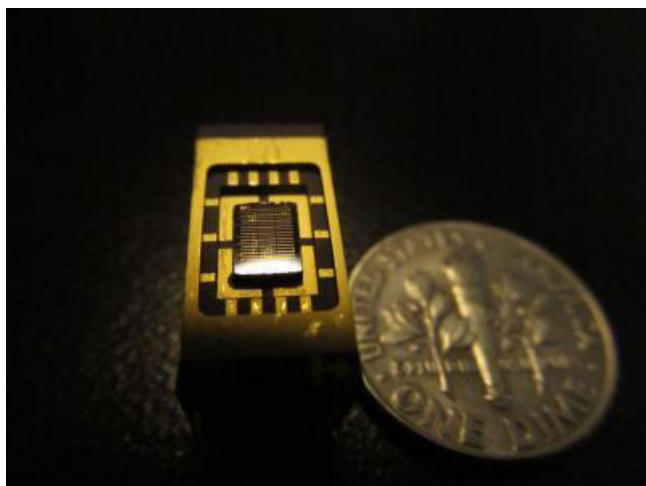
Data device schematic of a single-mode LED nanophotonic. (Credit: Gary Shambat, Stanford School of Engineering)

Jelena Vuckovic, an associate professor of electrical engineering at Stanford and the study’s senior author, and first author Gary Shambat, a doctoral candidate in electrical engineering, announced their device in paper published November 15 in the journal *Nature Communications*.

Vuckovic, had earlier this year produced a nanoscale laser that has a similarly efficiency and was very fast, but that particular device only operated at temperatures below 150 Kelvin, about 190 degrees below zero Fahrenheit, making them

impractical for commercial use. The new device operates at room temperature and could, therefore, represent an important step toward next-generation computer processors.

“Low-power, electrically controlled light sources are vital for next generation optical systems to meet the growing energy demands of the computer industry,” said Vuckovic. “This moves us in that direction significantly.”



Single-mode Nanophotonic LED Chip Carrier which holds hundreds of the Stanford low-power LEDs at its centre (Credit:Jan Petykiewicz, Stanford School of Engineering)

The LED in question is a “single-mode LED,” a special type of diode that emits light more or less at a single wavelength, very similar to a laser.

“Traditionally, engineers have thought only lasers can communicate at high data rates and ultralow power,” said Shambat. “Our nanophotonic, single-mode LED can perform all the same tasks as lasers, but at much lower power.”

Nanophotonics is key to the technology. In the heart of their device, the engineers have inserted little islands of the material indium arsenide, which, when pulsed with electricity, produce light. These islands are surrounded by photonic crystal – an array of tiny holes etched in a semiconductor. The photonic crystal serves as a mirror that bounces the light toward the centre of the device, confining it inside the LED and forcing it to resonate at a single frequency.

“In other words, the light becomes single-mode,”

said Shambat.

“Without these nanophotonic ingredients – the ‘quantum dots’ and the photonic crystal – it is impossible to make an LED efficient, single-mode and fast all at the same time,” said Vuckovic.



Members of the Vuckovic team in the lab from left to right: Arka Majumdar, Tomas Sarmiento, Jan Petykiewicz, Jelena Vuckovic, and Gary Shambat (holding the chip carrier). (Credit:Michal Bajcsy, Stanford School of Engineering)

The new device includes a bit of engineering ingenuity, too. Existing devices are actually two devices, a laser coupled with an external modulator. Both devices require electricity. Vuckovic’s diode combines light emission and modulation functions into one device that drastically reduces energy consumption.

On average, the scientists say the new LED device transmits data at 0.25 femto-Joules per bit of data. By comparison, today’s typical ‘low’ power laser device requires about 500 femto-Joules to transmit a single bit. Some technologies consume as much as one pico-Joule per bit.

“Our device is 2000 to 4000 times more energy efficient than best devices in use today” said Vuckovic.

Further details of this work have been published in the paper “Ultrafast direct modulation of a single-mode photonic crystal nanocavity light-emitting diode” by Shambat *et al*, *Nature Communications*, 2,

Miller William John pays tax liability with Veeco stock

MMD Newswire says that over the past 12 months, over 220 thousand shares of Veeco Instruments Inc. stock were sold by insiders, totalling over \$11.2 million, but that no shares have been purchased by insiders over the same time frame.

Miller William John performed a payment of a tax liability by selling 604 shares of Veeco Instruments Inc. (VECO) stock as noted in an SEC Filing yesterday. Miller William John's title was listed as "EVP LED & Solar" at Veeco Instruments Inc. within the filing.

Over the past 12 months, John has not sold or purchased any shares of Veeco Instruments stock. He has however performed other transactions including grants or awards and payment of tax liabilities.

MMD Newswire also says that a high-level look at insider trading at Veeco revealed that over the past 12 months, a total of 220,264 shares of Veeco Instruments Inc. stock were sold by insiders, totalling \$11,235,869. It adds that over the same time 12 month time period, no shares of Veeco Instruments Inc. were purchased by company insiders.

Rubicon's sapphire fires revenues up 64%

The increased revenues, compared to the same quarter last year, were mainly due to strong sales of the firm's six inch polished sapphire wafers which totalled \$24.9 million in the quarter.

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, Semiconductor, and Optical industries, has reported financial results for its third quarter ended September 30, 2011.

The Company reported third quarter revenue of \$33.6 million, which was at the high end of previously provided estimates due to strong sales of its six inch polished wafers which totalled \$24.9 million in the quarter, a 79 percent sequential

increase.

Gross margins in the third quarter were 48%, which was the top of management's previously provided guidance. Net income for the quarter totalled \$8.2 million, resulting in diluted earnings per share of \$0.35, driven by a favourable product mix and higher than anticipated pricing on two through four inch cores sales. Approximately \$5.5 million of Rubicon common stock was purchased under the share repurchase program announced in the last quarter.

Raja Parvez, President and CEO of Rubicon Technologies, commented, "Although overall substrate demand from the LED market declined in the third quarter, major LED chip manufacturers continue to focus on migrating to larger diameter substrates in order to gain efficiencies. As a result, we had strong growth in revenue from our six inch polished wafers which helped to compensate for reduced orders of two through four inch sapphire cores."

The Company ended the third quarter with \$72.6 million in cash and short-term investments and no debt. In the third quarter, the Company repurchased approximately 425,000 shares of its common stock at an average price of \$12.90 per share. At the end of the third quarter, the company had \$19.5 million authorised for future repurchases of its common stock under the current program.

Fourth Quarter 2011 Guidance

Commenting on the outlook for the fourth quarter of 2011, Parvez said, "Previously, we had anticipated improved demand for sapphire products by the end of the third quarter. However, we now expect to see continued softness in the LED market at least through the fourth quarter. Although inventory levels at our customers are in decline, there continues to be excess inventory throughout the supply chain limiting our visibility on future orders for two through four inch sapphire cores."

"As a result, we expect prices for those products will decline further in the fourth quarter. Additionally, the prolonged weakness in the LED market could also impact six inch polished wafer volumes and pricing making projecting fourth quarter results particularly challenging. As a result of these challenging market conditions, we expect revenue in the fourth quarter

to be between \$20 and \$23 million, gross margins in the low to mid-thirty percent range, and diluted EPS to be in the range of \$0.07 to \$0.10," Parvez concluded.

SemiLEDs not so bright with quarterly revenues slashed by 54%

The decline is partly due to pricing pressures caused by the weak demand of outdoor street lighting in China, together with the overcapacity of backlighting that has spilled over into the general lighting market.

SemiLEDs Corporation, a developer and manufacturer of LED chips and LED components, has announced its financial results for the fourth quarter of fiscal year 2011, ended August 31, 2011.

Revenue for the fourth quarter of fiscal 2011 was \$5.3 million, a 54% decrease from \$11.5 million in the fourth quarter of fiscal 2010.

GAAP net loss attributable to SemiLEDs stockholders for the fourth quarter of fiscal 2011 was \$13.6 million, or a loss of \$0.50 per diluted share, compared to GAAP net income attributable to SemiLEDs stockholders of \$5.3 million, or \$0.18 per diluted share, for the fourth quarter of fiscal 2010.

"As expected, the market remained challenging in Asia for LED chips and components. The China market is not improving due to inflationary and monetary issues together with depressed economic conditions around the world. We continue to see pricing pressure due to the weak demand in the China outdoor street lighting market, together with the overcapacity of backlight that has spilled over to the general lighting market. The ASP erosion is not as extreme as in prior quarters and prices have stabilised somewhat," said Trung Doan, Chairman and CEO of SemiLEDs.

"With so much uncertainty, we remain cautious in our near term outlook but continue to believe in the industry's long term market opportunities. When the Chinese government releases funds for the five year plan, we expect to benefit given that we are

one of the few companies that meets the program's requirements and that we have local presence with our JV, China SemiLEDs," continued Doan.

Revenue for the fiscal year end 2011 was \$33.9 million, a 5.2% decrease compared to \$35.8 million for the fiscal year end 2010. GAAP net loss attributable to SemiLEDs stockholders for the fiscal year 2011 was \$16.1 million, or a loss of \$0.88 per diluted share, compared to GAAP net income attributable to SemiLEDs stockholders of \$10.8 million, or \$0.24 per diluted share, for the fiscal year 2010.

GAAP gross margin for the fourth quarter of fiscal 2011 was negative 93%, compared with 53% in the fourth quarter of fiscal 2010. Operating margin for the fourth quarter of fiscal 2011 was negative 228%, compared with 42% in the fourth quarter of fiscal 2010. Margins were negatively impacted by a charge of \$4.3 million for the write-downs of inventory and a charge of \$1.1 million for bad debt reserve.

The Company's cash and cash equivalents was \$83.6 million at the end of the fourth quarter, compared to the prior quarter ending balance of \$94.4 million. Cash used in operations was \$2.0 million in the fourth quarter of fiscal 2011.

Financial Outlook

For its first quarter of fiscal 2012 ending November 30, 2011, SemiLEDs expects revenue in a range of \$6.0 million to \$7.0 million with GAAP net loss attributable to SemiLEDs stockholders of \$8.5 million to \$8.0 million, or a loss of \$0.31 to \$0.29 per diluted share, based on an estimated 27.3 million diluted weighted average shares. GAAP gross margin is expected to be negative.

SemiLEDs develops and manufactures LED chips and LED components primarily for general lighting applications, including street lights and commercial, industrial and residential lighting. SemiLEDs sells blue, green and ultraviolet (UV) LED chips under the MvPLED brand.

Cree shines the LED light on Camp Pendleton Marine Corps Base

Third-party testing of the Cree LR24 luminaires against the proposed linear fluorescent found that the LED luminaires emitted 44 percent less heat. The LEDs also contributed a 15 degree rise in ambient temperature rather than the 25 degree increase from the fluorescents when compared to a baseline of no lighting.

Cree has said that more than 930 LR6 six-inch LED downlights and LR24 LED lay-in luminaires have been installed at Camp Pendleton Marine Corps Base as part of an overall renovation currently underway.



More than 930 Cree LED Fixtures Installed in Base Renovation

Located outside of San Diego, Camp Pendleton is the major West Coast base of the United States Marine Corps, serving as its prime amphibious training base for nearly 100,000 Marines.

Prior to installation, Accelerated Electric, the electrical contractor for this project, and RA Burch, the general contractor, commissioned third-party testing of the Cree LR24 luminaires against the proposed linear fluorescent lighting to evaluate the amount of heat distributed and impact on air conditioning.

The study found that the LED luminaires put out 44 percent less heat than the proposed fluorescents and contributed a 15 degree rise in ambient temperature rather than the 25 degree increase

from fluorescents when compared to a baseline of no lighting.

“Based on the results from our model, we were able to demonstrate the efficacy of Cree LED fixtures, which use 31 percent less energy than traditional fluorescent lighting, for the Camp Pendleton installation,” said William Porges, president of Accelerated Electric. “Utilising these fixtures can significantly reduce building electrical loads and result in dramatically lowered energy costs. We also found that additional energy savings can be attributed to the decrease in air conditioning usage.”

“With the increased focus on greening government facilities, Camp Pendleton is a great example of how easy it is to achieve both energy and maintenance savings with LED lighting,” said David Elien, Cree, vice president LED lighting adoption. “The energy-efficient Cree products used in this installation comply with the Buy American Act and fulfil base lighting needs while providing high-quality light, reduced maintenance and potential HVAC savings, helping Camp Pendleton join the LED Lighting Revolution.”

Isamu Akasaki awarded Edison medal for blue LEDs

The pioneer of blue gallium nitride LEDs has been recognised for his outstanding contribution to research in the field.

Isamu Akasaki, with whom Toyoda Gosei has cooperated with in the development of LEDs since 1986, was awarded the 2011 Edison Medal from the Institute of Electrical and Electronics Engineers (IEEE).



The Edison Medal is presented “for a career of meritorious achievement in electrical science, electrical engineering or the electrical arts.” Akasaki, a research fellow at Akasaki Research Centre in Nagoya University, is the second Japanese to receive it after Junichi Nishizawa, who was a professor of Iwate Prefectural University and received the award in 2000.

On Akasaki’s achievements, Toyoda Gosei has expressed its congratulations and says that under his instruction, that the company succeeded in the development of the first ever GaN blue LEDs in 1991. By 1995, Toyoda started selling the LEDs commercially.

Demand for LEDs is escalating for their energy-saving and long-lived features, and their applications are noticeably broadened in lighting devices.

Akasaki has been pioneering the development of GaN blue LEDs, which is now receiving wide recognition.

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

Following the success of CS Europe 2011, next year’s conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined

to shape tomorrow’s compound semiconductor industry.

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- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

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- SiC and GaN Electronics - Dr. John Palmour, Cree

co-founder and chief technology officer, Power & RF

- Ammonon's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.
- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable «on-silicon» solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.
- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.
- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company
- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU
- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR- Professor Rik Jos, NXP
- Holistic Approach to MOCVD vacuum & Abatement –Dr. Mike Czerniak, EdwardsVacuum Ltd
- Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning
- Large diameter GaN-on-Si epiwafers for power electronics – Dr. Mariane Germain, EpiGaN
- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

•Damage - free Deposition on LED devices –Dr. Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

•Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

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PhotonStar to launch “ChromaWhite” range of tuneable LEDs

The high CRI white colour modules include ColourLoc, an onboard colour feedback loop, eliminating LED colour shift over the product lifetime.

The ChromaWhite modules are produced in a number of popular light engine footprints and with lumen packages between 600 and 2500 lumens available initially in CLE and SLLE footprints. Compatible with a wide range of existing components, the CLE version also features pre-mix technology optimised for spot reflectors.

According to PhotonStar, ChromaWhite are the first LED light engine modules in the market to provide a combination of tuning (2700K – 6500K) with both very high CRI (> 90 across tuning range) and high efficiencies. The modules include a number of advanced features to ensure performance over lifetime, including ColourLoc - an on board colour feedback loop which gives colour stability to a 2 MacAdam Ellipse stability over life.

This direct feedback approach eliminates LED colour shift over the product lifetime. ThermaLoc provides advanced adaptive thermal protection in the event of an installation fault causing overheating. CRILoc maintains the CRI over Ra90 across the tuning range and LumenLoc ensures that the lumen package is accurately maintained over product lifetime.

The ChromaWhite colour mix technology has been thoroughly proven in the challenging film and TV environment where the sensitivity of cameras requires CRI > 98, and has now been developed for general lighting. PhotonStar says the colour quality for ChromaWhite is excellent and at 4000k the Ra is 95 but critically the R9 and R14 performance is above 90 as well.

The LED light engines contain the high thermal performance Chip on Board (COB) technology platform Innovate. The standard ChromaWhite SLLE and CLE light engine modules are continuously colour tuneable from 2700K to 6500K using 2 channel control from most common digital dimming systems such as DMX, DSI and 1-10V. This has already won the EoN Light Source of the Year in the Lighting Association awards 2011.

PhotonStar LED Group is a regular member of Zhaga and recently raised an additional £1.35M through a placing of shares on AIM to fund high volume production of the ChromaWhite modules.

Cree LEDs power Labcraft lighting range

The Megalux is the latest product to be introduced as part of Labcraft's extensive LED lighting range and uses Cree's technology.

The Megalux has been developed with the refrigerated vehicle market in mind, however it can be fitted in a multitude of applications suitable for commercial vehicles lighting, caravan and marine lighting. and marine lighting.



Megalux LED light

Using Cree's high output LEDs, the Megalux lights consume 70% less energy than halogen work lights at 850 lumens operating at 10W. They also have a very low profile design with reduced 'hotspots' and

lens shadow so no secondary lens is required. This ensures that fewer shadows are present, just pure white light.

With a lifetime of 90,000 hours, they last more than 90 times longer than halogen bulbs, saving money and improving safety. What's more, the lights are waterproof to IP66, meaning their rugged weatherproof design with a cast aluminium base are suitable for tough working conditions.

Labcraft offers an extensive range of standard products, plus a dedicated design and custom build service for specialised projects.

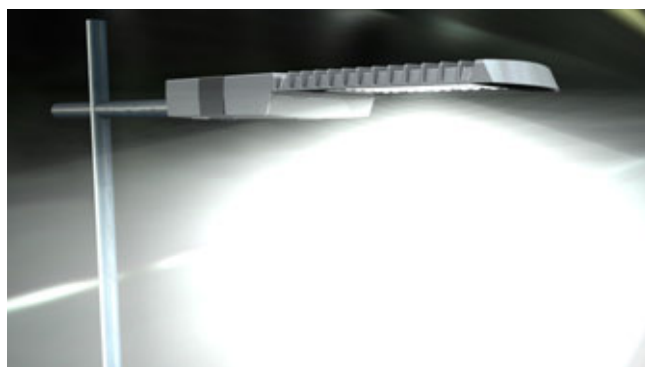
Africa illuminated with LED street lights

The new street lighting family, the "BEKA LEDlume" uses LEDs provided by Osram Opto Semiconductors.

The "BEKA LEDlume" is the latest range from the South African street lighting manufacturer BEKA. All variations of these luminaires are equipped with Oslon SSL LEDs by Osram Opto.

The "BEKA LEDlume" series is designed to improve the energy efficiency and durability of lighting in the streets of the African continent. Back in 2010, BEKA equipped its luminaires for the World Cup stadia in South Africa with LEDs supplied by Osram Opto.

Upon selecting the LED for the new street lights "BEKA LEDlume", BEKA was again convinced by the products provided by the Regensburg manufacturer of semiconductors: the choice was made in favour of Oslon SSL LEDs.



BEKA LEDlume with Oslon SSL LED by Osram Opto offer energy-efficient and long lasting street lighting

They are particularly compact, with housing dimensions measuring three by three millimetres, and thus enable a great variety of design possibilities. With a light colour of 4,500 K and a colour rendering index (CRI) of 70, the luminaires ensure pleasant light conditions on the streets of Africa.

An additional benefit of the modern LED street lighting is the high efficiency of Oslon light diodes, their light yields more than 100 lm/W at 350mA. As a result of this, Osram reckons that the BEKA LEDlume uses approximately 50 percent less energy than the technology that has been applied so far.

Optionally, the BEKA LEDlume can also be furnished with the ambient light sensor SFH5711 by Osram Opto, which automatically adapts the brightness of the luminaires to the ambient light or to customer-specified preferences. So, by dimming or intelligent switching of the luminaires on or off, even more energy can be saved.

BEKA LEDlume is available in numerous versions – ranging from 16 to 90W power consumption. Depending on the version, 12 to 60 Oslon SSL LEDs per luminaire are required. Thus, the street lights comply perfectly with the special requirements of the African continent. For instance, the 12 and 24 volt versions are also suited for operation with solar power.

What's more, the special thermal conditions of the continent have also been taken into account: the luminaires are designed for ambient temperatures of 35 degrees Celsius, and as a result, in spite of the high temperatures, the durability of the LED is not affected. Lasting more than 50,000 hours, the average durability of the LED also complies with the L80 Standard. This means that once the service life of the luminaire has expired, it will still generate more than 80 percent of the original brightness.

Ryan Hunt, Country Manager at Osram Opto Semiconductors in South Africa, commented on the renewed co-operation with BEKA, "We are very happy that BEKA has decided to use our Oslon SSL LED in their BEKA LEDlume. The consistently

high quality of our products, as well as our good relationship with BEKA, is what this project and many other joint projects have been based on."

Nanyang Tech University deploys Aixtron system for LED research

Apart from being used for gallium nitride research for solid state lighting applications, the CCS will provide a teaching facility for school students in becoming familiar with MOCVD technology.

Aixtron SE has announced that Nanyang Technological University (NTU) Singapore, has received its new Close Coupled Showerhead (CCS) system.

Commissioned by the local Aixtron support team, the CCS 3x2-inch wafer configuration system is being used for research into ultra-high brightness LEDs and related material systems.

Director of Luminous! Centre of Excellence for Semiconductor Lighting and Displays and Singapore NRF Fellow, Nanyang Associate Professor Hilmi Volkan Demir comments, "We have established a solid-state lighting (SSL) lab to develop cost-saving, green solutions to generate and harvest light. Already we have fabricated and tested nanostructured white LEDs of nanocrystal quantum dot emitters for high quality mesopic SSL. Areas where the CCS system will be absolutely vital include III-N epitaxy, doping engineering and epitaxial growth optimisation as well as colour-converting LEDs with high scotopic/photopic ratio."

He continues, "So we are looking to apply our new Aixtron system to some fairly challenging but highly promising areas of lighting development. My team is already familiar with the high technical standard of this equipment and has great trust in the excellent Aixtron local support, so I think we can be sure all our enquiries will be dealt with efficiently."

"Moreover, as well as being dedicated to GaN LED research, the CCS will provide a much needed teaching facility for our school students getting familiar with MOCVD technology. So, in more than one way the CCS is already proving its usefulness

and will continue to do so for many years to come,” concludes Demir.

Demir is a faculty member of the Division of Microelectronics at the School of Electrical & Electronic Engineering and Division of Physics and Applied Physics at School of Physical and Mathematical Sciences. He is a recipient of many prestigious awards including Singapore National Research Foundation (NRF) Fellowship, the European Science Foundation European Young Investigator Award (EURYI), and the Marie Curie Intra-European Fellowship; he completed his PhD at Stanford University, USA.

Luminous! Center of Excellence for Semiconductor Lighting and Displays is focused on various multidisciplinary studies to offer solutions addressing energy efficiency and photometric quality problems in lighting, including the Super-Excitonics Program funded by NRF Competitive Research Program. Luminous! pursues an integrated approach including materials research, device physics, and applications. The MOCVD facility is dedicated to SSL and displays by developing a new class of solid state lighting white LEDs integrated with semiconductor nanophosphors.

*Mesopic vision, the combination of photopic and scotopic vision for low but not completely dark lighting situations, covering light levels with luminances over 0.001 to 3 cd m⁻² which includes the majority of night-time outdoor and traffic lighting scenarios.

LED-TV explosion creates a boom in the LED market

According to “The Global and China LED Industry Report, 2010-2011”, since Veeco launched the K465I in the Chinese market, its revenue soared 230%, putting a great deal of pressure on Aixtron.

The report, available from reportlinker.com, says the LED market size climbed 58% to US\$15.8 billion in 2010 from US\$10 billion.

The market size of LED for LCD TV backlight actually boomed to approximately US\$3.9 billion from US\$960 million driven by the explosion of

LED-TV.

The market share of LED-backlit LCD TV arrived at 26.9% in 2010, and it is predicted to see 55.9% in 2011. Promisingly, LED will completely replace CCFL in 2014. The market share of LED-backlit NB rose to 95% in 2010 from the merely 59% in 2009; while that of LED-backlit LCD hit 15% in 2010 from 1.5% in 2009, and is projected to rest on 40% in 2012.

The global LED industry can be divided into four big regions elaborated as follows:

1. The European & American region that focuses on general lighting and gives priority to the high reliability and high brightness of products;
2. Japan which boasts the most comprehensive technology and the most powerful strength in both general lighting and backlight display, with the development orientation attaching equal importance to general lighting, automotive, mobile phone, and TV;
3. South Korea and Taiwan that highlight the laptop display backlight, LED-TV backlight, and mobile phone backlight, featuring large shipment, low unit price, and meagre gross profit;
4. Chinese Mainland which gives priority to yellow-green LED and aims at outdoor display, advertising screen, and signal lamp. The applications require low product technology and reliability, the clients are scattered and of small scales, yet the gross profit is not low due to the engineering projects in most cases.

The Chinese Mainland is at best a production workshop although it has manufactured 80% mobile phones, 95% notebook computers, 50% LCD TVs, and 95% LCDs worldwide. As a whole, the key raw materials, small & medium-sized panels, and large-sized panels are monopolized by Japanese, South Korean, and Taiwanese enterprises.

European & American enterprises have nothing to do with the flourishing LED backlight market in that they have targeted at the big market of general lighting from the very beginning. In 2010, the shipment expanded greatly, but the price dropped dramatically, which just brought along slight growth to these manufacturers. Japanese, South Korean,

and Taiwanese enterprises enjoyed the most rapid progress.

In 2010, LG Innotek presented the highest growth margin, and the revenue from the LED Division advanced to US\$783 million from US\$229 million in 2009. Nevertheless, LG Innotek sacrificed the profit whose growth margin was far from that of revenue. The revenue of Samsung LED also progressed considerably to US\$1.14 billion from US\$508 million in 2009, ranking the global No.2; while that of South Korea's Seoul Semiconductor climbed 105% to US\$726 million.

Nichia, the global No.1 for consecutive 8 years since 2003, also advanced rapidly, and its LED revenue rose 65% against 2009 to US\$2.246 billion. China is in possession of more than 150 LED enterprises, but their total revenue is inferior to that of Nichia and the total operating profit fails to meet 40% of Nichia's profit.

China's LED industry remained a hotspot in 2010 and a great number of enterprises successively announced the investment of at least RMB10 billion (US\$1.57 billion). Chinese government was eager about LED upstream and offered the subsidy of RMB10 million for each MOCVD machine, which stimulated the LED investment upsurge.

Chinese Mainland enterprises purchased only 25 MOCVD machines in 2009, but the number expanded to 267 in 2010, and it surpassed 450 considering the MOCVD machines purchased by Taiwanese enterprises in Mainland China. In 2010, the global shipment of MOCVD machines totalled just 768.

The MOCVD machines worldwide are almost monopolised by Aixtron and Veeco who have benefited a lot from the investment zeal of Chinese enterprises. In 2010, Veeco launched the K465I in the Chinese market, posing great pressure on Aixtron, and its revenue soared 230%.

Different from automobiles, MOCVD machines require debugging first, which will take 2-4 months for veteran manufacturers but possibly even longer time for those without experience of the technology.

Chinese Mainland manufacturers have frequently headhunted Taiwanese LED talents with the promised salary by several folds; however, few

have been attracted in view of the probable lay-off after the completion of debugging. Consequently, the actual mass production ratio of the available 267 MOCVD machines in 2010 is not high in 2011.

Since early 2011, partial local governments of China have suspended the procurement subsidy over MOCVD equipment taking into account possible overcapacity and insufficient utilisation of MOCVD devices.

Cree LEDs provide University of Michigan's "Big House" with a makeover

High-definition LED video screens have been installed at Michigan football stadium.

Football fans of the University of Michigan kicked off the 2011 season enjoying a new look to Michigan Stadium, now complete with newly upgraded scoreboards from Lighthouse Technologies.

The state-of-the-art video displays and scoring systems feature Screen Master high-brightness LEDs by Cree, delivering crystal-clear, high definition images to fans throughout "The Big House."

A college football icon, Michigan Stadium was built in 1927 and is the largest stadium in the United States, consistently boasting game day crowds of more than 100,000 fans. On September 10, the stadium hosted a record crowd of more than 114,800 Wolverine and University of Notre Dame fans at the first night time football game ever played at the "Big House."

The scoreboard replacement project began in March 2011, with the addition of two Lighthouse outdoor LED video systems. Positioned in each of the end zones, the high-resolution LED video boards are 40 percent larger than the previous system, providing in-game broadcast capability, instant replay, animation and dynamic promotional content in vivid colour and ultra-sharp detail.

More than three million Cree Screen Master CLV6A LEDs illuminate each of the LED video boards. With industry-leading water-resistant packaging, Cree's

versatile 3-in-1 LEDs feature the high-intensity output and wide viewing angles needed for the stadium's stunning outdoor LED video systems.

Cree-powered Lighthouse LED video screens are also installed at the University of Michigan's Yost Ice Centre, home to Wolverine hockey, as part of its first ever renovation. The Crisler Area, home to Michigan basketball since 1967, has also gone LED, replacing the centre-hung scoreboard that was installed in 1998 with a four-sided LED video system complete with 14 LED video displays.

"Cree's broad portfolio of high-brightness LEDs complements Lighthouse Technologies' state-of-the-art indoor and outdoor applications," said Mike Watson, Cree, senior director of marketing, LED components. "With vibrant colour and crisp in-game detail, the University of Michigan is a shining example of how sports arenas can increase the fan experience by upgrading to LEDs."

"Lighthouse is pleased to collaborate with Cree on this high-profile, multi-facility project," said Ed Whitaker, Lighthouse NASA, director of sales. "Cree's vast experience and exceptional LED technology enabled us to design the optimal solutions for Wolverine fans."

Cree redefines high-voltage LEDs

These low cost highly efficient LEDs are designed for compact lighting applications such as candelabras and retrofit lamps.

Cree, a market leader in LED lighting, has announced the commercial availability of high-voltage XLamp XT-E and XM-L LEDs.



These new LEDs can enable the use of more efficient, smaller drivers to lower cost for compact lighting applications such as candelabras and

retrofit lamps.

"The XLamp XM-L High-Voltage LED eliminates the trade-off between size and efficacy, allowing us to take advantage of the efficacy of high-voltage drivers," said Ken Chakravarti, chief technology officer, Ledzworld. "This translates to more efficient, better and more cost-effective small LED lamps and luminaires such as the B10 replacement lamp for our customers."

Small-form-factor lighting, like candelabras, historically presented a host of challenges for LED technology. Prior LEDs were unable to deliver the required system-level performance in the form factor consumers' demand.

"Maximising the LED voltage, as Cree has done in the new high-voltage XM-L and XT-E LEDs, is a very effective way to minimise current through the LED driver output rectifier," said Peter Vaughan, director of applications engineering, Power Integrations, Inc. "This can reduce losses and heat dissipation in the driver and increase the overall system luminous efficacy by several percentage points."

"Never before have lighting OEMs been able to leverage the benefits of high-voltage LEDs with this level of performance," said Paul Thieken, Cree director of marketing, LED components. "We continue to develop the right LEDs for the right applications—to accelerate the adoption of energy-efficient LED lighting."

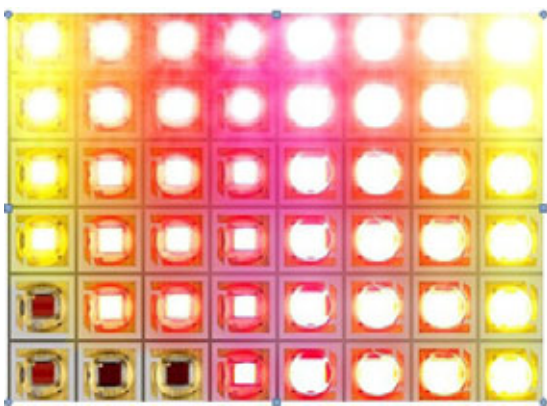
The XLamp XM-L LED delivers up to 600 lm in Cool White (6000 K) and up to 462 lm in Warm White (3000 K) at 6 W, 85°C. The XLamp XT-E LED delivers up to 300 lm in Cool White (6000 K) and up to 228 lm in Warm White (3000 K) at 3 W, 85°C. Both LEDs have a typical voltage of 46 V at binning conditions.

XLamp XT-E and XM-L LEDs are available now in production quantities with standard lead times.

LED performance and thermal stability boosted by Osram

The Oslon SSL LEDs in red, orange and yellow employ a new indium gallium aluminium phosphide chip technology.

The latest Oslon SSL LEDs from Osram Opto Semiconductors provide up to 20 percent more output than their predecessors and offer improved thermal stability, particularly in Hyperred (660 nm).



Increased output from coloured Oslon SSL LEDs: up to 49% of the current is converted into light

Energy-efficient applications such as commercial horticulture are therefore much more efficient. Behind this boost in performance lie the latest developments in InGaAlP chip technology.

Powerful, efficient long-life light sources are enormously important for lighting systems that are in operation for many hours day and night, such as those used in commercial horticulture, archtainment and stage lighting. The latest chip developments make the new generation of Oslon SSL LEDs even more attractive as light sources that precisely meet these requirements. They offer high efficiency and good thermal stability, combined with a low thermal resistance of 7 K/W.

Depending on the wavelength (590 nm - 660 nm) the new LEDs achieve per increases of 10 to 20 percent. The flagship is the Hyperred version (660 nm) that hits this 20 percent mark. With a brightness of 400 mW at an operating current of 400 mA the LED is much brighter than the predecessor

model. It converts 46 percent of the current into light. At an operating current of 350 mA it achieves an impressive 355 mW, which corresponds to a conversion rate of 49 percent. What's more, the LED has a long life: At an operating current of 700 mA and at a temperature of 80°C it will last more than 100,000 hours (L70/B50).

In practical applications this means that fewer LEDs are needed to achieve a particular brightness level, or the same number of LEDs can be used to produce a higher brightness level. Martin Wittmann, Marketing Manager at Osram Opto Semiconductors explains, "Our customers benefit from the large increase in brightness because it leads to much shorter payback times. In commercial horticulture, for example, lighting systems with these LEDs can result in huge energy savings and low electricity costs."

With their compact package size of just 3 mm x 3 mm and choice of beam angles (80° and 150°), the Oslon SSL LEDs are particularly good for clustering so high brightness can be achieved on a small footprint. When combined with LEDs in the Deepblue colour (450 nm), they create a light colour that is tailor made for the requirements of commercial horticulture.

Bridgelux LED arrays popular with Ilsung Moolsan

The project, which supports the Korean government's LED lighting penetration goals, will support the illumination of the Sheraton hotel in Seoul's D-Cube city.

Bridgelux has announced that luminaire manufacturer Ilsung Moolsan of Korea is incorporating its LED arrays in 1000 high quality high performance downlights to light up the new Sheraton Hotel in Seoul.

Bridgelux's award-winning RS and ES LED arrays are specified to light various areas of the hotel including the lobby, lounge, public gathering areas, banquet halls, and the indoor swimming pool and sauna.

Incorporating the new LED lighting will reduce energy consumed by up to 63 percent compared to

the typical use of halogen and compact fluorescent downlights in these areas of the hotel.

“We selected Bridgelux LED arrays as the light source for our luminaires because they deliver the high quality of light and product reliability demanded by both our company and the Sheraton Hotel’s rigorous lighting standards,” explained John Cho, President of Ilsung Moolsan.

“The Bridgelux arrays offer a high quality, highly cost-effective and easy to integrate solution while providing the beautiful, natural warm white light required for this high-end hotel environment,” he continued.

Bridgelux provides one of the industry’s broadest ranges of high quality, high performance LED light sources. The firm’s LED chips enable lighting OEMs to expand their portfolios of energy efficient lighting products to satisfy the power saving requirements without sacrificing light quality.

The firm hopes to help rapidly transform the lighting industry and to support government-led programs such as the Korean Government’s “LED Lighting 2060 Plan,” announced in June to promote greater energy efficiency by increasing the use of LED lighting.

“Bridgelux is very pleased to have been selected by Ilsung Moolsan to provide the solid state light source for their down lights,” said Jim Miller, chief sales and marketing officer at Bridgelux. “The collaboration between Ilsung Moolsan and the Sheraton organisation is an outstanding example for any hotel looking to gain significant and immediate savings. Switching to LED lighting now offers not only energy savings and maintenance avoidance, but also delivers the quality of light demanded by even the top hotels in the industry.”

Zinc Oxide microwires enhance LEDs

By using a piezoelectric material alongside a gallium nitride LED, the external efficiency can be amplified by a factor of more than four times.

Scientists have used zinc oxide microwires to significantly improve the efficiency at which GaN

LEDs convert electricity to ultraviolet light.

The devices are believed to be the first LEDs whose performance has been enhanced by the creation of an electrical charge in a piezoelectric material using the piezo-phototronic effect.

By applying mechanical strain to the microwires, researchers at the Georgia Institute of Technology created a piezoelectric potential in the wires, and that potential was used to tune the charge transport and enhance carrier injection in the LEDs.

This control of an optoelectronic device with piezoelectric potential, known as piezo-phototronics, represents another example of how materials that have both piezoelectric and semiconducting properties can be controlled mechanically.



Studying LEDs

Zhong Lin Wang (right) and Ying Liu study LEDs whose performance has been enhanced through the piezo-phototronic effect. (Georgia Tech Photo: Gary Meek)

“By utilising this effect, we can enhance the external efficiency of these devices by a factor of more than four times, up to eight percent,” said Zhong Lin Wang, a Regents professor in the Georgia Tech School of Materials Science and Engineering. “From a practical standpoint, this new effect could have many impacts for electro-optical processes - including improvements in the energy efficiency of lighting devices.”

Because of the polarisation of ions in the crystals of piezoelectric materials such as ZnO, mechanically compressing or otherwise straining structures made from the materials creates a piezoelectric potential - an electrical charge. In the GaN LEDs, the researchers used the local piezoelectric potential to tune the charge transport at the p-n junction.

The effect was to increase the rate at which electrons and holes recombined to generate photons, enhancing the external efficiency of the device through improved light emission and higher injection current. "The effect of the piezo potential on the transport behaviour of charge carriers is significant due to its modification of the band structure at the junction," Wang explained.

The ZnO wires form the "n" component of a p-n junction, with the GaN thin film providing the "p" component. Free carriers were trapped at this interface region in a channel created by the piezoelectric charge formed by compressing the wires.

Traditional LED designs use structures such as quantum wells to trap electrons and holes, which must remain close together long enough to recombine. The longer that electrons and holes can be retained in proximity to one another, the higher the efficiency of the LED device will ultimately be.

The devices produced by the Georgia Tech team increased their emission intensity by a factor of 17 and boosted injection current by a factor of four when compressive strain of 0.093 percent was applied to the ZnO wire. That improved conversion efficiency by as much as a factor of 4.25.

LED improved



An LED whose performance has been enhanced through the piezo-phototronic effect is studied in the laboratory of Regents professor Zhong Lin Wang. (Georgia Tech Photo: Gary Meek)

The LEDs fabricated by the research team produced emissions at ultraviolet wavelengths (about 390 nm), but Wang believes the wavelengths can be extended into the visible light range for a variety of optoelectronic devices. "These devices are important for today's focus on green and

renewable energy technology," he said.

In the experimental devices, a single ZnO micro/nanowire LED was fabricated by manipulating a wire on a trenched substrate. A magnesium-doped GaN film was grown epitaxially on a sapphire substrate by MOCVD, and was used to form a p-n junction with the ZnO wire.

A sapphire substrate was used as the cathode that was placed side-by-side with the GaN substrate with a well-controlled gap. The wire was placed across the gap in close contact with the GaN. Transparent polystyrene tape was used to cover the nanowire. A force was then applied to the tape by an alumina rod connected to a piezo nanopositioning stage, creating the strain in the wire.

The researchers then studied the change in light emission produced by varying the amount of strain in 20 different devices. Half of the devices showed enhanced efficiency, while the others - fabricated with the opposite orientation of the microwires -- showed a decrease. This difference was due to the reversal in the sign of the piezopotential because of the switch of the microwire orientation from +c to -c.

High-efficiency ultraviolet emitters are needed for applications in chemical, biological, aerospace, military and medical technologies. Although the internal quantum efficiencies of these LEDs can be as high as 80 percent, the external efficiency for a conventional single p-n junction thin-film LED is currently only about three percent.

Beyond LEDs, Wang believes the approach pioneered in this study can be applied to other optical devices that are controlled by electrical fields.

"This opens up a new field of using the piezoelectric effect to tune optoelectronic devices," Wang said. "Improving the efficiency of LED lighting could ultimately be very important, bringing about significant energy savings because so much of the world's energy is used for lighting."

Further details of the research are reported in the paper "Enhancing Light Emission of ZnO Microwire-Based Diodes by Piezo-Phototronic Effect" by Yang et al in *Nano Letters*.

DOI: 10.1021/nl202619d

This research was sponsored by the Defence Advanced Research Projects Agency and the U.S. Department of Energy.

AIXTRON exercises operational business flexibility in response to market weakness

AIXTRON SE a worldwide provider of deposition equipment to the semiconductor industry, today announced the consolidated financial results for the third quarter and first nine months of 2011.

Financial Highlights

In the third quarter of 2011, the previously high investment activities by Asian LED manufacturers, driven by substantial government funding, have become restrained by an unscheduled but significant slow-down in demand. This partially resulted from insufficiently developed end-market demand, but is also evidence of some financing pressures on the Asian LED manufacturers, including increasing credit tightness in this region.

As a consequence, AIXTRON equipment order intake in Q3/2011 decreased sequentially by 77% to EUR 51.5m (Q2/2011: EUR 222.2m). Equipment order intake of the 9 month 2011 period came in at EUR 484.1m and was 11% lower in a year on year comparison (9M/2010: EUR 544.3m).

Quarterly revenues decreased by 49% sequentially from EUR 175.6m in Q2/2011 to EUR 89.8m in Q3/2011. In a year on year comparison, the 9M/2011 revenues of EUR 470.8m were down by 16% (9M/2010: EUR 559.1m). This sudden decrease in revenues is principally down to a small number of significant customer delayed deliveries, which are also reflected in the order backlog adjustment, announced on September 15th.

The Company's gross margin decreased sequentially by 1 percentage point, from 44% (EUR 76.9m) in Q2/2011 to 43% (EUR 38.7m) in Q3/2011. In 9M/2011, the gross margin recorded

was EUR 219.7m in absolute terms or 47% of sales, 25% or 6pp down from the same period of the previous year (9M/2010: EUR 294.5m, 53% of sales). The year on year decrease by comparison was mainly due to adverse effects the currency had on revenues resulting in higher cost of sales relative to revenues.

The Q3/2011 EBIT came in slightly above break-even, at EUR 0.6m with a 1% EBIT margin (Q2/2011: EUR 54.3m or 31% margin). In 9M/2011 EBIT was EUR 129.8m with a 28% EBIT margin (9M/2010: EUR 189.6m or 34% margin). This EBIT decline is largely due to lower revenues at the previously planned cost base and due to the adverse effects of quarter-end mark-to-market of pending hedging instruments and customer deposits in the third quarter of 2011. Without these non-operational currency related effects, recorded as other operating expenses, the Q3/2011 EBIT would have been EUR 13.0m or 14% of sales.

Management Review

Despite the current market correction, the AIXTRON Management remains convinced that the development of a sustainable LED lighting industry will follow this temporary period of uncertainty.

Paul Hyland, President & Chief Executive Officer at AIXTRON: "There can be no doubt in anybody's mind that the LED lighting investment cycle will come and will be the biggest end market opportunity this industry has ever seen. It is not a question of "If" it is only a question of "When".

As you would expect; In the difficult market conditions we face today, we are exercising our operational business flexibility and have already initiated immediate cost reduction measures to ensure that the margin effect of reduced shipping volumes is minimized.

However, the shorter-term market challenges we face will not distract us from the longer-term market opportunities, into which we are continuing to extensively invest in, through our R&D programs. We have a comprehensive pipeline of product developments in progress which directly address the needs of our customers to produce the highest quality products at the lowest possible manufacturing cost and I am in no doubt, that the products in development, will reinforce our

traditionally very strong positioning in all of the markets we serve.”

Outlook

AIXTRON Management confirms the guidance for the full fiscal year 2011 given on September 15, and is expecting revenues of EUR 600 million to EUR 650 million and an EBIT margin of circa 25-30%.

<http://www.aixtron.com>

New Cree LEDs deliver higher brightness, colour quality and consistency

Pushing LED brightness, colour quality and consistency to new levels, Cree announces another step in eradicating today’s energy-wasting halogen light sources. New XLamp® MT-G LEDs deliver higher brightness levels, unparalleled color quality and proven lighting-class reliability.

The new MT-G LED is now more than 10 percent brighter, and can deliver up to 1670 lumens at 85C in warm white (3000K) color temperatures. Additionally, MT-G LEDs are now available in high CRI versions optimized for applications such as retail and restaurant lighting where high CRI and lighting uniformity are required. These new capabilities can enable customers to extend existing MT-G designs, and enable new applications traditionally supported by halogen light sources.

USAI Lighting is one of the first lighting manufacturers to incorporate the new MT-G high-CRI LED into a luminaire—its award-winning NanoLED® lighting solution. The Cree MT-G-based NanoLED provides designers with color quality, efficiency, flexibility and control via proprietary optics to bridge striking aesthetics with functional application in a variety of interior installations.

“We have a relentless focus on providing only the best—and superior color quality is an essential part to ensuring our customers a high-performing lighting solution,” said Bonnie Littman, president of USAI Lighting. “Being able to offer our customers halogen-like color and brightness along with the energy-efficient benefits of LEDs is going to be a

game-changer.”

“Cree MT-G LEDs are the flagship product to bring real freedom to lighting OEMs,” said Mike Watson, Cree, Senior Director of Marketing, LED components. “Real freedom is providing options to customers who want the ability to order their LEDs in 2-step or 4-step color consistency at many color points. Cree was the first in the industry to offer LED components binned at operating temperature. Combine all of that with commercially-available parts, and that’s the advantage Cree brings to its customers.”

XLamp MT-G LEDs are now available with brighter flux and with 90-minimum CRI options. Cree also offers more than 6,000 hours of IESNA LM-80 published lifetime data, which can assist lighting manufacturers with ENERGY STAR® qualification. With color temperature options ranging from 2700K to 5000K, all MT-G LEDs are available in 2- and 4-step EasyWhite™ color temperatures, with the option of either 6V or 36V forward voltages. The full range of MT-G LEDs are available for sampling immediately, and production volumes are available with standard lead times.

Rubicon ships 200,000th six-inch sapphire wafers to the LED manufacturing industry

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, Semiconductor, and Optical industries, today announced that it has shipped a total of 200,000 six-inch sapphire wafers to the LED manufacturing industry. Sapphire, the base material used for the majority of LEDs, is used in consumer products such as LED-based lighting, HDTVs, laptops, netbooks, smart phones and tablets, and automotive lighting.

Rubicon was instrumental in the development of large diameter sapphire wafers for use in the RFIC market and further developed the process to serve other markets requiring large diameter sapphire wafers, such as LED lighting and other semiconductor applications.

“I believe Rubicon has significantly more experience

in producing large diameter sapphire wafers than any of our competitors,” explains Raja Parvez, Rubicon President and CEO. “LED manufacturers understand that migration to a large diameter sapphire wafer platform offers an opportunity to achieve production and cost efficiencies. This is increasingly important as LED manufacturers seek to reduce costs throughout the LED manufacturing process to help the industry lower prices of LED-based lighting and encourage adoption worldwide.”

Bringing down the price of LEDs is a key element in supporting the worldwide commercial adoption of solid state lighting based on LEDs as a light source. Government entities around the world including Australia, Canada and the United States have introduced legislation to require energy efficient lighting. The transition to larger diameter wafers in LED production has started. Several key LED chip manufacturers have announced plans to migrate to and/or test large diameter wafers in 2011/2012.

“There is significant large diameter wafer activity among LED manufacturers with nearly a half dozen working with six-inch in some way,” said Dr. Philippe Roussel, LED Senior Project Manager, Yole Développement. “By 2016, our research projects that large diameter wafers measuring six inches and greater will capture more than 50 percent of the market.”

According to market research firm DisplaySearch, TV applications currently dominate the LED market, but LED lighting will capture the lead by 2014. The firm said that LED lighting penetration rate in 2010 was 1.4%, and is forecast to reach 9.6% in 2014 with the growth due to government incentive programs, and growth in commercial applications and consumer adoption worldwide.

Sensor Electronic Technology gears up for high volume manufacturing of UVLEDs

Manufacturer of short wavelength UV LEDs, Sensor Electronic Technology have announced that it has put an expansion plan in motion to both expand its R&D efforts and to transition to its production line to

high volume manufacturing, making it the first high volume supplier of UV LEDs shorter than 365nm, initially scaling to supply quantities of over 100 million LEDs per year.

SETi was first to market with short wavelength UV LEDs in 2004 and has remained the leading supplier with its product portfolio of LEDs and high power LED lamps from 240nm to 355nm.

SETi currently operates a 15,000 sq.ft. ISO9001 certified facility in Columbia, SC, where it runs a vertically integrated R&D and small volume production line with epitaxial growth, chip fab, packaging and test and analysis, plus a prototyping line for integration of its LEDs into complete systems. The first phase of the expansion, currently underway, involves retrofitting this facility to 20,000 sq.ft and converting it to the company’s R&D center. The expansion in this facility will predominantly be focused around additional clean room space for chip fab and device packaging, where new mask designs, processing techniques and packaging solutions will be developed to further improve the performance of SETi’s UVTOP® and UVClean® devices and ensure that SETi maintains its world leading position in the UV LED market.

SETi has recently closed on the purchase of a new property, also in Columbia, SC, where it will focus its high volume manufacturing lines. SETi’s growth plans include the expansion of this new facility to 130,000 sq.ft. Initially, this facility will house SETi’s proprietary production MOCVD reactors where the company will focus on the high volume manufacturing of its MEMOCVD® process that will be used for the scale up in volume of its UV LEDs and a new Engineering Center for the development of new applications and production of custom solutions.

Riber announce sale of 3 research machines in Russia

RIBER announces the sale of three research systems to two leading research institutes based in Russia. With these orders, Epineat, Compact12 and Compact 21 model MBE systems will be supplied in 2012.

Two systems will be delivered to the Saint Petersburg Academy of Sciences' Nanotechnology Research and Education Centre in connection with the "Alferov-Riber MBE

Academy", set up jointly in 2010 with Nobel Prize in Physics Zhores Alferov and RIBER.

Riber states that these new orders confirm RIBER's growing reputation among the scientific community in Russia, enabling it to further strengthen its positions on this market, where the semiconductor industry is booming. They also state it illustrates the quality of RIBER's business model, focused on:

- Continuing to further strengthen RIBER's leadership on the market for molecular beam epitaxy machines;
- Capitalizing on the installed base and growing sales of epitaxy equipment, spare parts and accessories, as well as the corresponding services;
- Diversifying the business, releasing a range of high value-added equipment (cells and sources) on the market for strong-growth application fields (thin-layer solar cells, OLED lighting and screens, etc.).

www.riber.com

Bridgelux revenues soar 792 percent from 2006 to 2010

The firm attributes the company's dramatic revenue growth to both strong growth in the general illumination market, and the dramatic adoption of Bridgelux's array architecture.

Bridgelux, a developer and manufacturer of LED lighting technologies and solutions has announced that it ranks number 135 on Deloitte's 2011 Technology Fast 500 list.

Deloitte's list rates the 500 fastest growing technology, media, telecommunications, life sciences and clean technology companies in North America based on percentage of fiscal year revenue growth from 2006 to 2010. Bridgelux grew 792 percent during this period.

Bridgelux's Chief Executive Officer, Bill Watkins,

attributes the company's dramatic revenue growth to both strong growth in the general illumination market, and the dramatic adoption of Bridgelux's array architecture.

He says, "Bridgelux's ranking in the Technology Fast 500 is a not only a reflection of our success in delivering leading technology and products, but in our ability to leverage numerous strategic partnerships with global leaders in materials technologies, embedded wireless communication and control technologies, as well as Energy Service Providers. We are honoured by our ranking in the Technology Fast 500 and excited for future growth as we continue toward our goal of bringing revolutionary LED lighting solutions to market."

Technology Fast 500, which was conducted by Deloitte & Touche LLP, a subsidiary of Deloitte LLP, provides a ranking of the fastest growing technology, media, telecommunications, life sciences and clean technology companies - both public and private - in North America. Technology Fast 500 award winners are selected based on percentage fiscal year revenue growth from 2006 to 2010.

In order to be eligible for Technology Fast 500 recognition, companies must own proprietary intellectual property or technology that is sold to customers in products that contribute to a majority of the company's operating revenues. Companies must have base-year operating revenues of at least \$50,000 USD or CD, and current-year operating revenues of at least \$5 million USD or CD. Additionally, companies must be in business for a minimum of five years and be headquartered within North America.

Average retail price for 60W incandescent LED lamps \$36 in October

IMS Research found a significant variation in the price of these lamps by region. Germany has the most expensive lamps, priced at \$70, while in Taiwan; equivalent lamps are priced at \$19.

IMS Research has launched a Global Monthly LED Lamp Retail Price Tracker to monitor and provide

insight into the rapidly growing and changing LED lamp market. With the phasing out of incandescent lamps and the dislike that consumers have with compact fluorescent lamps (CFLs), LED replacement lamps have an enormous opportunity as prices fall further.

According to IMS Research SVP of Displays, LEDs and Lighting Ross Young, "The number of LED lamps becoming available to consumers is rapidly accelerating. This report represents the most cost effective way for lighting related companies to monitor the evolution of LED lamp prices, specifications and other product trends. By having analysts in six countries and speaking six different languages, IMS Research is in a unique position to track the evolution of LED lamp prices both in-store and online."

According to the latest analysis from IMS Research, in October 2011, the global average retail price for 60W incandescent LED replacement lamps was \$36, up from \$34 in the previous month. Global changes in price were mostly due to fluctuations in currency values.

That being said, the average price for 60W replacement LED lamps in the US decreased mainly due to the 38% drop in the price of the Philips Ambient 60W replacement lamp from \$40 to \$25. This change is extremely important as 60W incandescent lamps are the most widely installed lamp in the world today. In the residential sector in North America alone, there are more than 2 billion of these lamps installed.

IMS Research also found a significant variation in the price of these lamps by region. Germany has the most expensive lamps, priced at \$70, while in Taiwan; equivalent lamps are priced at \$19.

According to IMS Research Lighting Market Analyst Philip Smallwood, "The LED lamp market is going to evolve at a breakneck pace in the coming years. New brands, improvements in the technology, consumer awareness and government regulations are all driving the demand for these lamps. With price being one of the most important purchasing decision factors for consumers and a healthy oversupply in the LED space as quantified in our Quarterly LED Supply/Demand Report, it will be exciting to see how quickly prices drop around the world."

During this research, it was also found that a lack of product standards has led to a large amount of replacement lamps being mislabelled or misrepresented. By comparing advertised replacement types with actual lumen output, IMS Research found that more than 20% of all LED lamps were mislabelled and did not meet the minimum lumen requirements to be considered as replacements.

Cree and Veeco to benefit from LED lighting demand

The general lighting market for LEDs will be the fastest-growing market, up 29 percent.

The LED market is facing significant headwinds of late. The current downturn in the LED market is largely due to reduced prices for LED-based TV backlight and lighting systems. This is because of inventory adjustments, and increased competition from more backlight makers entering the LED market. The Bedford Report examines the outlook for companies in the semiconductor industry and provides stock research on Cree and Veeco Instruments.

According to IMS' research, backlighting, which ranges across consumer electronics such as flat panel TVs and cell phones, is expected to grow at a mere 2 percent this year, while the general lighting market for LEDs will be the fastest-growing market, up 29 percent. IMS Research's latest "LED Supply and Demand Report" expects longer-term strength in the LED market. The firm estimates 36 percent revenue compound annual growth rate from 2010 to 2015 for packaged LEDs to \$6.3B, up from \$1.75B in 2011.

Reflecting on the industry in general, Cree CEO Chuck Swoboda believes the huge increase in chip production to service LED backlighting applications in recent years has put pressure on the rest of the market. On the upside, Cree is gaining strong demand for its product due to rising number of LED-based lighting designs on the market.

Veeco makes equipment to develop and manufacture LEDs, solar panels, hard disk drives and other devices and so should also benefit.

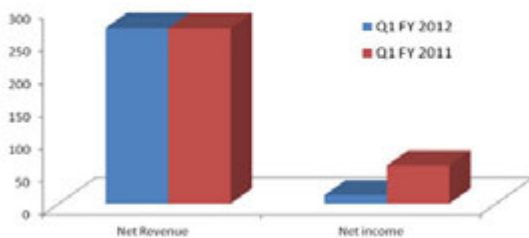
Cree's revenues hit \$269.0 million

For its first quarter of fiscal 2012, ended September 25, 2011, the LED innovator's revenues hardly changed compared to the same time last year.

This represents a 0.2% increase compared to revenue of \$268.4 million reported for the first fiscal quarter last year and a 11% increase compared to the fourth quarter of fiscal 2011.

GAAP net income for the first quarter of \$12.8 million, or \$0.11 per diluted share, decreased 78% year-over-year compared to GAAP net income of \$58.0 million, or \$0.53 per diluted share, for the first quarter of fiscal 2011.

GAAP Financial Results for fiscal years Q1 2012 & 2011



Financial results for the quarter reflect the acquisition of Ruud Lighting on August 17, 2011, approximately one month before the end of the quarter.

"We got off to a good start in Q1 as results were in-line with our updated targets and our LED lighting and LED components product lines continued to grow," stated Chuck Swoboda, Cree chairman and CEO. "We also took the next step in our strategy to lead the LED lighting revolution with the acquisition of Ruud Lighting. Although we have seen tremendous growth in LED lighting sales over the last few years, it is clear that we have only scratched the surface of LED lighting adoption and there is growing demand for products that offer innovative solutions and good payback."

Cash and investments ended the quarter at \$632.2 million, which was a decrease of \$453.6 million from Q4 of fiscal 2011 due to the disbursement of \$457 million as part of the Ruud Lighting acquisition. Cash flow from operations was \$41.6 million.

Accounts receivable (net) increased \$47.2 million from Q4 of fiscal 2011 to \$165.7 million, with days sales outstanding of 55. Ruud Lighting receivables were approximately \$22 million at the end of the quarter. Days sales outstanding would have been 50 if Ruud Lighting were part of Cree for the entire quarter. Inventory increased \$27.1 million from Q4 of fiscal 2011 to \$203.6 million and represents 107 days of inventory. Ruud Lighting inventory was approximately \$38 million at the end of the quarter. Days of inventory would have been 96 if Ruud Lighting were part of Cree for the entire quarter.

Business Outlook:

For its second quarter of fiscal 2012 ending December 25, 2011, Cree targets revenue in a range of \$300 million to \$320 million with GAAP gross margin targeted to be in a similar range as Q1 at 37%-38%. GAAP operating expenses are targeted to increase by approximately \$10 million to \$95 million. The increase in targeted operating expenses is primarily related to the addition of Ruud Lighting for an entire quarter. The tax rate is targeted at 21.5% for fiscal Q2. GAAP net income is targeted at \$13 million to \$18 million, or \$0.11 to \$0.15 per diluted share. The GAAP net income target is based on an estimated 118 million diluted weighted average shares.

Bridgelux LED targets 20-40 W replacement lamp market

The firm's new Micro SM4 features the latest technical advancements in epitaxial gallium nitride layer growth, LED chip design and packaging technologies.

Bridgelux, a developer and manufacturer of LED lighting technologies and products, has expanded its broad portfolio of solid-state light sources to address the requirements of the \$1 billion 20-40W lamp replacement market with the introduction of the Bridgelux Micro SM4.

Leveraging Bridgelux's award-winning array technology into a surface mountable LED component, the Micro SM4 delivers high flux density in a smaller footprint, making it ideal for applications where discrete LEDs are preferred.

The Bridgelux Micro SM4 dramatically reduces the component count, cost, complexity and size of the lighting system, enabling a cost-effective, high performance LED solution for diffuse and directional lighting, such as 20-40 watt incandescent, 20-35 watt halogen, B10-style (candelabra), and low wattage compact fluorescent lamp replacements.

Using only 4.6 watts of power, the Bridgelux Micro SM4 will deliver between 330 and 520 lumens in both warm white (2700K and 3000K) and cool white (5600K) colour temperatures. Minimum 80 and 90 CRI options, with 3-step MacAdams Elipse colour selections, will be offered for warm white products. Production shipments of the Micro SM4 will be available in the first quarter of 2012.

“The Bridgelux Micro SM4 delivers comparable efficacy and performance to some of our smaller form factor arrays in the size of a miniaturised discrete component,” said Jason Posselt, vice president of marketing at Bridgelux. “The ability to use high volume surface mount assembly methods will open up new design integration options and help our customers to improve both cost-to-market and time-to-market.”

The new Micro SM4 features the latest technical advancements in epitaxial GaN layer growth, LED chip design and packaging technologies. These products are configured to align with industry standard drive currents to simplify the electronic driver selection process for new lamp and luminaire product development, and are offered in both 6V and 12V design configurations to enable driver design flexibility. As with all Bridgelux light sources, the Micro SM4 is offered with a five year warranty.

Optogan opens Europe’s second largest LED chip plant

The foundation of the new site is a former Hitachi semiconductor factory and offers a clean room area of up to 4,000m².

The Minister of Economic Affairs of the German Federal State of Bavaria, Martin Zeil, has opened a new Optogan production site in the German city of Landshut.

“Bavaria is gaining a shining example for future-oriented innovations“, proclaimed Zeil in his opening speech. “I am delighted that Optogan has decided to use a site in Bavaria when expanding its operations in Germany. The site’s proximity to Munich Airport and its access to highly qualified specialists and experts form an excellent foundation for the company to develop its international business.”



Grand Opening – Production Start-Up in Landshut, from left: Markus Zeiler, General Manager; Martin Zeil, Bavarian Minister of Economic Affairs, Maxim Odnoblyudov, President of the Optogan Group, Hans Peter Ehweiner, CEO of Optogan GmbH.



The Minister of Economic Affairs of the German Federal State of Bavaria, Martin Zeil, opens the new Optogan production site.

The conversion of energy supplies to green technology means that LED lighting will become increasingly important in the future. One of the main tasks involved in this development is to make energy use more effective, for example by using high-performance LEDs that lead to energy savings of up to 80 percent. On top of this, a LED lamp

has an operating life of up to 50,000 hours, while a conventional incandescent bulb has a lifespan of just approximately 1000 hours. Another advantage of LEDs is that they contain neither lead nor mercury.

“In Landshut, we have discovered the ideal infrastructure for our future high-volume production of efficient LED chips. Our LED lamps and luminaires are on the way towards lighting up indoor, outdoor and residential areas all over the world”, explains Hans Peter Ehweiner, the Managing Director of Optogan GmbH.

The foundation of the new site is the former Hitachi semiconductor factory, which offers a clean room area of up to 4,000m². Investments reaching double figures of millions of euros and up to 100 members of staff form the framework for the company’s production activities. An initial capacity of over one billion LED chips per year combined with innovative and cost-effective manufacturing processes means that Optogan is well equipped for a bright future.

The Landshut site also forms the basis of the international sales activities carried out by the Optogan Group. The company’s core business currently involves the European markets, but it is also becoming increasingly popular on a worldwide level.

The Optogan Group was founded by three Russian physicists in Finland in 2004. Since 2005, the company has been developing and manufacturing state-of-the-art chip technologies in the German city of Dortmund. At the end of 2010, Optogan opened the largest production site for LED components and moderns in the whole of Eastern Europe in St. Petersburg. The Landshut site is now home to the production of light-emitting diode chips, which are able to light up lamps for 30 years and carry the seal of “Made in Germany”.



Europe’s second largest chip production in the Bavarian district of Landshut

Epistar impressed with Candela inspection system for LEDs

The advanced technology will help determine root cause analysis of defects in gallium nitride grown on sapphire substrates.

KLA-Tencor has announced that Epistar, a leading Taiwanese manufacturer of LED chips, has adopted its Candela substrate and epwafer inspection system.

KLA says this order marks the growing adoption by LED device manufacturers worldwide of this advanced inspection system for wafer defect detection and classification at production-grade throughputs.

The introduction of the Candela tool to Epistar’s manufacturing process provides automated inspection methods for sapphire substrates to ensure vendor quality, and provides greater visibility into the GaN epi process to help detect the root causes of defects and early prediction of process excursions.

According to an Epistar spokesperson, «Adoption of KLA-Tencor’s Candela inspection has provided Epistar with improved sapphire quality control and MOCVD process control.»

Substrate defects are known to impact epi process yield, and the Candela system provides increased sensitivity to these yield-limiting defects. With its proprietary optical design and detection technology, the Candela system detects and classifies sub-micron defects - including micro-cracks and -scratches, polishing and brushing streaks, and chemical residues.

As LED manufacturers transition production to larger wafer sizes and introduce new patterned sapphire substrate (PSS) processes, the economic impact of resulting process-induced defects is significant. For defects occurring during the epi process steps, the Candela tool can detect hexagonal pits and bumps which can lead to electrical failure and epi cracks that can adversely impact field reliability.

«The Candela system allows LED manufacturers to conduct root cause analysis to speed process development, quickly fine tune production processes to minimise process excursions, and ultimately achieve higher yield per wafer,» said Jeff Donnelly, group vice president, Growth and Emerging Markets (GEM) Group at KLA-Tencor. «We are pleased to add Epistar to the growing list of Candela adopters.»

Cree continues to lead with even brighter LEDs

The firm's lighting-class XLamp XP-G LED which now delivers 140 lumens per watt is currently in production.

Cree continues to extend the advantage of its innovative, industry-leading XLamp LED family with the announcement of new levels of performance for its highly efficient XLamp XP-G LEDs, now delivering up to 140 lumens per watt.

The proven XP-G LED can help lighting manufacturers reduce system cost and complexity and can make existing designs brighter and more efficient.

By leveraging the popular XP-G LED form factor, these increases in brightness and efficacy can shorten the LED fixture design cycle and improve customer time to market, with drop-in-ready performance enhancements. Cree also boasts that its XP-G LEDs have the longest projected lifetime data published.

“The XLamp XP-G is an oft-imitated yet unmatched lighting-class LED,” said Mike Watson, Cree senior director of marketing, LED Components. “Never content, Cree continues to innovate with this highly efficient platform—raising our bar yet again by providing commercially available 140 lumen per watt components. For lighting manufacturers looking to lower system cost through high performance LEDs, the answer is Cree.”

Cree's XLamp XP-G LEDs are optimised for directional lighting, used in a variety of applications from street and area lighting to PAR replacement lamps to high-output flashlights. Cree is also the first LED supplier to publish 10,000 hours of lifetime

data, which can allow customers to project TM-21 reported lifetimes greater than 60,000 hours, or nearly seven years.

The cool white XLamp XP-G provides up to 148 lumens and 141 lumens per watt, while the outdoor white (4000K) XP-G LED delivers up to 139 lumens and 132 lumens per watt and warm white (3000K) offers up to 122 lumens and 116 lumens per watt, all at 350mA.

XLamp XP-G LEDs are available now with standard lead times.

Bridgelux LED Arrays extend leadership in retail and hospitality lighting

The firm's ultra-high colour rendering Decor is optimised for demanding applications such as retail, hospitality, museums and high-end architectural lighting.

Bridgelux has launched its Decor line of ultra-high colour rendering index (CRI) LED arrays.

With a CRI of 97 and a 3-step MacAdams Eipse colour control option, the Decor arrays enable lighting designers to render a full palette of colours over a wide range of light levels to create stunning and sophisticated lighting effects.

Delivering 1200 to 2500 lumens, these new arrays have been spectrally engineered to closely replicate the light quality of halogen and incandescent light sources. These arrays deliver R9 and R15 values of 98, to both enhance reds and represent skin tones accurately, ensuring clean and natural lighting. The Decor series expands lighting options available to the lighting designer, complimenting the standard minimum 80 and minimum 90 CRI products already available from Bridgelux.

“The new Decor arrays take us to the next level, enabling very high-end lighting design,” said Giorgio Martini, vice president at Martini. “Developed in collaboration with Martini Lighting R&D, these new arrays have allowed us to rethink lighting and luminaire design in fresh and innovative ways. We can design precision lighting effects and striking

contrast ratios enhancing the presentation of retail merchandise. The Decor arrays now permit us to deliver the highest quality light, brilliantly rendering colours and textures. These are the elements that allow us to present our shops and restaurants in living colour.”

The Decor arrays deliver light output equivalent to a 75 - 150 watt halogen bulb, while using only 25 - 50 watts of power. Further, the Decor arrays feature the same form factor as previous Bridgelux Array product generations, allowing for a simple upgrade path for existing customers while minimizing design efforts.

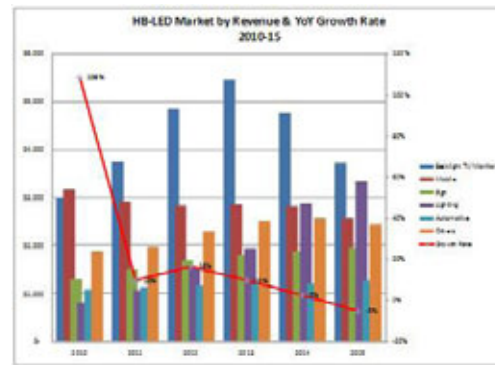
Bridgelux says it is the only vertically integrated LED manufacturer and developer of solid-state light sources that designs its solutions specifically for the lighting industry.

LED revenues to peak at \$16.2B in 2014

Revenue is however expected to fall to \$15.3 B in 2015 although the dip will be temporary, as lighting will take over as the engine for growth after 2015.

Revenues for high-brightness LEDs grew by a remarkable 108% to \$11.2 billion in 2010, according to new market report “High-Brightness LED Market Review and Forecast-2011” by Strategies Unlimited.

The growth was propelled by applications in TV backlight units, but expanding supply and a slowdown in overall TV demand in 2011 led to a drastic drop in LED prices, leading to a revised estimate of \$12.3 billion in LED revenues for 2011. Revenue is expected to peak in 2014 at \$16.2B and then fall to \$15.3 B in 2015. The dip in revenues will be temporary, as lighting will take over as the engine for growth after 2015.



The report says LED prices have plummeted 20-40%, except for some specialised applications, such as headlamps. Weaker players or new entrants without much experience, like many from China who entered in during 2010, will retreat from the market. As LEDs become more like commodities, only strong players with deep pockets will survive the fluctuations, much like DRAM suppliers.

Revenues of LEDs for lighting will see compound growth of 33% over the period. With LEDs being approximately 30% of the bill of materials, the recent drop in the prices may accelerate LED adoption. For example, a high quality, large volume 1W cool white packaged LED with delivery in September 2011 was quoted around \$0.65.

The worldwide sign industry experienced explosive growth to \$3.4B in 2010. The domestic Chinese market grew 54% to \$1.9B and is expected to continue growing at 14% compounded annually through 2015. LED revenues for signs were \$1.1B in 2010, growing to about \$1.6B in 2015. About 83% of worldwide signs were manufactured in China, with that trend continuing toward Chinese manufacturing.

The mobile appliance segment is the only one with negative growth through the period. Smartphone units will grow at 30% and tablet computers at 57%, compounded annually. However, most mobile appliances, such as feature phones and notebooks, have reached saturation, and falling prices will erode LED revenues by -4.1%, compounded annually.

LED revenue from the automotive segment reached \$1.1B in 2010, propelled by strong growth in the China market. Expected growth for 2011 has been revised to 5%, due to cooling of the Chinese market and the effect of the Japanese tsunami on LED

supply.

Increased use of LEDs in daytime running lights and headlamps will fuel revenue growth for LEDs in exterior automotive lighting at 10%, compounded annually. Falling prices and saturation of LEDs in instrument panels, reaching 90% in 2015, will erode LED revenue for that segment by 2% over the period.

NEDI to develop power devices and LEDs with Aixtron tools

The Chinese firm will use one of the two reactors to produce 4" arsenide and phosphide based LED materials and the other to produce 4" silicon carbide based epiwafers.

Aixtron SE has announced that Nanjing Electronic Devices Institute (NEDI), an existing customer and a leading manufacturer of electronic components in China, has placed an order for one AIX 2600G3 IC system in a 12x4-inch wafer configuration and one VP2400HW with 6x4-inch wafer capacity.

NEDI will use the systems to investigate power devices and LEDs.

Following delivery in the third and fourth quarter of 2011, the new systems will be installed and commissioned by a local Aixtron service support team alongside the company's already existing Aixtron MOCVD systems at the company's state-of-the-art facility located in the Jiangning Economic & Technological Development Zone, Nanjing China.

Kun Chun Mao, who is in charge of purchasing these systems at NEDI, comments, "These are not our first Aixtron MOCVD systems but they will play a vital part in our planned development of materials for power devices and LEDs. My team is very familiar with the technology and they trust Aixtron's advanced technology with its ease of use, versatility as well as process compatibility with our existing recipes and procedures."

"We have also been very satisfied with the first-class local support provided by the Aixtron service office and the enlarged spare parts stock in

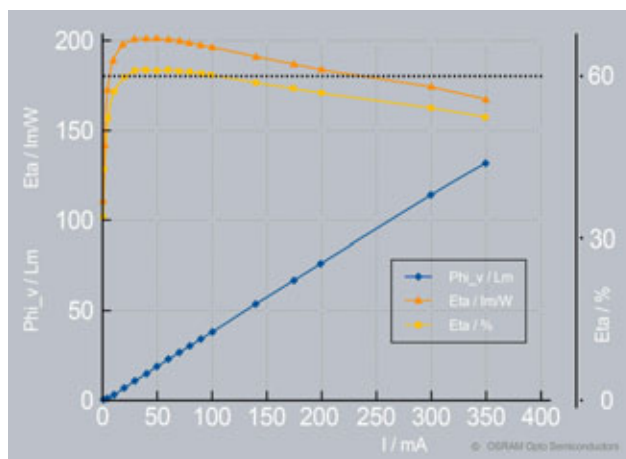
Shanghai. This partnership will serve us well when we begin operations with the new reactors," he continues.

Osram red LED smashes the 200 lm/W barrier

The firm says the results of this project can be extended to all the wavelengths in the aluminium indium gallium phosphide (AlInGaP) range to boost efficiency.

A red high-power LED has set a new efficiency record in an Osram Opto Semiconductors R&D lab with an electro-optical efficiency of 61%.

The 1 mm² chip housed on a laboratory package emits at a wavelength of 609 nm (λ -dom) and has achieved a record value of 201 lm/W at an operating current of 40 mA. At a typical operating current of 350 mA its luminous efficacy is still an impressive 168 lm/W, which means that even at this high wattage more than half of the electrical energy is converted into light.



World record in the Osram laboratory: 201lm/W – 61% efficiency (WPE)

LED colour mixing systems such as the Osram Brilliant Mix concept are the latest trend, particularly for general illumination applications. These systems enable any kind of white light to be produced, from Warm White through Neutral White to Daylight White. The overall performance of the system is as good as the individual components will allow.

Osram's says its new red high-power LED promises a further improvement in the quality of light with lower power consumption, especially in Warm White. This will benefit not only colour mixing concepts but also all applications that use high-efficiency red LEDs – in the general illumination, projection and automotive sectors.

Higher efficiency means more light from the same amount of electricity, which in turn means lower power consumption for a particular application. Because fewer chips are needed to produce the same brightness level, designers will have greater freedom. The light sources can be made smaller while still producing the same brightness.

Martin Behringer from the LED development team at Osram Opto said, "The results of this project can be extended to all the wavelengths in InGaAlP chip technology so we anticipate a boost in efficiency in these light colours – even at 660 nm which is the wavelength needed for plant lighting for example. Probably we will be introducing the results of this development project across the entire wavelength spectrum into production in about a year's time."

The enormous increase in output was achieved by a chip with the latest generation of the company's own thin-film technology.

Osram flexes its muscles in two key growth markets

The firm is looking to increase its market share in LED based technologies and light management systems.

Osram has signed an agreement with Townsend Ventures to increase its stake in Encelium Technologies from 15 percent to 100 percent.

This move will enhance the company's position in two key global growth markets, LED based technologies and Light Management Systems (LMS). Encelium is an ideal complement to Osram's General Lighting portfolio of energy-efficient lighting products and solutions.

Encelium, headquartered in Teaneck, N.J., is a leading software technology development company concentrating in advanced lighting control and

energy management systems for commercial and industrial buildings. Encelium employs approximately 70 people in the United States and Canada.

Encelium's expertise and distribution network will extend the already deep Osram reach into the energy efficiency business and position the company for further LED expansion. After closing, Encelium will become part of the Osram General Lighting – LMS organisation.

"The acquisition of Encelium, and its cutting edge lighting control software for commercial buildings, is the next logical step for Osram in becoming one of the leading LED lighting solutions providers," said Klaus-Günter Vennemann, CEO of General Lighting at Osram.

"Today lighting is responsible for 20 percent of electrical energy consumption globally. In the US it accounts for more than 30 percent of the commercial building's electrical energy consumption. With an ever-increasing demand for improved energy efficiency of commercial buildings, this acquisition enables us to offer smart LMS options to our customers worldwide that provide the right light, in the right amount, at the right place, at the right time," he continued.

LMS is a key growth market as lighting controls support the transition of standard lighting products to networked, intelligent and value-added solutions. According to a recent McKinsey study, the current global market volume for lighting systems control components is roughly estimated at two billion euros. This is expected to double by 2016 and triple by 2020.

"Osram leadership in LED lighting solutions, from modules, luminaires and controls, to installation and maintenance services, coupled with Encelium's software technology capabilities, supports an aggressive growth strategy and further penetration into both existing and new markets", said Anthony Marano, Chief Executive Officer of Encelium.

LMS growth is largely a result of its energy saving capabilities and quality of life improvements. In instances, solutions combining highly efficient lighting products with advanced LMS structures yield energy savings up to 80 percent. In addition to energy and environmental benefits, Light

Management Systems deliver quality of light that shapes the quality of life. With new ways of dimming, colour control and mood enhancing lighting, the development of dynamic light possibilities are endless.

Frank Tillner is the new COO at Osram Opto

The semiconductor expert takes responsibility for worldwide opto component production.

There is a new addition to the executive team of Osram Opto Semiconductors. Born in Aachen, Germany, Frank Tillner, 51, will be succeeding the previous Chief Operating Officer, Elke Eckstein, at the headquarters in Regensburg and taking the responsibility for the chip and LED production plants in Regensburg, Germany, and Penang, Malaysia.

Frank Tillner has many years of experience in semiconductor processes and production to commend him. He was last employed as Senior Vice President at Conergy AG.



Frank Tillner is the new Chief Operating Officer of Osram Opto Semiconductors GmbH

“Our company has found the ideal candidate for the post of COO in Frank Tillner. With his long-standing experience in the sector, he not only has an immense specialist knowledge but also the management expertise required to meet the demands of the various processes at Osram Opto

Semiconductors, thus fulfilling all the prerequisites for this key position,” said Aldo Kamper, CEO of Osram Opto Semiconductors, about the new appointment.

Tillner’s career kicked off in the semiconductor sector some 26 years ago. Following his studies in physics engineering, his first post was with Siemens AG, where he worked as a process engineer for lithography in the Semiconductor Memories division. In the course of his career, Tillner held various different positions at the company, including six years in Essonnes, France.

He also worked with Texas Instruments GmbH, Infineon Technologies AG and Qimonda AG. He soon had a chance to demonstrate his professional expertise and his excellent leadership skills in executive posts – be it as Chief Operating Officer for the Secure Mobile Solutions Group of Infineon AG, as Senior Vice President Production & Purchasing at Qimonda AG or as Senior Vice President Solar Components & Global Large Projects at Conergy AG.

Thanks to his expertise in the fields of product and technological development, marketing, logistics, quality and finances, along with his worldwide responsibility for production plants, Tillner offers a vast wealth of experience and a holistic view of people and structures.

Telecoms

Anadigics adds to 4G power amplifiers family

The new 2.5 to 2.7 GHz WiMAX/LTE PA delivers higher linear output power to provide greater range and throughput.

The new AWM6268 power amplifier is claimed to provide world-class linearity and integration similar to that of Anadigics’ current WiMAX solutions.

It also increases output power to deliver greater range and throughput in the 2.5 GHz to 2.7 GHz

frequency band.



This device also delivers exceptional linearity and output power for LTE applications. Anadigics' 4G power amplifiers are optimised for high data rate broadband wireless devices, such as smartphones, notebook PCs, netbooks, data cards, and Wi-Fi hotspots.

"While LTE technology continues to gain traction, mobile broadband system operators around the world continue to deploy and expand WiMAX networks, offering new WiMAX-enabled devices to support the rapidly increasing demand for wireless data," said Glenn Eswein, director of product marketing for broadband RF products at Anadigics.

He continued, "Anadigics remains at the forefront of WiMAX RF performance by providing power amplifiers that enable longer range and higher throughput, while maximizing battery-life. These performance advantages have been validated by volume shipments of our existing WiMAX PA products, and through design wins with the new AWM6268 power amplifier."

"The expansion of Anadigics' 4G power amplifier family demonstrates our commitment to innovation and product excellence," said Joe Cozzarelli, senior director of broadband RF products at Anadigics. "As 4G applications evolve, it is becoming more evident that the performance of the PA affects network performance and the user experience directly. The new AWM6268 power amplifier enables a wider range of these applications by delivering enhanced linear output power and efficiency."

In WiMAX applications, the AWM6268 PA provides one of the best-in-class linearities and high power added efficiency of 25% at +26 dBm output power to help maintain excellent battery-life under the most demanding, data-intensive usage scenarios.

For LTE, the PA delivers high linearity and

33% power added efficiency at +28 dBm output power. The AWM6268 uses a footprint, a pin-out, and controls that are compatible with the earlier AWT6264 PA. Anadigics' complete family of 4G PAs is manufactured using the Company's advanced InGaP HBT MMIC technology, which offers state-of-the-art reliability, temperature stability, and ruggedness.

With a footprint of 4 mm by 4 mm by 1 mm, the AWM6268 meets UTRA adjacent channel power limits at +28 dBm output power and has low off-state leakage current for extended battery life.

The device is footprint- and pin- compatible to other products in its family and has an integrated step attenuator and integrated RF input and output impedance matching circuits.

Anadigics WiMAX Power Amplifier Family Key Specifications:

Part Number	Frequency Band	Output Power	Efficiency	Gain
AWT6264	2.3 GHz to 2.7 GHz	+25 dBm	24%	32 dB
AWM6268	2.5 GHz to 2.7 GHz	+26 dBm	25%	31 dB
AWT6283	3.3 GHz to 3.8 GHz	+25 dBm	22%	31 dB

Samples of Anadigics' WiMAX power amplifiers are available now.

Skyworks and AnalogicTech amend merger agreement

The innovator of high reliability analogue and mixed signal semiconductors will acquire the outstanding shares of AnalogicTech for \$5.80 per share in cash.

Skyworks Solutions intends to commence the tender offer to purchase Advanced Analogic Technologies, Inc. (AnalogicTech) within seven business days. The companies expect the transaction to be completed in January 2012.

AnalogicTech develops advanced semiconductor

system solutions that play a key role in the continuing evolution of feature-rich, energy efficient electronic devices. The company focuses on addressing the application-specific power management needs of consumer devices such as mobile handsets, digital cameras, tablets, notebooks, TV and LCD displays as well as devices in a broad range of industrial, medical and telecom applications. AnalogicTech also licenses device, process, package, and application-related technologies.

Skyworks intends to finance the tender offer with cash in hand. The tender offer will not be subject to financing and, among other things, will be conditioned upon a majority of the shares of AnalogicTech common stock outstanding being tendered and no injunctions being issued prohibiting the offer or the merger.

AATI has addressed and satisfactorily clarified all issues previously raised by Skyworks. As part of the settlement, the companies have agreed to voluntarily dismiss the claims asserted against each other in the Delaware Chancery Court. Skyworks and AnalogicTech have mutually determined that their respective claims were insignificant in light of the overall value of the transaction.

“Skyworks is pleased to have reached this agreement with AnalogicTech and to be moving forward together,” said David J. Aldrich, president and chief executive officer of Skyworks. “We believe this transaction will enable Skyworks to further capitalise on our strong smart phone, tablet, set-top box and infrastructure positions with an expanded and differentiated product portfolio while accelerating our entry into new vertical markets.

Analogue power management semiconductors represent a strategic growth market for Skyworks as our customers increasingly demand both ubiquitous wireless connectivity and power optimization across seemingly every kind of electronic platform. With AnalogicTech, Skyworks will be well positioned to address these twin market opportunities by leveraging our broad customer relationships and innovative product portfolios, and increasing operational scale.”

“We believe the revised agreement with Skyworks provides AnalogicTech stockholders with immediate value and certainty for their investment in the

Company, while providing important benefits to AnalogicTech’s employees and customers,” said Richard K. Williams, president, chief executive officer and chief technical officer of Advanced Analogic Technologies.

“We share Skyworks’ vision of the enormity and growth potential of the analogue semiconductor market and continue to believe that together, we can better address customers’ demand for highly integrated power management solutions across a broader range of markets and applications. We look forward to closing this transaction quickly and are committed to ensuring a smooth transition.”

Skyworks noted that the Registration Statement on Form S-4 that had been previously filed with the U.S. Securities and Exchange Commission (SEC) on June 17, 2011, and withdrawn on November 3, 2011 will not be resubmitted for filing.

Skyworks expects the transaction to be earnings accretive in FY12 post synergies and will provide more information during its first fiscal quarter 2012 earnings conference call to be held in January 2012.

In light of the revised merger agreement, AnalogicTech’s Annual Meeting of Stockholders, that was previously scheduled to be held on December 16, 2011, has been postponed until further such notice.

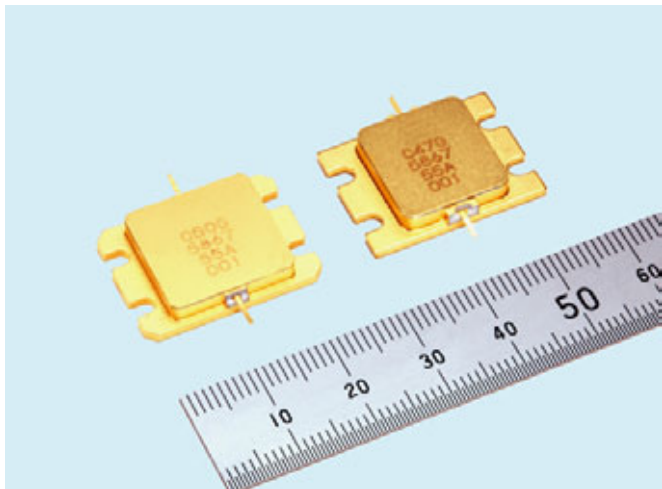
C-band gallium nitride HEMTs for satellite Earth stations

With more than 43% of power added efficiency, the devices have power outputs of 100W and 50W and feature 40V high-voltage operation.

Mitsubishi Electric Corporation has developed two GaN High-Electron Mobility Transistor (HEMT) C-band (4-8GHz) amplifiers for satellite earth stations.

The firm says its MGFC50G5867 and MGFC47G5867, featuring power outputs of an industry-leading 100W and 50W, respectively, will

ship on a sample basis beginning January 10, 2012.



Left: MGFC50G5867 Right: MGFC47G5867

GaAs amplifiers have been commonly employed in microwave power transmitters. In recent years, however, GaN amplifiers have become increasingly popular due to their high breakdown-voltage and power density, high saturated electron speed and ability to contribute to power saving and the downsizing of power transmitter equipment.

Mitsubishi Electric first began sample shipments of high-output GaN HEMT amplifiers for C-band space application in March 2010.

With more than 43% of power added efficiency, the modules feature 40V high-voltage operation. The internally impedance-matched devices have a low distortion with an output power meeting 3rd-order Inter Modulation (IM3) of -25dBc of 46dBm.

Other Features

		MGFC50G5867	MGFC47G5867
Operating Conditions	VDS ²	40 V	40 V
	IDQ ¹	1.15 A	0.58 A
Frequency		5.8~6.7 GHz (C band)	
Output Power of 3dB Compression	P3dB (Typ.)	50 dBm (100 W)	47 dBm (50 W)
Linear Power Gain	G1dB ⁴ (Typ.)	10 dB	10 dB
Power Added Efficiency	PAE ⁵ (Typ.)	43 %	45 %
Drain to Source Voltage			
Quiescent Drain Current			
@ frequency = 6.4 GHz			
Power Added Efficiency (@3dB, frequency = 6.4 GHz)			

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on "The Market for LEDs in Lighting".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense

Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable "on-silicon" solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Soraa Inc.

Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on SI based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound Semiconductor Markets: Current Status and Future Prospects".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems

Technology Office

- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

- III-V on 200 mm Si for VLSI - Richard Hill, Sematech

- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : "CS Europe 2012: LEDs, lasers, PV and electronics Conference"

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

- Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors

- Scalable "on-silicon" solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

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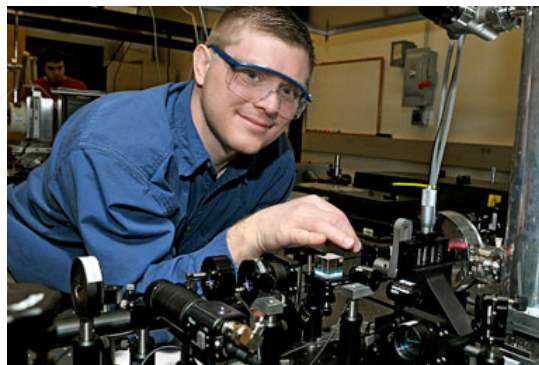
Philips Lumileds Lighting Company

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- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

How to assemble InAs quantum dots

Researchers at the University of Delaware have explored novel methods for assembling indium arsenide quantum dots for use in next generation computing devices and solar energy capture.

Matthew Doty, assistant professor in the University of Delaware Department of Materials Science and Engineering, is co-author of two papers exploring novel methods for assembling quantum dots to control how electrons interact with light and magnetic fields.



Matthew Doty, a co-author of two papers exploring novel methods for assembling quantum dots to control how electrons interact with light and magnetic fields.

The papers recently appeared in Physical Review B, a journal of the American Physical Society (APS). Both papers were selected as “Editor’s Suggestions,” a designation reserved for only five percent of articles submitted to the journal.

A team led by the University of Delaware has received a Department of Energy grant to study the effects of adding wind power to the electric grid in the Mid-Atlantic region.

Doty’s group studies quantum dots, tiny semiconductors that can trap single electrons in a manner comparable to atoms like hydrogen and helium. Quantum dots are often referred to as “artificial atoms” because they have electronic properties similar to natural atoms.

Doty’s group explores the way these “artificial atoms” can be assembled to create “artificial molecules.” Unlike natural molecules, the properties of these quantum dot molecules can be tailored to create unique and tuneable properties for the electrons trapped in the molecules.

The first paper, entitled “*In situ tunable g factor for a single electron confined inside an InAs quantum dot molecule*,” documents a new strategy for engineering the spin properties of single confined electrons.

Doty’s team demonstrates this strategy by designing, fabricating and characterising a quantum dot molecule that allows the electron properties to be tuned with a small change in the voltage applied to the molecule. The success of the

strategy validates a new approach to engineering optoelectronic devices with dramatically improved computational power.

The second paper, entitled “*Spectroscopic signatures of many-body interactions and delocalized states in self-assembled lateral quantum dot molecules,*” describes a different molecular design, in which the two quantum dots are placed side by side instead of one on top of the other. The lateral geometry changes the way in which electrons are trapped in the molecule and creates more complex electronic molecular states.

These new electronic states of the lateral molecular design provide a template for new computing architectures that overcome scaling limits of conventional charge-based computing by mediating interactions between single confined spins.

Doty’s work with quantum dot molecules is supported, in part, through funding from the National Science Foundation, which awarded him the prestigious Faculty Early Career Development Award in 2009. The highly competitive NSF Career Award is bestowed on researchers deemed most likely to become the academic leaders of the 21st century.

Doty, who joined the UD faculty in 2007, previously served as a National Research Council research associate at the Naval Research Laboratory after earning his bachelor’s degree in physics from Pennsylvania State University and his doctoral degree in physics at the University of California, Santa Barbara.

EuroPIC announces session on photonic integration platforms

Integration of multiple optical functionalities on a single chip is now a principal direction for industry growth and development in optics and photonics.

The EuroPIC project has today launched a call for presentations on optical integration platforms at a special session of the European Conference on Integrated Optics to be held in Barcelona, Spain: 18-20 April 2012.

Integration platforms, involving design, simulation, and manufacture using a foundry approach, are a cost-effective pathway to photonic chips with increased functionality and performance, often specific to a particular application. Such platforms are currently being developed for Silicon (www.helios-project.eu) and Indium Phosphide (www.europic.org), and there is interest in the development of a platform for Gallium Arsenide based circuits, as well.

Of particular interest in this session are presentations on:

1. Beyond the state-of-the-art results
2. Prospects for the combination of both Silicon and Compound semiconductors on the same platform
3. Software tools for integrated design, simulation of processing and performance.

Proposal for participation in this session is a one-step process. Prospective authors should indicate their preference to make a presentation in the Integration Platform Session by noting this after the presentation title in their submission. All the details for submission are given on the conference site: www.ecio2012.com/paper-submission. The deadline for submissions is 2 February 2012.

About EuroPIC: EuroPIC is a consortium of experts including Europe’s key players, consisting of a mix of SMEs, industry and academic partners, in the fields of component manufacturing, PIC design and applications, photonic CAD, and packaging. It facilitates access to fabrication of advanced but very cost effective Photonic Integrated circuits. (www.europic.org)

About EPIC: With 80 voting members and over 400 associate members, EPIC is Europe’s leading photonics industry association. EPIC promotes sustainable development for European organisations working in photonics. Working together, EPIC members have played a leading role in creating and operating the European Technology Platform, Photonics-21, as well as many influential European projects, such as LIFT for fibre laser development, and Nexpresso which supports commercial innovation by SMEs. (www.epic-assoc.com)

WIN Semiconductors named 2011 Foundry Supplier of the Year Award by M/A-COM

M/A-COM Technology Solutions, a supplier of high performance analog semiconductor solutions, announced today that it has honoured WIN Semiconductors Corporation with its Foundry Supplier of the Year Award for 2011.

WIN Semiconductors provides M/A-COM Tech with market leading GaAs MMIC foundry services across a broad range of HBT and pHEMT technologies. The superior level of support and comprehensive technology portfolio provided by WIN Semiconductors' advanced foundry services has facilitated M/A-COM Tech's development and introduction of new products in many of its markets. This award recognizes WIN Semiconductors for its outstanding performance in quality and service, technology development, and strategic collaboration.

"WIN Semiconductors is one of our most trusted suppliers. Our close collaboration with WIN enhances the performance and quality of our products and greatly reduces time to market," said Bob Donahue, Chief Operating Officer of M/A-COM Tech. "We thank WIN for its continued dedication to high quality, fast cycle times, and collaborative engagement with our team."

Yu-Chi Wang, Chief Executive Officer of WIN Semiconductors, stated, "It is a great honour to receive this award. Our successful foundry relationship with M/A-COM Tech is a testament to our commitment to provide WIN's customers with superior foundry services that leverage the best possible technology for their products."

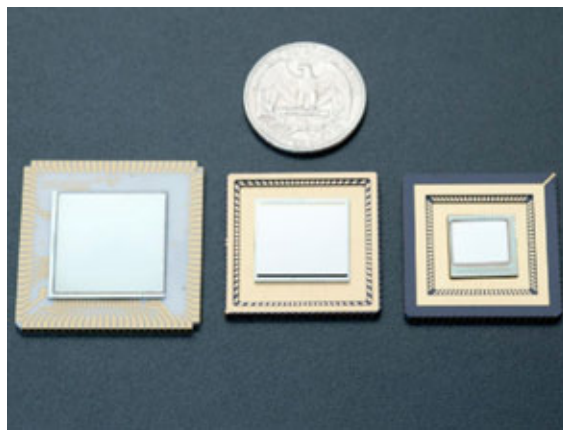
Dennis Chen, Chairman of WIN Semiconductors, added, "We are proud to accept this award from M/A-COM Tech, who has been an outstanding customer for many years. We continually strive to advance our foundry services and look forward to continually exceed their expectations in the future."

NASA develops new compound semiconductor game-changing technology

Two NASA California centres have been selected to develop new space-aged technologies that could change the way we look at planets from above and how we safely transport robots or humans through space and bring them safely back to Earth.

NASA's Jet Propulsion Laboratory in Pasadena, California, will use advanced compound semiconductor materials to develop new technologies for the High Operating Temperature Infrared Sensor Demonstration.

The higher the temperature at which an infrared detector can operate, the less power is required to cool it. Reduced power needs can translate into operational cost and system weight savings. If successful, this sensor technology could be used in many future NASA Earth and planetary science instruments, as well as for U.S. commercial and defence applications.



Three High Operating Temperature Infrared Sensors, mounted on leadless chip carriers, fabricated in the Microdevices Laboratory at NASA's Jet Propulsion Laboratory, Pasadena, California. From left to right, a 1,024 x 1,024 pixel sensor, 640 x 512 pixel sensor and a 320 x 256 pixel sensor. The quarter is for size comparison. (Image credit: NASA/JPL-Caltech)

«The technology demonstration effort is different in the fact that we're focused on affordability

concurrently with performance,» said Sarath Gunapala of JPL, who is project manager for the High Operating Temperature Infrared Sensor Demonstration. «This technology has excellent potential for transitioning from laboratory demonstration to NASA and commercial product lines.»

The overall goal for this technology development effort is to achieve 100 percent cost savings as compared with traditional cryogenically cooled infrared sensors. The weight and volume savings allow for more compact instruments - an important consideration for a spacecraft's payload size and cost. This state-of-the-art technology also will have spinoff applications for commercial instrument manufacturers.

Seeking to radically change the way heat shields protect spacecraft during atmospheric entry, NASA's Ames Research Centre at Moffett Field, Calif., is developing the Woven Thermal Protection System. The project is a revolutionary approach to thermal protection system design and manufacturing for extreme environments. Ames is the lead centre for the project, partnering with NASA's Langley Research Centre in Hampton, Va.

Partnering with the U.S. textile industry, NASA is employing an advanced, three-dimensional weaving approach in the design and manufacture of thermal protection systems. Today, lightweight aircraft parts are being manufactured using similar weaving technologies. This will be expanded to include spacecraft heatshield applications. The system will enhance performance using advanced design tools with cost savings from a shortened product development and testing cycle.

“Woven TPS has the potential to significantly impact future NASA missions by changing heat shield development from a challenge to be overcome into a mission-enabling component,” said NASA Langley's Ethiraj Venkatapathy, principal investigator of the project. “By delivering improved heat shield performance and affordability, this technology will impact all future exploration missions, from the robotic science missions to Mars, Venus and Saturn to the next generation of human missions.”

NASA's Game-Changing Technology Division focuses on maturing advanced space technologies that may lead to entirely new approaches for

the agency's future space missions while finding solutions to significant national needs. NASA Langley oversees project management of the Game Changing Technology programs.

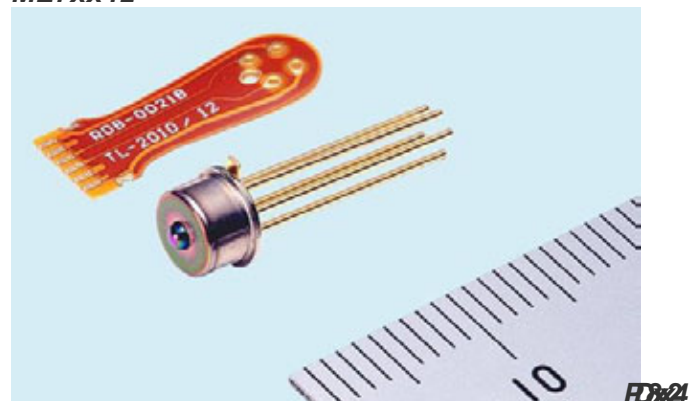
Mitsubishi Electric launches DFB & APDs for 10G-EPON networks

The DFB-LD, which incorporates an aluminium indium gallium arsenide active layer and the APD featuring an aluminium indium arsenide (AlInAs) multiplication layer will contribute to simpler networks and faster broadband service.

Mitsubishi Electric Corporation is launching a distributed feedback laser diode (DFB-LD) (ML7xx42) and an avalanche photodiode (APD) (PD8xx24) suitable for the optical network units (ONU) of symmetric 10 gigabit Ethernet passive optical networks (10G-EPON). The ML7xx42 and PD8xx24 both will launch commercially on November 30, 2011.



ML7xx42



While current fibre to the home (FTTH) services are mainly based on 1 Gbps gigabit Ethernet passive optical networks (GE-PON), symmetric 10G-EPON offering 10 Gbps upstream and downstream performance are expected to be commercialised soon. However, 10G-EPON are simple networks that use optical couplers and require high-power DFB-LD and high-sensitivity APD due to optical loss in the couplers. Mitsubishi Electric's new high-power, low-current DFB-LD and high-sensitivity APD are both suitable for symmetric 10G-EPON ONUs and thereby will contribute to network simplification and faster broadband service. The high-power, low operating current DFB-LD, which has an AlGaInAs active layer, offers 10 Gbps high-speed performance due to improved modulation bandwidth. It can operate at 10 mW output power despite low operating current in high-temperature conditions. The TO-CAN APD featuring an AlInAs multiplication layer has a typical top-level sensitivity of 31.5dBm, low-noise and a new high-frequency circuit board with suppressed noise output.

Further specifications of the products are below:

DFB-LD ML7

xx42

APD

PD8xx24 φ4.8mm TO-CAN package
 φ5.4mm TO-CAN package
 Aspherical lens cap with high coupling efficiency
 Products with ball lens cap
 Light emission peak wavelength: 1,270nm
 Wavelength band: 1,570nm
 Output power: 10mW
 Minimum sensitivity: -31.5dBm (typ.*2)
 Operating current: ≤70mA
 APD responsivity: 0.8A/W (typ.*2)
 Operating temperatures: -5°C to 75°C
 Bandwidth: 6.5GHz (typ.*3)
 Coupling efficiency: 60%*1 (typ.*2)

- *1 ML767T42 with aspherical lens.
- *2 Typical value, not guaranteed.
- *3 Typical value at multiplication factor M=10.

Oclaro expands high bit rate transponder portfolio

The firm says its latest transponders leverage its history in delivering coherent solutions, its competencies in indium phosphide and lithium niobate (LiNbO3) material technologies, its vertical integration in optical components, and its production and application expertise.

Oclaro, an has further strengthened its coherent product portfolio with the introduction of the MI 8000XM, a high-performing, low-power 100 Gbps MSA-compliant coherent transponder module.

The MI 8000XM is the second member of the Oclaro coherent transponder family, joining the MI 5000XM 40 Gbps coherent module, which is currently shipping in volume.

Both the new 100 Gbps and the current 40 Gbps modules employ a PM-QPSK modulation format combined with coherent detection. Coherent detection, the leading technology for enabling 100 Gbps and higher optical transmission, delivers the scalability and flexibility needed for transmitting more bandwidth cost-efficiently over fibre optic networks.

Complementing this family, Oclaro also has an established leadership position in the high bit rate direct detection transponder market with 40 Gbps transponders providing DPSK and DQPSK modulation formats with volume shipments that started in 2007. Oclaro also provides a full range of the optical components necessary to implement complete transponder solutions.

By providing customers with both coherent and direct detection module families and the key associated components, Oclaro enables network equipment manufacturers to develop market-leading, cost effective transponders for both new next-generation network implementations as well as upgrades on existing networks.

“Following on the success of our 40 Gbps transponders, the 100 Gbps MI 8000XM leverages Oclaro’s expertise in module design combined with a deep understanding of high bit rate propagation challenges in optical fibre networks,” said Terry Unter, President and General Manager of the

Oclaro Optical Networks Solutions Business Unit. "The MI 8000XM transponder integrates the latest generation DSP with an advanced control and management implementation to deliver state-of-the-art performance in a module that is easy for our customers to integrate into their network equipment."

"Merchant coherent transponders are critical for mass deployment of 100 Gbps DWDM systems," said Ron Kline, Principal Analyst at Ovum. "We continue to see strong growth of coherent technology for both 40G and 100G applications. The availability of standardised modules will help lower system costs and increase market competitiveness of vendors offering high-capacity bandwidth solutions."

The MI 8000XM fully complies with the OIF 100 Gbps MSA Implementation Agreement including specifications on power consumption. This transponder employs an advanced low-power digital signal processor large-scale integrated (DSP-LSI) circuit supplied by NEL (NTT Electronics Corporation). The DSP-LSI was an outcome of the "R&D on High Speed Optical Transport System Technologies" project, which was supported by the Ministry of Internal Affairs and Communications of Japan.

The DSP offers correction of chromatic dispersion as well as polarization mode dispersion, which enables the transponder module to adapt automatically to the dispersion properties of a wide range of new and existing optical networks. The inclusion of soft-decision forward error correction (SD-FEC) further broadens the application space for the MI 8000XM 100 Gbps transponder module.

The new MI 8000XM transponder module is targeted at optical network solutions from metro through ultra-long haul, including submarine networks to support the growth of bandwidth intensive services such as video, cloud computing, and wireless broadband data services. The automatic chromatic dispersion and polarization mode dispersion compensation properties make this module particularly well suited for the next generation optical network architecture with extensive optical routing and richer mesh network topologies.

High spectral as well as physical density, the latter

enabled by reduced power dissipation, are key characteristics for deployment in those networks, which will serve to meet the ever-increasing bandwidth demands over the coming years.

The MI 8000XM 100 Gbps coherent module is scheduled to start shipping in April 2012.

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be "An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program."

Defining the next steps for the Compound Semiconductor Industry

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix of quality speakers making it the must attend industry event for 2012.

The CS Europe 2012 Conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip

Smallwood, Lighting Market Analyst, IMS Research

- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
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12th March 2012 pm & 13th March - full day : “CS Europe 2012: LEDs, lasers, PV and electronics Conference”

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- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree
- Ammono’s ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.
- Tomorrow’s RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors

- Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

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- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

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- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

- GaN the enabler for true SDR- Professor Rik Jos, NXP

- Holistic Approach to MOCVD vacuum & Abatement - Mike Czerniak, EdwardsVacuum Ltd

- Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning

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- Damage - free Deposition on LED devices –Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Finisar to exhibit its Quadwire FDR active optical cables

The firm will showcase its latest technologies, many of which incorporate III-V europ, at the Supercomputing 2011 conference this week in Seattle.

Finisar Corporation, a provider of active cables that accelerate storage, networking, and high-performance computing connectivity, has announced the commercial availability of its Quadwire FDR active optical cable.

The Quadwire FDR cable provides high-bandwidth performance with 4 lanes at 14 Gb/s per lane in a standard QSFP+ form factor and is ideally suited for InfiniBand 4xFDR and 4x16x Fibre Channel applications. Finisar will provide a live Quadwire FDR cable demonstration and display its complete portfolio of active cable products at booth #2634 at the 24th annual SC Conference 2011 this week in Seattle, Washington.

As the speed of supercomputing clusters continues to accelerate, the High Performance Computing (HPC) and Datacentre markets demand higher speed VCSEL technology to provide this next level of data throughput. The FDR active optical cables are compact, lightweight and flexible to support very high-density deployments.

“The commercial availability of our Quadwire FDR cable illustrates our strong commitment to providing leading InfiniBand cable technology in the growing HPC and Datacentre markets,” said Steffen Koehler, Product Line Manager at Finisar. “Leveraging our unmatched expertise and vertical integration in optics technology we provide active optical cable solutions that address bandwidth and link-distance challenges that cannot be supported by existing copper cables.”

At SC’11, Finisar will also display its complete family of active cables including Laserwire for 10GbE, Quadwire for 40GbE and InfiniBand QDR, and C.wire for 100GbE and InfiniBand QDR. Finisar will be at booth #2634 and will exhibit how it exploits fibre optic technology to decrease weight and power consumption while improving the density and reach

of data transmission relative to traditional copper solutions.

Senior executive Thomas Shields resigns from Anadigics

Terrence Gallagher, will take over the positions of Vice President and Chief Financial Officer and hopes to help the business return to profitability.

Anadigics has announced that Thomas Shields had resigned from the positions of Chief Operating Officer, Executive Vice President, Chief Financial Officer and Secretary.

The resignation, which became effective November 14, 2011 will see the semiconductor veteran pursue career advancement opportunities outside of Anadigics.

Terrence Gallagher, who had served as Vice President, Finance and Controller, has been promoted to the positions of Vice President and Chief Financial Officer. Shields has agreed to provide consulting services to the company for a period of time to ensure an orderly transition of all of his current responsibilities.

Ron Michels, Chief Executive Officer, said “Tom advised me today that he is resigning his position at Anadigics to pursue career advancement opportunities outside of Anadigics. I understand and appreciate Tom’s desire to advance his career. He has been instrumental in helping me transition from my previous role to my current Chief Executive Officer role. I would like to thank him for his assistance in that regard as well as for his many years of service and contributions to Anadigics.”

Tom Shields added, “I have great respect and fondness for Anadigics, its shareholders, Board of Directors, and employees. I want to thank all of you for being part of my life, and for allowing me to be part of yours, for the past twelve years. Ron and the Anadigics team have accomplished a great deal in a short period of time. I will miss the team greatly, and I am quite confident in the future of Anadigics.”

Ron Michels said, "I have worked with Terry for many years. He is a seasoned semiconductor industry veteran with an outstanding knowledge of both Finance and the Anadigics business. He will be an outstanding addition to Anadigics' senior leadership team. I am confident that the breadth and depth of Terry's financial experience will enable him to make very meaningful contributions as we maintain our focus on a product leadership strategy that delivers improved financial performance as quickly as possible."

Terry Gallagher added "On behalf of our shareholders, I am committed to working closely with the entire Anadigics management team to return our business to profitability."

Emcore ramps up production of 56 Gbps computing cables

The provider of compound semiconductor-based components has gone into volume production of its fibre optic cables for use in high-performance computing, ethernet router and switch applications.

Emcore Corporation has ramped up to full-scale production of its 56 Gigabits per second (Gbps) Fourteen Data Rate (FDR) active optical cables.



Emcore high-performance 56 Gbps active optical cable

The 56 Gbps FDR cable is the latest in the Emcore Connects Cables line of high-speed active optical cables produced at Emcore's contract manufacturing facility in China. Emcore says it is the first manufacturer in full-scale production of 56 Gbps FDR active optical cables.

Designed for high-performance computers, telecommunication routers, storage networks, and grid and cloud computing systems, Emcore's 56

Gbps FDR active optical cables provide the highest aggregated level of data throughput in a compact, lightweight form factor capable of supporting the bandwidth needs of these advanced systems.

Each 56 Gbps FDR cable has four 14 Gbps lanes in each direction. These lanes support InfiniBand FDR data rates and will also run at lower data rates to support 40, 20 and 10 Gbps, as well as 40 Gigabit Ethernet Quad Small Form-factor installations.

"Emcore is the industry leader in active optical cable sales. Our 40 Gbps Quad Data Rate cables are currently deployed in two of the top five supercomputers in the world," commented Jaime Reloj, Emcore's Vice President of Business Development.

"By leveraging our next-generation Vertical Cavity Surface Emitting Lasers (VCSEL) and photodetectors, we will continue to advance the technology for high-performance computing applications and demonstrate the same quality, reliability, on-time delivery and competitive pricing our customers have come to expect," concluded Reloj.

5,000 ARC-231 radio systems in the field

Raytheon has achieved a major milestone in its ARC-231 radio program, fielding the 5,000th ARC-231 radio system.

ARC-231 is part of the Fire Series multi-band, multi-mode radio product line. In addition to being standard in all U.S. Army Aviation aircrafts, it is also in use on several U.S. Air Force and international aircrafts.

Recently, Raytheon was selected to modernise the ARC-231 program under the Mobile User Objective System (MUOS) waveform, as well as modernising the cryptographic system of the radio, which will extend the service life of the ARC-231 beyond 2030. The contract was awarded through the U.S. Army Communications-Electronics Command on behalf of the end-user, U.S. Army Aviation.

"Raytheon has a great opportunity to provide readily available, high-performance, high-quality products

at competitive prices,” said David Patton, ARC-231 program manager for Raytheon Network Centric Systems. “The upgrade applies 3G technologies similar to current cell phones as a way to reduce size, weight and power of radio communication terminals used by the war fighters.”

To support MUOS, the ARC-231 radio system will be redesigned to provide full duplex RF communications and cryptographic modernization, while being fully backward interchangeable with the existing radio. Raytheon will leverage common airborne and ground radio solutions to improve life-cycle costs and joint mission success due to the equipment’s inherent interoperability.

“Raytheon’s ARC-231 radio upgrade was chosen because of its ability to implement these new features with minimal impact to aircraft,” Patton added.

GigOptix now ISO 9001:2008 certified

The firm says this marks the integration of its various teams, including ChipX and Endwave subsidiaries, under a single Quality Management System.

GigOptix, a fabless supplier of semiconductor and optical components that enable high-speed information streaming, has achieved the International Organisation for Standardisations’ (ISO) 9001:2008 certification, for its corporate headquarters located in San Jose, California.

The firm says this demonstrates and organisation’s commitment to quality-of-service standards. The voluntary certification assures customers of GigOptix’s adherence to documented processes and procedures that ensure continued and ongoing improvements in delivering high-quality product and outstanding customer satisfaction.

Julie Tipton, Senior Vice President of Operations at GigOptix stated, “While our international office in Zurich, Switzerland plus our ChipX and Endwave subsidiaries have been certified for some time, this milestone marks the integration of our various teams under a single Quality Management System. Achieving ISO certification is a cornerstone of

our focus on delivering quality products to our customers and a platform for driving constant improvement in our processes to ensure customer satisfaction so that we can continue our rapid growth. “

The ISO 9001:2008 standard specifies Quality Management System (QMS) requirements focused on an organisation’s ability to meet and improve upon product quality requirements and customer satisfaction. As part of the certification process, GigOptix established a new QMS to ensure the continued its longstanding commitment to high-quality and high-reliability products.

By identifying areas for improvement, creating recommendations to resolve identified gaps, and executing against these recommendations, GigOptix is ensuring that it has the global processes necessary to consistently improve product quality on a regular, quantifiable, and demonstrable basis.

Efficiently extract photons from GaAs QDs directly into an optical fibre

The new approach means that an optical fibre taper waveguide captures some of the larger fraction of the gallium arsenide quantum dot’s emission which is trapped in the compound semiconductor.

Researchers from the NIST Centre for Nanoscale Science and Technology have led the development of a new technique for efficiently out-coupling photons from epitaxially-grown quantum dots directly into a standard single-mode optical fibre.

Single epitaxially-grown semiconductor quantum dots are potentially bright and stable sources of “on-demand” single photons for many applications in quantum information processing and communications. However, because these quantum dots are embedded in a high-refractive index semiconductor, total internal reflection limits the photon flux escaping the semiconductor to a small fraction (< 1 %) of the original emitted light.

The team of researchers from NIST, the University of Maryland, the University of Regensburg, and the University of Rochester has developed an

approach that circumvents this limitation, resulting in a collection efficiency of 6 % into a single-mode optical fibre, with broadband spectral operation over tens of nanometres. Each quantum dot is embedded in a suspended GaAs channel waveguide with a width and thickness of about 200 nm and a length of a few micrometres.

Rather than collecting the small amount of emission from a selected quantum dot that escapes this waveguide vertically into free-space, an optical fibre taper waveguide captures some of the larger fraction of that quantum dot's emission which is trapped in the semiconductor. The taper waveguide is a standard 125 µm-diameter, single mode optical fibre that is gradually tapered to a diameter of about 1 µm along an approximately 1 cm-long section.

The two waveguides form a directional coupler, a common device used in lightwave systems to transfer power between adjacent waveguides through evanescent coupling. Photon correlation measurements confirm the single photon nature of the out-coupled quantum dot emission. By using single mode optical fibres typical to lightwave systems, the new technique is designed to be compatible with many quantum information processing applications. Finally, detailed simulations predict that the collection efficiency can be improved by an additional factor of 5 if the location of the quantum dot can be precisely controlled.

Further details of this work have been published in the paper, "Efficient quantum dot single photon extraction into an optical fiber using a nanophotonic directional coupler" by Davanço *et al*, *Applied Physics Letters*, 99, 121101 (2011).

NeoPhotonics bags Huawei Golden Supplier Award

At the Core Partner Convention, the firm was honoured for its modules for high speed 40G and 100G systems.

NeoPhotonics Corporation, a designer and manufacturer of photonic integrated circuit (PIC), based modules and subsystems for bandwidth-intensive, high speed communications networks, has received the prestigious Golden Award as an

Excellent Core Partner from Huawei Technologies, a leading provider of telecommunications network solutions.

At an awards ceremony at Huawei's corporate headquarters in Shenzhen, NeoPhotonics was honoured for its contributions as a supplier of innovative technology, plus high-quality and on-time delivery of its optical products for high-speed, agile and access communications networks. NeoPhotonics Chairman and CEO Tim Jenks attended the event.

Of the more than one thousand suppliers that Huawei works with each year, the award is given only to companies that consistently deliver the highest performance and quality products that meet Huawei's highly specialized requirements. Out of 30 vendors of optical products, Huawei selected six as Core Partners, and, out of the six, four, including NeoPhotonics, were given the Golden Award for supplier excellence. This is the third time that NeoPhotonics has been recognised as a Huawei Core Partner.

«We are honoured that Huawei chose NeoPhotonics to win this prestigious Supplier Award,» said Tim Jenks, CEO of NeoPhotonics. «We are proud that NeoPhotonics has been integral to the success of Huawei, just as Huawei has been pivotal to the success of NeoPhotonics. We believe that we provide the highest value to our customers by not only delivering high-performance and high-quality products, but also by working seamlessly with our customers, leveraging our engineering strength, supply chain systems, and collaborative working relationships to anticipate their needs. This recognition by Huawei is a testament to the high quality products and volume manufacturing capabilities of NeoPhotonics.»

TeliaSonera uses Infinera's InP PICs to break barriers

The firms have successfully completed, what they say, is the world's first Terabit optical transmission based on 500 Gigabit per second (Gb/s) super-channels using indium phosphide based devices.

The demonstration spanned 1,105 kilometres of fibre between Los Angeles and San Jose,

California, marking a milestone in optical networking and offering a glimpse of what the network will be. The trial was conducted with elements of the new Infinera DTN-X platform and demonstrated twice the capacity of previous trials by adding a Terabit of capacity to a route carrying 300 Gb/s of production capacity.

“Our vision is to offer customers leading-edge services that efficiently scale their business. As 10 Gb/s services proliferate and 100 Gb/s router ports emerge, we are trialling advanced solutions that scale optical networks beyond 100 Gb/s,” said Erik Hallberg, President at TeliaSonera International Carrier. “This Terabit demonstration with Infinera highlights our commitment to delivering an outstanding experience for the most demanding customers.”

“We are delighted to work with TeliaSonera International Carrier to validate the 500 Gb/s super-channel implementation that is the foundation of this Terabit demonstration,” said Tom Fallon, CEO of Infinera. “We share a common vision of delivering the scale, simplicity and agility needed to win in a highly competitive environment.”

Infinera is a pioneer in the field of super-channels, and one of the first to demonstrate super-channels based on 500 Gb/s photonic integrated circuits (PICs). A super-channel is a large unit of optical capacity created by combining multiple optical carriers into a single managed entity, so that optical networks can scale capacity without scaling operational cost and complexity.

Super-channels based on PICs enable operators to simply provision 500 Gb/s of capacity with a single operational maneuver. Infinera’s DTN platform, ATN platform and Infinera Managed Services are elements of Infinera’s portfolio as well as the recently announced DTN-X packet optical transport network platform that supports 500 Gb/s super-channels.

TeliaSonera International Carrier is part of Europe’s 5th largest telecommunications group, TeliaSonera, with 164 million subscribers generating revenues of over \$11 billion. The company continues to expand the North American footprint of their global network, driven by strong demand from both operators and content players for IP, DWDM, voice and specialist-mobile services.

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

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- An Overview of the DARPA Diverse Accessible

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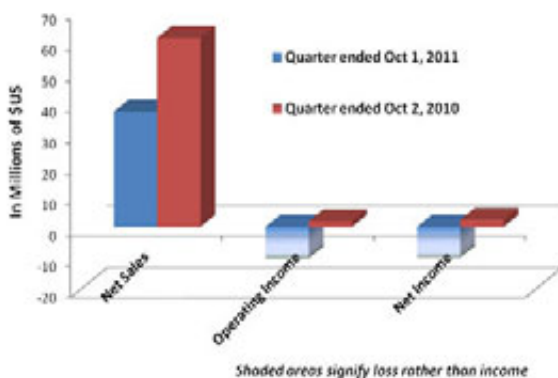
Dwindling WiMAX demand causes Anadigics' revenues to crash 39%

The provider of gallium arsenide based products in the broadband communications market did however see a sequential increase of 4.7% driven by increased sales to key wireless OEMs.

Anadigics has reported third quarter 2011 net sales of \$37.3 million.

This represents a sequential increase of 4.7% and a decrease of 39.2% from the third quarter of 2010. For the first nine months ended October 1, 2011, net sales were \$116.3 million, a decrease of 25.7% over the prior year. GAAP net loss for the third quarter of 2011 was \$10.0 million, or (\$0.15) per share.

GAAP Financial Results for Q3 2011 and 2010



As of October 1, 2011, cash, cash equivalents and short and long-term marketable securities totalled \$100.6 million compared with \$103.4 million at July 2, 2011.

Ron Michels, President and Chief Executive Officer commented, "Our revenue increased 4.7% sequentially driven by increased sales at key wireless OEMs, and we continued to make notable progress with the largest reference design partner on next generation product development. Additionally, we are expanding our served available market with new product introductions, including PADs, MMPAs and dual band PAs, which will be the driving force behind our future growth. I remain confident in our current strategy and I want to emphasise our commitment to re-establishing Anadigics as a technology leader in our industry."

Maryland Broadband selects Infinera InP PICs

The firm's indium phosphide optical networks will be deployed statewide and should increase competitiveness for businesses in Maryland.

Infinera and the Maryland Broadband Cooperative have announced the launch of a statewide optical transport network built with Infinera's regional DTN and metro ATN platforms.

Maryland Broadband says it chose Infinera because of the simplicity, scalability and efficiency of Infinera's solution.

The Maryland Broadband Cooperative is an open-access, middle-mile fibre provider, offering its members high-capacity synchronous optical network, Ethernet and Internet services. Spanning more than 1,300 miles, Maryland Broadband's network will enable service providers to offer high speed broadband services to businesses, healthcare facilities, educational institutions, public safety offices and residents in rural Maryland.

"Maryland Broadband Cooperative was created to contribute to the quality of life of rural Maryland and spur economic development by providing cost effective high speed internet services to underserved regions," said Patrick Mitchell, President & CEO of Maryland Broadband.

"We looked at all the market leaders and Infinera's solutions made the most sense - it's reliable, simple to deploy and manage, and scalable to meet future growth in our network," he continued.

"This is a great private-public partnership and I am excited Maryland Broadband Cooperative selected Infinera for this network," added Peter Franchot, Comptroller, State of Maryland. "This network is important to the state in promoting economic development through the deployment of cutting edge technologies that improves communications and broadband access to rural areas of Maryland."

"We are delighted to partner with the Maryland Broadband Cooperative on this project to bring broadband services to underserved communities," said Tom Fallon, Infinera CEO. "Infinera's DTN and ATN platforms enable scalable, simple and efficient

regional and metro networks.”

Maryland Broadband’s deployment of Infinera’s DTN and ATN platforms through Infinera Managed Services provides their members with a state-of-the-art network that is easy to operate.

The Infinera DTN platform, powered by InP photonic integrated circuits (PICs), is designed to scale up to 6.4 Tb/s of transmission capacity per fibre. The Infinera ATN, a scalable WDM transport platform with multi-service aggregation, brings the intelligence of the Infinera Digital Optical Network to the metro edge.

Infinera’s DTN platform, ATN platform and Infinera Managed Services are elements of the Infinera product portfolio that includes the recently announced DTN-X packet optical transport network platform with 500 Gb/s FlexCoherent super-channels.

Infinera revenues to drop 5-15% due to Thailand floods

Factors affecting the size of the loss include the firm’s ability to move production to other locations, incrementally increase production at other facilities, and utilise existing inventory to meet customers’ needs.

Infinera has announced that flooding in Thailand is impacting the operations of component and service suppliers to the optical industry. Fabrinet, one of Infinera’s contract manufacturers, reported this week a significant escalation of the impact of the flooding on its facilities in Thailand.

«Our thoughts and prayers are with our partners and their families in Thailand as they deal with this disaster,» said Tom Fallon, CEO of Infinera.

Infinera is executing business continuity contingency plans using existing inventory and moving to alternate contract manufacturers and second sources. However it will probably not be possible to transition all components and subsystems quickly enough to avoid some supply chain disruption. Infinera’s priority is to invest the necessary resources to minimise the number of customers affected and to limit any impact on their

operations.

Infinera is still assessing the full extent of the impact on its financial results for the current and future quarters. Based on the information available at this time, Infinera currently estimates the potential negative impact to its December quarter guidance to be in the range of 5-15% of revenues.

Factors affecting the size of the revenue loss include, but are not limited to, Infinera’s ability to move production to other locations, incrementally increase production at other facilities, and utilise existing inventory to meet customers’ needs.

Additional factors that may affect the size of the revenue loss include the level of demand from customers for the affected products, the level of competition for alternative sources for relevant components and the ultimate extent of the damage caused by the flooding.

Smartphone Purchases Soften in the Q3

The worldwide mobile phone market grew 12.8% year over year in the third quarter of 2011 (3Q11), as smartphone growth declined in key mature markets. According to the International Data Corporation (IDC) Worldwide Mobile Phone Tracker, vendors shipped 393.7 million units in 3Q11 compared to 348.9 million units in the third quarter of 2010. However, the 12.8% growth was higher than IDC’s forecast of 9.3% for the quarter and stronger than the 9.8% growth in 2Q11.

It was also the second-lowest growth rate for the overall mobile phone market over the past two years; a reflection of delayed smartphone purchases and conservative consumer spending last quarter. Economically mature regions, such as the United States and Western Europe, were hardest hit as shipment volume to both regions declined on a year-over-year basis.

“The combination of economic uncertainty and anticipation over fourth quarter or late third quarter product releases caused some consumers to delay their smartphone purchases,» said Kevin Restivo, senior research analyst with IDC’s Worldwide Mobile Phone Tracker. “Many waited for products such as the iPhone 4S, which was announced

after the quarter closed, or Research In Motion's BlackBerry 7 phone series, which were released in the final weeks of the quarter."

However, smartphones drive the overall mobile phone market and will continue to do so in the quarters and years to come.

"Smartphone centrality continues to be the hallmark of the mobile phone market," says Ramon Llamas, senior research analyst with IDC's Mobile Phone Technology and Trends team. "Two years ago, smartphones comprised just a small portion of overall shipments among the leading vendors. Today, that proportion has grown considerably, thanks in large part to LG, Motorola, Samsung, and Sony Ericsson making Android smartphones a priority. At the same time, the growing presence of companies focused exclusively on the smartphone market - Apple, HTC, and RIM - also demonstrate the impact that smartphones have had on the mobile phone market as a whole."

Regional Analysis

- In Asia/Pacific (excluding Japan) (APeJ), feature phones recovered in the third quarter on the back of Nokia's resolved inventory channel issues in China combined with the strong showing of its dual-SIM handsets across emerging markets like India and Southeast Asia. With Nokia fighting back at the Chinese low-end competitors, the proliferation of these smaller brands has slowed as margins hit razor-thin levels. APeJ smartphone growth last quarter was driven primarily by Samsung and HTC, as well as ZTE in China. In Japan, the market rebounded sharply after two quarters of either low single-digit growth or outright market decline following the natural disasters of this spring.

- The Western European phone market declined as a result of lower demand for both feature phones and smartphones. The smartphone device type growth was mainly driven by mid-tier Android devices. High-end smartphone growth was negatively impacted by Apple's fourth-quarter iPhone 4S launch, which caused consumers to delay purchases. Meanwhile, Nokia's transition from the Symbian to the Windows Phone operating system as its primary smartphone platform led to a transition. Feature phones declined as consumers that replaced their devices upgraded to smartphones while others held on to their devices

for longer periods of time. Overall the Central Europe, Middle East and Africa (CEMA) markets showed strong growth due in large part to Nokia's rebound in the regions. Bucking its global troubles, Nokia had a very strong 3Q11 due to feature phone growth. Its smartphone decline continued, however, but it remained the market leader in the region. Among the niche smartphone brands, HTC did particularly well in some markets, including Russia. RIM continues to make progress in the Middle East and Africa, but fared less well in Central and Eastern Europe.

- In North America, new iPhone demand went unfulfilled during 3Q11, leaving the door open for other companies to launch their competing devices. Research In Motion, which had not introduced a new BlackBerry smartphone during the entire first half of 2011, debuted several new models running on the new BB OS7 platform. Similarly, LG, Motorola, and Samsung unveiled their own respective Android flagship models, keeping the Android platform front and center in the smartphone market.

- The Latin America market growth was driven by smartphones though some users delayed purchases in anticipation of new hero device launches in the region. However, more touchscreen smartphones hit the market as vendors seek to broaden the appeal of smartphones to users. Meanwhile, Greater China vendors released new high-end devices in an attempt to grow market share in the region.

Top Five Mobile Phone Vendors

Nokia reversed a global market share on a sequential basis last quarter thanks to stronger feature phone sales in key regions as well as the clearing of inventory backlogs in traditional strongholds, namely China and Europe, which led to a sharp year-over-year shipment and share decline last quarter. Nokia's smartphone fortunes could improve in quarters to come now that it has introduced the Nokia Lumia devices, powered by Windows Phone 7, to markets where its brand is still relatively strong and in areas where the company has lost share over the past two years.

Samsung registered double-digit growth compared to the third quarter a year ago and also outpaced the market. The company's growth was again

driven by smartphone sales, such as the Galaxy S2. Smartphone sales were notably higher in emerging markets including China. Samsung outpaced the feature phone market as well in terms of growth. The vendor didn't close the market share gap on Nokia for the top mobile phone position, but it remains within striking distance.

LG Electronics maintained its position as the number 3 mobile vendor worldwide for the twelfth quarter in a row, but continued soft demand for both its feature phones and smartphones led to volume levels not seen since 2Q 2007. With only a few new devices launched and an aging feature phone portfolio, LG's warnings of lower year-over-year shipment volume appears to have come to fruition. By the end of the year, LG's grasp on the number 3 position may be loosened as Apple's aggressive smartphone campaign takes hold in 4Q 2011.

ZTE jumped into the number 4 position thanks to momentum carried into 3Q 2011 with key devices shipping into strategic regions. In China, ZTE has nearly doubled its smartphone volumes from the previous quarter, while within North America, ZTE's entry-level voice-centric phones at AT&T have gained greater depth. At the same time, ZTE's target of 12 million smartphone shipments worldwide in 2011 became more of a reality with the introduction of two new Android-powered smartphones for the North American market.

Apple gained share and posted the third-highest growth rate of any Top 5 vendor but dropped to the number 5 position globally. Global iPhone shipments declined sequentially during the same quarter that company founder Steve Jobs handed the CEO reins to Tim Cook. The decline, not coincidentally, happened as Apple readied itself for the 4S launch, which many waited for. Apple's ability to upgrade 3GS users to the 4S, for example, and make continued inroads into developing economies, where it has been less successful, will help dictate the company's smartphone fortunes in the future.

www.idc.com

Infinera revenues plummet 20%

The indium phosphide based PIC provider has reported revenues of \$104 million for the latest quarter.

Infinera Corporation, a provider of digital optical communications systems, has released financial results for the third quarter ended September 24, 2011.

GAAP revenues for the third quarter of 2011 were \$104.0 million compared to \$96.0 million in the second quarter of 2011 and \$130.1 million in the third quarter of 2010.

GAAP gross margin for the third quarter of 2011 was 39% compared to 39% in the second quarter of 2011 and 50% in the third quarter of 2010. GAAP net loss for the quarter was \$21.8 million, or \$(0.21) per share, compared to net loss of \$24.2 million, or \$(0.23) per share, in the second quarter of 2011 and net income of \$4.4 million, or \$0.04 per diluted share, in the third quarter of 2010.

"We remain encouraged by our recent revenue performance and the momentum in booking activity as customers continue to address their increased bandwidth needs with Infinera-based networks," said Tom Fallon, president and chief executive officer. "Several factors are contributing to these trends-- our significant installed base, the broader application of our product line, our expanded sales force and a stronger focus at Infinera on key vertical markets and across geographies."

Fallon noted that the company's top customer for the third quarter was one of North America's leading cable companies and that the company's pipeline remains active with opportunities in the submarine space and with wholesale carriers in North America and Europe. One of the company's Tier 1 customers was among its top five customers in Q3.

"We were also pleased with the recent launch of the DTN-X, our new multi-terabit packet optical network platform based on our third generation 500 Gb/s PICs, a pair of chips that integrate more than 600 optical functions and will deliver the world's first 500 Gb/s FlexCoherent super-channels," said Fallon.

“Customer response to the value proposition of the DTN-X—as well to the newly enhanced features of the DTN—has been very positive. The DTN-X reinforces Infinera’s position at the forefront of the innovation curve in the optical transport industry at a time when the industry requires the next step function in capability.”

Infinera hosted a conference call for analysts and investors to discuss its third quarter results and fourth quarter outlook. An archived version will be available on the website for 90 days. To hear the replay, parties in the United States and Canada should call 1-800-813-5525. International parties can access the replay at 1-203-369-3346.

Keith Barnes joins JDSU Board of Directors

The senior executive brings extensive test and measurement industry knowledge and global operations expertise that spans North America, Europe and the Asia-Pacific region.

JDSU has appointed Keith Barnes to its Board of Directors, which became effective on October 15, 2011.

“We welcome Keith to JDSU’s Board of Directors and look forward to drawing on the expertise he has built over the last 35 years as a global technology business leader,” said Martin Kaplan, chairman of JDSU’s Board of Directors. “We are particularly pleased to complement JDSU’s board with a senior executive who brings extensive test and measurement industry knowledge and global operations expertise that spans North America, Europe and the Asia-Pacific region.”

During his career, Barnes has held senior executive positions in semiconductor, manufacturing and test and measurement companies, including serving as chairman and chief executive officer for three public companies. Most recently he was chairman of Verigy, a semiconductor equipment company focused on lab and manufacturing test solutions for companies in the communications, consumer electronics, computers and memory industries.

He also served as division president of the Agilent Technologies test business which was spun out

to become Verigy. Earlier in his career, Barnes served in executive positions with Electroglas, IMS, Cadence and Kontron. He also serves on the board of Spansion and is a director of the San Jose State University Foundation Board.

“JDSU’s technology and innovation expertise has a far-reaching, positive impact on the lives of millions of people every day,” said Barnes. “I look forward to working with such an exciting company and contributing to its continued growth.”

With Keith Barnes’ election, JDSU’s board consists of 10 members, including nine independent directors.

JDSU receives 2011 customer value enhancement award

It is the second year in a row that JDSU has been honoured with the award.

JDSU has been honoured with Frost & Sullivan’s 2011 Global Customer Value Enhancement Award for helping service providers deliver high-quality broadband services.

The award recognises JDSU’s market-leading xDSL test solutions used by service providers worldwide to speed the cost-effective deployment of a key technology used to support rapidly growing volumes of video and other high-bandwidth traffic.

“JDSU is renowned for its expertise in developing innovative test solutions by closely collaborating with its customers,” said Srihari Padmanabhan, Senior Research Analyst, Frost & Sullivan. “This close collaboration results in broadband test solutions that deliver tangible value, including reduced network expenses, improved quality and more loyal subscribers.”

Frost & Sullivan noted that JDSU has a range of xDSL test equipment used to help field technicians pinpoint issues quickly and accurately before they affect subscribers. JDSU’s test solutions are capable of testing multiple services in a premise, instead of testing a single service at a time which can sometimes lead to missed critical interaction

issues in limited bandwidth environments.

JDSU addresses the global xDSL test equipment market with the JDSU SmartClass , HST, MTS/ TBERD, and QT probe product lines.

The Frost & Sullivan Customer Value Enhancement Award recognises the company that has demonstrated excellence in implementing strategies that proactively create value for its customers with a focus on improving the return on the investment that customers make in its services or products.

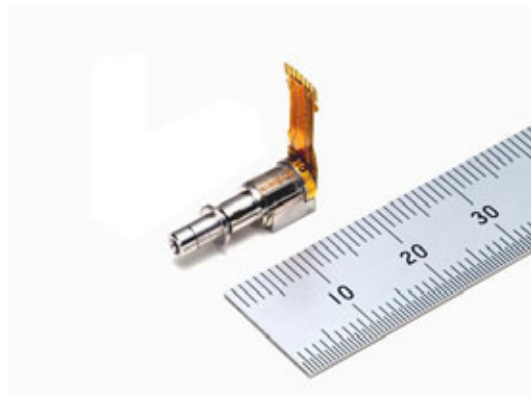
New optical transmitter module slashes power consumption by 50%

Mitsubishi Electric's compound semiconductor device emits between 1530 nm and 1565 nm.

Mitsubishi Electric Corporation has announced the coming launch of a 10 Gbps optical transmission device that cuts power consumption by 50% compared to conventional models used for high-speed large-volume data transmission between data centres.

Comprising an electro-absorption modulator laser (EML) coupled with a transmitter optical sub-assembly (TOSA), the module transmits up to a distance of 40 kilometres thanks to its high-quality signal performance. Mitsubishi Electric will commercially launch its new EML-TOSA, known as the FU-613REA, on October 31.

The module complies with the 10 Gbps Miniature Device Multi Source Agreement (XMD-MSA) and uses in CAN packaging suitable for mass production, replacing box-type packaging used in conventional models.



FU-613REA

The increasing use of high-speed, large-volume optical transmission devices at data centres accounts for the consumption of considerable amounts of electrical power, so Mitsubishi Electric's new power-saving EML-TOSA module is expected to attract considerable attention.

With a power consumption of 0.6 W, the module uses approximately 50% less than that of Mitsubishi Electric's current FU-612REA model. EML operation at high temperatures allows the thermo-electric coolers to be downsized.

The module's newly developed EML chip achieves a low power penalty (difference in power before and after transmission), high extinction ratio (optical output ratio between "on" and "off" modes) and high mask margin (standardised specification indicating performance of optical output waveform), resulting in the capability to transmit data up to 40 kilometres.

Mitsubishi Electric's CAN-type packaging is suitable for mass production, With light emission at a central wavelength between 1530 nm and 1565 nm, the device has an output power of -2 to +2 dBm. The operating temperature range is -5 to 85 degrees C and the power penalty after 40 km transmission is less than 1.0 dB (typ.). The extinction ratio is more than 10 dB (typ.) and the mask margin is more than 20% (typ.)

GaAs device revenue to reach \$6.4 billion in 2015

Mobile trends have increased gallium arsenide revenues by 34 percent in 2010 to \$5 billion and

this surge is set to continue.

As consumers continue to embrace mobile data applications, operators are expanding wireless networks and developing new mobile devices.

The recently released Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) Forecast and Outlook, "GaAs Industry Forecast 2010-2015," forecasts that handset developments, like smartphones and other multi-mode, multi-band devices, powered the entire GaAs device market to 34 percent growth in 2010. This forecast estimates these handset trends will push GaAs device revenue to nearly \$6.4 billion in 2015.

Strategy Analytics forecasts that device shipments into mobile handset applications will account for 50 percent of total GaAs device revenue in 2015, when more than 20.8 billion GaAs devices will ship into all market applications. In addition to GaAs devices, the report also forecasts growth for semi-insulating bulk and epitaxial GaAs substrates.

"Driven by the mobile handset segment, 2010 proved to be a banner year for GaAs devices," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service. "Smartphones and other types of handsets are becoming increasingly sophisticated in order to accommodate multiple bands, multiple standards and features like GPS, Wi-Fi and Bluetooth. This is increasing the number of GaAs devices required per handset."

Asif Anwar, Director in the Strategy Analytics Strategic Technologies Practice, added, "While handset content will continue to drive the GaAs market, infrastructure and military opportunities for GaAs will also increase."

The Strategy Analytics Gallium Arsenide (GaAs) service segments the entire GaAs device market by application, device type, process technology, function, geography and frequency. It also forecasts the demand and market value for the semi-insulating and epitaxial GaAs substrates that form the basis for the GaAs devices.

Microsemi acquires Zarlink Semiconductor

Microsemi has taken control of Zarlink's board and operations and will shortly acquire all remaining Zarlink shares not tendered by way of compulsory acquisition under the Canada Business Corporations Act.

Microsemi Corporation, a provider of semiconductor products used for power, security, reliability and performance, and Zarlink Semiconductor have announced that ULC, an indirect wholly-owned subsidiary of Microsemi, has accepted the tender of and has acquired 123,438,737 Zarlink shares.

This represents approximately 96 percent of Zarlink's outstanding shares, and CAD\$54,417,000 principal amount of Zarlink convertible debentures, and is approximately 87 percent of Zarlink's outstanding debentures.

With the success of this tender, Microsemi will take control of Zarlink's board and operations and will shortly acquire all remaining Zarlink shares not tendered by way of compulsory acquisition under the Canada Business Corporations Act. Microsemi will then take the necessary steps to delist Zarlink from the TSX and to cease to be a reporting issuer under Canadian and U.S. securities laws.

First Solar CdTe modules to spice up Northern Chile

Solar Chile has teamed up with the cadmium telluride solar panel maker to transform Chile into the first country in Latin America to generate solar energy at competitive prices.

Solar Chile, a subsidiary of Fundación Chile, and First Solar, a provider of photovoltaic (PV) system solutions have formed a strategic alliance to co-develop solar projects in Chile.

First Solar will provide its CdTe PV modules and engineering and procurement services to future development projects, subject to execution of definitive project agreements.

"Solar Chile is pleased to work with First Solar,

leveraging their cost-effective PV modules and extensive experience in the development of industrial-scale projects,” said Cristián Sjögren, CEO of Solar Chile. “Together we will transform Chile into the first country in Latin America to generate solar energy at competitive prices.”

The signing of the strategic alliance was held on 12 October at the auditorium of Fundación Chile, in Vitacura. Kathleen Weiss, Vice President of Federal Government and Corporate Affairs for First Solar and Kim Oster, Director of Business Development, Latin America for First Solar, presented developments on solar technologies rapidly declining costs and provide a global perspective on the development of a sustainable solar industry in Chile.

With strong growth projections, significant energy demand and abundant solar resource, Chile represents a tremendous opportunity to generate clean, renewable solar electricity cost effectively,” said Kim Oster, Director of Business Development, Latin America for First Solar. “We are delighted to collaborate with Solar Chile and Fundación Chile to accelerate the adoption of PV technology and meet the growing demand for clean, renewable solar energy.”

Northern Chile has a solar resource that is among the most abundant in the world, and Fundación Chile has been exploring its potential by implementing measurement services and pilot projects and by working in conjunction with the regional government on initiatives such as the Atacama Solar Platform, which has the goal to convert the plentiful solar resource in the Atacama Desert into a source of competitive and sustainable energy.

Fundación Chile supports this and several other initiatives, including Solar Chile, related to developing the solar cluster, an industry ecosystem that will bring together technology and service companies, promote research and development, and support human capital development related to the broader solar energy sector.

NeoPhotonics completes acquisition of Santur

The firm has bought the indium phosphide based PIC product innovator for an estimated \$39.2 million.

NeoPhotonics Corporation, a creator of subsystems for bandwidth-intensive, high speed communications networks, has completed the acquisition of privately held Santur Corporation, a designer and manufacturer of InP based PIC products.

As previously disclosed, NeoPhotonics agreed to pay an estimated \$39.2 million in cash for Santur, after deductions for closing costs and other adjustments, plus up to \$7.5 million additional cash contingent on the financial performance of Santur products subsequent to closing of the transaction through the end of 2012.

“The acquisition of Santur further enhances our leading position in PIC-based modules and subsystems for high speed networks,” said Tim Jenks, Chairman and CEO of NeoPhotonics. “By combining active InP PICs from Santur with our hybrid PICs, we can provide our customers with new products for 100G coherent systems that feature higher levels of integration, higher performance and greater functionality.”

Founded in November 2000, Santur is located in Fremont, California, and is focused on commercialising PIC-based laser array and packaging technologies for communications. Santur’s technology includes established telecom designs offering elegant approaches to wide tunability as well as high speed transceivers.

Santur products are designed to provide reduced size, power consumption and cost for a wide range of DWDM, Coherent and Client Side networking applications in 10G, 40G and 100G networks.

In connection with the acquisition of Santur, NeoPhotonics has granted special inducement grants under the “NeoPhotonics 2011 Inducement Award Plan” to retain certain Santur employees (118 in total) as employees of the NeoPhotonics group. The company granted an aggregate of 466,450 stock options, each of which vests 25%

on the first anniversary of the closing of the Santur acquisition and the remainder in thirty-six substantially equal monthly instalments thereafter, subject to such employees being employed by the NeoPhotonics group on the vesting dates.

The stock options were granted effective upon the acquisition closing date, have a ten year term and an exercise price equal to \$5.97 per share, which was the closing price of NeoPhotonics common stock on the New York Stock Exchange on the date of grant. The stock options were approved by the Compensation Committee of NeoPhotonics board of directors and were granted as a material inducement to employment with the NeoPhotonics group.

The NeoPhotonics Board of Directors approved the 2011 Inducement Award Plan based on the employment inducement exemption provided under the NYSE listing standards. As a result, the 2011 Inducement Award Plan did not require shareholder approval.

Infinera 100Gb/s InP system takes the plunge

The US-based provider of digital optical communications systems has successfully used its DTN platform, which feature indium phosphide PICs, to complete the world's first transpacific 100 Gigabit subsea trial.

Infinera and Pacific Crossing, a wholly owned subsidiary of NTT Communications Corporation and operator of the transpacific submarine cable system PC-1, have successfully completed a 100 Gigabit per second (Gb/s) subsea trial.

The subsea trial spanned more than 9,500 kilometres on Pacific Crossing's PC-1 fibre from California to Japan. This is the first and longest successful 100 Gb/s trial performed across the Pacific delivering digital coherent transmission.

This trial demonstrates the unique ability to deliver two industry firsts. The 100 Gigabit Ethernet (GbE) demonstration was the first transmission of a 100 GbE client service carried across the Pacific using 40 Gb/s optical channels with Infinera's FlexCoherent transmission.

The success of this trial was based on Infinera's commercially available 40 Gb/s optical line module and 100 GbE client interface on Infinera's DTN platform. The second demonstration was the first realisation of a 100 Gb/s optical channel using binary phase shift keying (BPSK) with soft decision forward error correction (SD FEC) that will be available in the future on Infinera's DTN-X platform.

Infinera's FlexCoherent technology enables service providers to optimise transmission performance across a range of applications using multiple software-programmable modulation formats. Infinera recently announced the availability of new DTN capabilities and the new DTN-X platform featuring both InP photonic integrated circuit (PIC) based super-channels and FlexCoherent transmission.

The Asia Pacific region has been experiencing exponential growth in Internet bandwidth demand. According to Internet World Stats, the number of Internet users in Asia grew from 114 million to 922 million from 2000 to 2011. The growth is forecast to continue, thereby driving the need for subsea networking equipment that can deliver the required capacity.

"Customer demand for transpacific bandwidth continues to grow," said Takahiro Sumimoto, Chief Executive Officer at Pacific Crossing. "We are delighted to work with Infinera to demonstrate 100 Gigabit transmission on our existing subsea fibre plant. We are also pleased that our leading transpacific network capabilities contributed to the successful demonstration of this new technology."

"Infinera is pleased to partner with Pacific Crossing in conducting this trial as it marks a major milestone for the delivery of next-generation optical systems in the Asia Pacific region," said Deryck Robinson, Vice President, Subsea Business Unit at Infinera. "We are committed to support the Asia Pacific region and believe this trial demonstrates the scale, simplicity and efficiency of Infinera's solutions to provide a glimpse of what the network will be."

Infinera has completed successful trials of 100 Gb/s and 500 Gb/s super-channels across the globe, recently with SEACOM in Africa and Interoute in Europe. To underscore its commitment to provide enhanced levels of service and support

for customers in the Asia Pacific region, Infinera recently opened an office in Hong Kong with a customer demonstration centre and a training centre for its growing client base in the region.

Integrated DVGAs for optimal performance in transceiver systems

TriQuint's new amplifiers are suited for public safety, 3G/4G wireless base station transceivers, remote radio heads, point-to-point microwave links and satellite communications terminal applications.

TriQuint Semiconductor has released a family of broadband, digitally-controlled variable gain amplifiers (DVGAs) that combine high linearity, gain and output power with a low noise figure and a broad range of output gain control.

These integrated products are internally matched at 50 Ω and can reduce BOM's, increase efficiency and reduce overall costs.

TriQuint's new DVGAs are suited for public safety, 3G/4G wireless base station transceivers, remote radio heads, point-to-point microwave links and satellite communications terminal applications.

The new TQM8M9075, TQM8M9076, and TQM8M9077 DVGAs combine a high-performance gain block with a precision digital step attenuator to amplify input signals in 0.5-dB steps from 0 to 31.5dB based on commands delivered through a 6-bit serial control interface.

They can be employed in the IF and RF sections of a receiver to amplify or attenuate incoming signals, especially to levels desirable for analogue-to-digital converters. They can also be used in the transmit chain to vary gain levels to amplifier stages.

A broad operating range of 500 MHz to 4 GHz and integrated performance advantages make TriQuint's DVGAs a good choice for many wireless communications systems, enabling RF designers to use one device across multiple applications. Their noise figure (as low as 2.9dB) and high linearity (OIP3 up to 38.5dB) can be critical to ensuring the best possible overall performance. In addition, their

state-to-state attenuator accuracy (0.3 + 4% of attenuation setting) provides precision gain control throughout their 31.5-dB range.

The TQM8M9075, TQM8M9076 and TQM8M9077 operate from a single 5 VDC power supply at between 87 and 125 mA, have an operating temperature range of -40 to +85°C, and have a minimum MTTF of 1,000 years at a mounting temperature of +85°C.

Technical Details: (All three DVGAs operate from 500 MHz to 4 GHz)

TQM8M9075

+20.5dBm P1dB output power, +36.5dBm OIP3, 18dB gain, 2.9dB noise figure.

TQM8M9076

+22dBm P1dB output power, +38.5dBm OIP3, 19.5dB gain, 2.9dB noise figure.

TQM8M9077

+21.5dBm P1dB output power, +38.5dBm OIP3, 13dB gain, 3.7dB noise figure.

Samples of the three new DVGAs as well as evaluation boards are now available.

New GaAs MMIC sets bandwidth benchmark

Hittite's low noise gallium arsenide MMIC performs divide-by-1 and divide-by-3 functionality to 13 GHz.

Hittite Microwave Corporation has released a new low noise programmable frequency divider which is ideal for use in signal generation architectures found in test equipment, laboratory systems and various military applications.



The HMC861LP3E is a Low Noise Programmable Frequency Divider which can be programmed

to divide-by-1 or divide-by-3, and accepts input frequencies from 100 MHz to 13 GHz. The module exhibits extremely low additive phase noise of -152 dBc/Hz in divide-by-1 mode, and -153 dBc/Hz in divide-by-3 mode.

This versatile frequency divider accepts input signal levels from -10 to +10 dBm, while delivering +2 dBm of output power. The wide input frequency and power level ranges, and the low single sideband phase noise make the HMC861LP3E ideal for synthesizer and phase locked loop applications in wideband and high data rate communication systems.

The division ratio of the HMC861LP3E is selected by a single CMOS compatible input and the device is powered from a +5V supply. Hittite says the HMC861LP3E is the only known MMIC divide-by-3 available in the marketplace which operates to 13 GHz.

The HMC861LP3E is conveniently housed in a miniature 3x3 mm RoHS compliant QFN leadless SMT package and is specified for operation over -40 °C to +85 °C.

Samples and evaluation PC boards for all SMT packaged products are available from stock and can be ordered via the company's e-commerce site or via direct purchase order.

First CMOS integrated poly-SiGe pressure sensor

Imec's silicon germanium integrated CMOS circuit showed no significant deterioration after MEMS processing.

Imec has developed an integrated poly-SiGe-based piezoresistive pressure sensor directly fabricated above 0.13 µm copper (Cu) -backend CMOS technology.

The research institute says this represents not only the first integrated poly-SiGe pressure sensor directly fabricated above its readout circuit, but is also the first time that a poly-SiGe MEMS device is processed on top of Cu-backend CMOS.

Polycrystalline SiGe has emerged as a promising

MEMS structural material since it provides the desired mechanical properties at lower temperatures compared to poly-silicon, allowing the post-processing on top of CMOS. The MEMS-last approach is the most interesting approach for CMOS-MEMS monolithic integration as it leads to smaller die areas and enables integrating the MEMS without introducing any changes in standard foundry CMOS processes.

Comparing to alternative technologies, for example using the CMOS top interconnect layers to fabricate the MEMS device, poly-SiGe offers a more generic and flexible technology for above CMOS integration, thanks to the fact that the MEMS fabrication can be completely decoupled from the CMOS fabrication.

In the past, imec has already proved the potential of poly-SiGe for MEMS above-aluminium-backend CMOS integration. However, aggressive interconnect scaling has led to the replacement of the traditional aluminium metallization by copper metallization, due to its lower resistivity and improved reliability. Our results now broaden the applications of poly-SiGe to the integration of MEMS with the advanced CMOS technology nodes.

The integrated sensor fully fabricated in imec includes a surface-micromachined piezoresistive pressure sensor, with a poly-SiGe membrane and four poly-SiGe piezoresistors, and an instrumentation amplifier fabricated using imec's 0.13 µm standard CMOS technology, with Cu-interconnects (two metal layers), oxide dielectric and tungsten-filled vias.

To enable above-CMOS integration the maximum processing temperature of the complete sensor, including the poly-SiGe piezoresistors, is kept below 455°C. Moreover, an appropriate passivation layer was included to protect the electronic circuit from the aggressive etch and deposition steps needed to fabricate the MEMS devices.

The CMOS circuit showed no significant deterioration after the MEMS processing. Despite the low processing temperature, the poly-SiGe piezoresistive sensor alone (250x250µm² membrane) showed a sensitivity of around 2.5 mV/V/bar. The integrated sensor (same sensor + Cu-based CMOS amplifier underneath) showed a sensitivity of about 158 mV/V/bar, ~64 times higher

than the stand-alone sensor.

Sofradir awarded multi-million Euro IR contract

The earth observation military satellite contract increases Sofradir's achievements in supplying state-of-the-art IR detectors based on mercury cadmium telluride technology, for space applications.

French firm Sofradir, a developer and manufacturer of advanced infrared detectors for military, space and industrial applications, has been awarded a multi-million Euro contract.

The firm will manufacture Infrared (IR) detectors for the engineering and flight model phases for the MUSIS/CSO next generation Earth observation military satellites. These satellites will replace the current Helios 2 observational system.

Within the framework of the four-year MUSIS/CSO contract, Sofradir will deliver to Thalès Alenia Space France (TAS-F), a worldwide manufacturer of satellite and space equipment, high resolution custom design IR focal plane arrays for the optical imaging cameras. The exact value of the contract was undisclosed.

"After our successful involvement in the satellites Helios IIA and IIB, launched in 2004 and 2009 respectively, Sofradir is proud to be part of the MUSIS/CSO project and have the continued confidence of the French MoD and TAS," said Philippe Bensussan, chairman and CEO at Sofradir.

"Our expertise in developing state-of-the-art IR detectors for Earth observation applications will be further strengthened through this collaboration. We look forward to other opportunities to make our MCT IR detectors that operate reliably in harsh environments available for other challenging space projects in Europe and around the world."

The CSO (Optical Space Component) is the French government's contribution to the future MUSIS (MUltinational Spacebased Imaging System) that will include optical and radar space components. Astrium, a leading aerospace company, is the prime contractor for the CSO satellite development

contract. The French space agency CNES awarded the contract to Astrium in 2010. CNES was delegated by the French procurement agency DGA to manage the project.

Sofradir first became involved in MUSIS/CSO in 2005, when it carried out a feasibility study and preliminary development of the IR detectors. Sofradir will complete delivery of all the IR detectors by 2015. These are based on Sofradir's Mercury Cadmium Telluride (MCT) technology, a highly complex semiconductor material that is unavailable to all but a few manufacturers in the world because it is tricky to master.

Imec demonstrates extremely high-speed SiGe HBTs

The silicon germanium devices open new avenues in wireless communications and imaging.

Imec have created a fT/f_{MAX} 245GHz/450GHz SiGe:C HBT device, a key enabler for future high-volume millimetre-wave low-power circuits to be used in automotive radar applications.

These HBT devices also pave the way to silicon-based millimetre wave circuits penetrating the so-called THz gap, enabling enhanced imaging systems for security, medical and scientific applications.

The extremely high-speed devices have a fully self-aligned architecture by self-alignment of the emitter, base and collector region, and implement an optimised collector doping profile. Compared to III-V HBT devices, SiGe:C HBTs combine high-density and low-cost integration, making them suitable for consumer applications.

Such high-speed devices can open up new application areas, working at very high frequencies with lower power dissipation, or applications which require a reduced impact of process, voltage and temperature variations at lower frequencies for better circuit reliability.

To achieve the ultra high-speed requirements, state-of-the-art SiGe:C HBTs need further up-scaling of the device performance. Thin sub-collector doping profiles are generally believed to be mandatory for

this up-scaling. Usually, the collector dopants are introduced in the beginning of the processing and thus exposed to the complete thermal budget of the process flow.

This complicates the accurate positioning of the buried collector. By in-situ arsenic doping during the simultaneous growth of the sub-collector pedestal and the SiGe:C base, imec introduced both a thin, well controlled, lowly doped collector region close to the base and a sharp transition to the highly doped collector without further complicating the process. This resulted in a considerable increase of the overall HBT device performance: Peak f_{MAX} values above 450GHz are obtained on devices with a high early voltage, a BVCEO of 1.7V and a sharp transition from the saturation to the active region in the IC-VCE output curve.

Despite the aggressive scaling of the sub-collector doping profile, the collector-base capacitance values did not increase much. Moreover, the current gain is well defined, with an average around 400 and the emitter-base tunnel current, visible at low VBE values, is limited as well.

Compound semiconductors are a priority for Sumitomo Chemical

The firm has strengthened its compound semiconductor materials business to cope with demand for high frequency devices which use gallium arsenide and gallium nitride epiwafers.

Sumitomo Chemical will expand its facilities for production of compound semiconductor materials at the Chiba Works (Sodegaura, Chiba Prefecture) to further strengthen this business and enhance a stable supply of these materials to customers.

GaAs-based compound semiconductors are widely adopted for high-frequency devices used in mobile phones and other equipment because of their outstanding signal processing at high frequencies and low power consumption. In recent years, demand has been growing rapidly for applications for antenna switches and power amplifiers used in multifunction mobile phones typified by smartphones.

As such, demand is expected to continue to increase in the future. Compound semiconductor materials for which the Company will expand production are GaAs epiwafers prepared by thin film crystal growth of materials, such as GaAs, on GaAs substrates.

Up to now the company has been manufacturing GaAs epiwafers at the Chiba Works and Sumika Electronic Materials, its US subsidiary, with production capacity expanded stepwise in the past. Given expectations of a continued increase in demand for GaAs epiwafers, the Company has decided to double the compound semiconductor materials production capacity at the Chiba Works with an investment of about US \$52 million for the purpose of establishing a fully secured system for stable supply as well as expanding the business.

In addition, capitalising on its technology cultivated through the GaAs epiwafer business, Sumitomo Chemical is engaged in the development of new compound semiconductor materials. Specifically, the Company will participate in the government-private sector joint project for next generation power semiconductors at the Nagoya Institute of Technology where it undertakes R&D on GaN, one of the next generation power semiconductor materials.

Next generation power semiconductors are capable of being operated at high voltage and high temperatures. They are expected to contribute to the improved performance of home electrical appliances and personal computers, as well as electric vehicles, solar cells, and other equipment for wind power or geothermal power generation, areas likely to show market expansion in the future. Also, these semiconductors are believed to contribute to energy saving.

Positioning the compound semiconductor materials business as one of the priority areas of the IT-related Chemicals Sector, the Company will enhance existing operations through this expansion of production capacity as well as to seek to further expand its business by focusing efforts on the development of new materials.

A new family of VCO products from M/A-COM Tech

The indium gallium phosphide VCOs deliver low phase noise, a wide tuning range and low current consumption.

M/A-COM Technology Solutions is launching a new set of voltage controlled oscillators (VCOs) for radio applications. The VCOs are ideal for point-to-point radio, point to multipoint radio, communications systems, and low phase noise applications.

The InGaP HBT-based VCOs are easily integrated into a phase lock loop, using a divide-by-two output. The MAOC-009871, MAOC-009872, and MAOC-010344 meet the high performance requirements of high capacity digital radios by optimising for low phase noise, wide tuning range, and low current consumption.



“The MAOC-009871, MAOC-009872, and MAOC-010344 are expansions to M/A-COM Tech’s point-to-point VCO product family. Low phase noise and low DC power consumption are key product features that are beneficial for cellular backhaul radios,” said Jack Redus, Product Manager. “The full product family consists of 15 standard product VCOs covering 5.7 to 14.2 GHz. Custom frequency ranges are available upon request.”

Packaged in a lead-free 5mm, 32-lead PQFN package, the VCOs feature an integrated buffer amplifier and excellent temperature stability. The package also features low lead inductance and an excellent thermal path. Operating with case temperature at or below +85°C, the VCOs allows for a MTBF of 2,500,000 hours. With a 5.0 V bias supply, these VCOs operate between the 8.4 GHz to 11.8 GHz frequency band.

The table below outlines typical part number

performance:

Parameters	Units	MAOC-009871	MAOC-009872	MAOC-010344
		Typ	Typ	Typ
Frequency	GHz	5.7 - 11.8	11.0 - 11.8	8.4 - 9.25
Phase Noise (at 100 kHz Offset)	dBc/Hz	-113	-112	-115
Output Power RF Port	dBm	7	7	10
Output Power RF2 Port	dBm	6	5	3
Supply Current	mA	185	160	168
Tuning Sensitivity @ 100 kHz	GHz/V	0.18	0.19	0.14
Tuning Current Leakage	µA	2	5	7

Production quantities and samples of MAOC-009871, MAOC-009872, and MAOC-010344 are available from stock and further details are available from M/A-COM’s website.

RF Electronics

RF SP3T switch for Wi-Fi, Bluetooth & applications up to 6GHz

Low insertion loss and small package size of the gallium arsenide MMIC switch enable combo wireless designs at frequencies from 0.5 to 6.0 GHz.

Renesas Electronics and California Eastern Laboratories (CEL) are now shipping a new compact SP3T Switch for applications up to 6GHz, the µPG2430T6Z.

The µPG2430T6Z is a GaAs MMIC SP3T switch which can be used in a variety of applications. These include single or dual-band 802.11a,b,g,n Wi-Fi / WLAN + Bluetooth, cordless phones, 5.8GHz electronic toll collection, mobile communication, and general short range communications applications up to 6GHz using control voltages of 1.6V – 3.6V.

The µPG2430T6Z provides designers with a combination of low cost, high frequency operation, low insertion loss, high isolation, wide control voltage range, compact packaging, all with quality, reliability and consistency.

This device is housed in a 8-pin plastic TSON (Thin

Small Out-line Non-leded) package and is suitable for high density surface mounting.

Technical Information

Frequency: 0.5 to 6.0GHz
 Control Voltage: +1.6V to 3.6V
 Insertion Loss: 0.55dB @ 2.5GHz
 0.65dB @ 6.0GHz
 Isolation: 28 dB @ 2.5GHz
 25 dB @ 6GHz
 Pin (0.1dB) / Pin (1dB): +28dBm / +31dBm at 3V
 +22dBm / +25dBm at 1.8V
 Package: 1.5 x 1.5 x 0.37mm

µPG2430T6Z is in stock and available now from CEL. Pricing at 100K pieces is \$0.40.

CEL is the exclusive sales and marketing partner in North America and Latin America for products made by the Compound Semiconductor Devices Business Division (CSDBD) of Renesas Electronics Corporation, formerly NEC Electronics Corporation. These products include RF components and RFICs, optocouplers, solid state relays, and lasers and detectors for fibre optics.

RFMD's GaN CATV hybrids go platinum

The firm's gallium nitride devices received dual honours in the categories of Energy-Savings Technology and RF/HFC Technology.

RF Micro Devices has been honoured with two Platinum Awards from Communications Technology magazine, a leading engineering publication in the CATV industry and the official trade journal of the Society of Cable Telecommunications Engineers (SCTE).

The awards will be presented formally by Communications Technology magazine on December 8, 2011 during an awards ceremony held in New York City.

Platinum Awards from Communications Technology magazine recognise the broadband industry's most innovative hardware, software, service, and marketing initiatives, as judged by a panel of industry experts. RFMD's GaN CATV hybrids

received dual honours in the categories of Energy-Savings ("Green") Technology and RF/HFC Technology.

Alastair Upton, general manager of RFMD's Broadband Components Business Unit, said, "RFMD is honoured to receive these two prestigious awards recognising our GaN CATV hybrid devices. We believe our GaN CATV hybrids help our customers to maximize RF performance in cable networks while also minimizing energy consumption – two very important priorities in the broadband industry."

RFMD offers a broad range of CATV products, including packaged amplifiers, MMICs, modules, frequency modulation components, and passive components. The company's GaN technology delivers superior performance versus competing GaAs and silicon power technologies, while also supporting "green" architectures that reduce energy consumption, improve thermal management and optimise network efficiency for network operators.

Skyworks and AnalogicTech amend merger agreement

The innovator of high reliability analogue and mixed signal semiconductors will acquire the outstanding shares of AnalogicTech for \$5.80 per share in cash.

Skyworks Solutions intends to commence the tender offer to purchase Advanced Analogic Technologies, Inc. (AnalogicTech) within seven business days. The companies expect the transaction to be completed in January 2012.

AnalogicTech develops advanced semiconductor system solutions that play a key role in the continuing evolution of feature-rich, energy efficient electronic devices. The company focuses on addressing the application-specific power management needs of consumer devices such as mobile handsets, digital cameras, tablets, notebooks, TV and LCD displays as well as devices in a broad range of industrial, medical and telecom applications. AnalogicTech also licenses device, process, package, and application-related technologies.

Skyworks intends to finance the tender offer

with cash in hand. The tender offer will not be subject to financing and, among other things, will be conditioned upon a majority of the shares of AnalogicTech common stock outstanding being tendered and no injunctions being issued prohibiting the offer or the merger.

AATI has addressed and satisfactorily clarified all issues previously raised by Skyworks. As part of the settlement, the companies have agreed to voluntarily dismiss the claims asserted against each other in the Delaware Chancery Court. Skyworks and AnalogicTech have mutually determined that their respective claims were insignificant in light of the overall value of the transaction.

“Skyworks is pleased to have reached this agreement with AnalogicTech and to be moving forward together,” said David J. Aldrich, president and chief executive officer of Skyworks. “We believe this transaction will enable Skyworks to further capitalise on our strong smart phone, tablet, set-top box and infrastructure positions with an expanded and differentiated product portfolio while accelerating our entry into new vertical markets.

Analogue power management semiconductors represent a strategic growth market for Skyworks as our customers increasingly demand both ubiquitous wireless connectivity and power optimization across seemingly every kind of electronic platform. With AnalogicTech, Skyworks will be well positioned to address these twin market opportunities by leveraging our broad customer relationships and innovative product portfolios, and increasing operational scale.”

“We believe the revised agreement with Skyworks provides AnalogicTech stockholders with immediate value and certainty for their investment in the Company, while providing important benefits to AnalogicTech’s employees and customers,” said Richard K. Williams, president, chief executive officer and chief technical officer of Advanced Analogic Technologies.

“We share Skyworks’ vision of the enormity and growth potential of the analogue semiconductor market and continue to believe that together, we can better address customers’ demand for highly integrated power management solutions across a broader range of markets and applications. We look forward to closing this transaction quickly and are

committed to ensuring a smooth transition.”

Skyworks noted that the Registration Statement on Form S-4 that had been previously filed with the U.S. Securities and Exchange Commission (SEC) on June 17, 2011, and withdrawn on November 3, 2011 will not be resubmitted for filing.

Skyworks expects the transaction to be earnings accretive in FY12 post synergies and will provide more information during its first fiscal quarter 2012 earnings conference call to be held in January 2012.

In light of the revised merger agreement, AnalogicTech’s Annual Meeting of Stockholders, that was previously scheduled to be held on December 16, 2011, has been postponed until further such notice.

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on “The Market for LEDs in Lighting”.

Following the success of CS Europe 2011, next year’s conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow’s compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammono S.A.

Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Soraa Inc.

Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices
- Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Skyworks begins volume shipments of GaAs ICs to Siemens Healthcare

The analogue control ICs, some of which incorporate gallium arsenide, enable MRI scanners; Skyworks is capitalising on the increasing RF content required in the medical market.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, has begun volume shipments of analogue control switches to Siemens Healthcare for their state-of-the-art MAGNETOM magnetic resonance imaging (MRI) scanners.

Skyworks' devices allow Siemens to manufacture scanning equipment that is 50 percent more productive and easier for medical technicians to manoeuvre. The switches deliver low insertion loss, positive voltage operation and very low direct current power consumption - all critical elements for magnetic resonance imaging. Each scanner requires hundreds of switches.

Skyworks' portfolio of low noise amplifiers, Schottky and varactor diodes, attenuators and multi-throw switches are also supporting other wireless medical applications including blood sugar and heart monitors, pacemakers, and patient telemetry devices.

According to Nerac, a research and advisory firm, the number and variety of wireless medical devices is growing rapidly, driven by the expansion of wireless communication technology and the medical needs of an aging population. Wireless medical devices that monitor patients range from defibrillators to infusion pumps.

According to Nerac's "Wireless Medical Devices: Security Issues, Market Opportunities and Growth Trends" article, by 2020 at least 160 million

Americans alone will be monitored and treated remotely for at least one chronic condition. The market for such remote monitoring of patients is forecast to reach \$5.1 billion by 2013 up from \$3.6 billion in 2007.

"Skyworks is delighted to be partnering with Siemens to help enable state-of-the-art imaging for medical applications," said Liam K. Griffin, executive vice president and general manager of high performance analogue. "At a higher level, this design win is yet another example of how Skyworks' analogue portfolio is gaining traction across a wide array of end markets, demonstrating Skyworks' success in diversifying into highly profitable, adjacent segments."

About Skyworks' Product Portfolio Supporting Medical Applications

Switches

SKY13267-321LF – a GaAs T/R diversity switch
SKY13268-344LF – a GaAs SPDT switch
SKY14151-350LF – a high-power SP4T switch with decoder

Low Noise Amplifiers

SKY67014-396LF – a 1.5 – 3.0 GHz low power, active bias LNA

Attenuators

SKY12348-350LF – a GaAs IC 4-bit digital attenuator

Diodes

SMV1233, SMV1236 and SMV1237 Series – hyperabrupt junction tuning varactors for discrete devices

SMV1763-079LF – a silicon hyperabrupt junction varactor diode for 3 V platforms

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound Semiconductor Markets: Current Status and Future Prospects".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

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The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems

Technology Office

- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

- III-V on 200 mm Si for VLSI - Richard Hill, Sematech

- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : "CS Europe 2012: LEDs, lasers, PV and electronics Conference"

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

- Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

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- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

RFMD release RF1604D broadband low power SP4T switch

RFMD's new RF1604D is a single-pole four-throw (SP4T) switch designed for Receive Diversity switching applications.

The RF1604D is ideally suited for battery-operated applications requiring high performance switching with very low DC power consumption. It features very low insertion loss and is optimized for diversity routing with 1.3V GPIO control voltage compatibility. Additionally, RF1604D includes integrated decoding logic, allowing just two control lines needed for switch control. The RF1604D is packaged in a

very compact 2.5mm x 2.5mm x 0.6mm, 12-pin, leadless QFN package. No DC-blocking capacitors are required on RF paths unless DC is applied externally to the device ports.



Features

- 2kV HBM ESD Protection on All Ports
- Low Frequency to >2.7GHz Operation
- Low Insertion Loss: 0.4dB at 1GHz
- Very High Isolation: 40dB at 1GHz
- Compatible With Low Voltage Logic (VHIGH Min=1.3V)
- No External DC Blocking Capacitors Required on RF Paths

Applications

- Multi-Mode GSM/EDGE/WCDMA, and LTE Applications
- Cellular Infrastructure Applications
- Receive Diversity Switching

This product is currently available for purchase. Pricing begins at \$0.98 each for 100 pieces.

For more information on RF1604D, visit https://estore.rfmd.com/RFMD_OnlineStore/Products/RFMD+Parts/PID-P_RF1604D.aspx?DC=25

GaN-on-Si 48V technology cooler than ever

Enabling more reliable RF power, Nitronex has upgraded its 28V NRF1 gallium nitride on silicon technology.

Nitronex has developed a 48V GaN-on-silicon process platform.

Designated NRF2, this new platform delivers double the power density, 1-2dB higher gain, improved broadband performance, higher breakdown voltage and higher supply voltage operation over Nitronex's 28V NRF1 process technology.

The new technology further increases reliability for GaN-on-silicon, with more than one million hours (114 years) mean time to failure (MTTF) at an operating junction temperature of 230°C using a stringent 10% drift failure criteria. In addition, improvements in thermal management in initial 48V products have demonstrated thermal resistance reduction of more than 40% compared to existing Nitronex products.

The NRF2 process platform heavily leverages Nitronex's existing NRF1 platform which has been used to ship more than 500,000 production devices (including more than 50,000 MMICs) since volume shipments began in 2009.

"A robust and reliable high voltage process can deliver superior performance in high-power RF applications. We have developed several semi-custom products for customers with high volume applications using the NRF2 48V technology, and

our customers are very pleased with our solution versus alternatives," said Ray Crampton, VP of Engineering. "In addition to increased reliability and RF performance, we have demonstrated robustness to 15:1 output VSWR at all angles at 90°C flange temperature under saturated drive conditions."

Nitronex says its patented SIGANTIC GaN-on-Si process is the only production qualified GaN process using an industry standard 4" silicon substrate. This results in a robust, scalable supply chain and positions Nitronex well for the growth expected from emerging GaN markets such as military communications, CATV, RADAR, commercial wireless, satellite communications and point to point microwave.

Additional technology under development includes a 48V MMIC process platform.

Initial 48V samples are available now with pre-production and production quantities available in early 2012.

Nitronex NRF1 GaN process qualified at GCS

GCS is adding Nitronex's 100mm gallium nitride on silicon technology to its extensive compound semiconductor capability allowing the firm access to the expanding GaN RF market.

Nitronex, a designer and manufacturer of GaN based RF solutions for high performance applications in the defence, communications, cable TV, and industrial & scientific markets, has successfully completed qualification of its NRF1 discrete process for volume production at Global Communication Semiconductors (GCS).

Under a long-term supply agreement between the two companies, GCS will exclusively provide Nitronex with NRF1 discrete and MMIC foundry services. NRF1 is Nitronex's proprietary 100mm GaN-on-Silicon process and has been used to ship more than 500,000 production devices since volume shipments began in 2009.

Devices fabricated at GCS show equivalent performance across the board to devices fabricated at Nitronex's Durham, N.C. facility. Qualification

includes extensive DC, RF, thermal, reliability, and other parametric testing. Nitronex plans to work closely with customers through a Process Change Notification to ensure a smooth transition as it establishes GCS as a qualified wafer source for all of its products.

“When evaluating GaN suppliers, our customers tell us they want to compare performance, reliability, manufacturability, and cost. We believe that our current NRF1 discrete and MMIC-based processes have enabled us to develop a family of products that, for many market applications, meet or exceed our customers’ needs relating to performance and reliability — and we have the data to prove it,” said Charlie Shalvoy, CEO of Nitronex.

“Partnering with GCS gives Nitronex a significant increase in capacity, improves our near and long-term cost reduction roadmap and provides access to capabilities that allow us to develop new GaN technologies. The combination of our proprietary 100 mm GaN-on-Si process, and the full suite of production and new process development capabilities at GCS, gives us the ability to be a leader in the rapidly emerging market of GaN RF power devices”, he added.

“We are pleased to partner with Nitronex and add GaN-on-Si to our extensive compound semiconductor capability. Nitronex’s unique technology gives us access to a new and growing GaN RF market”, said Jerry Curtis, CEO of GCS. “Now that NRF1 process is qualified at GCS, we look forward to working closely with Nitronex and moving to volume production.”

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be “An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program.”

Defining the next steps for the Compound Semiconductor Industry

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- Commercialisation of GaN on SI based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR- Professor Rik Jos,

NXP

- Holistic Approach to MOCVD vacuum & Abatement - Mike Czerniak, EdwardsVacuum Ltd
- Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning
- Large diameter GaN-on-Si epiwafers for power electronics –Dr Mariane Germain, EpiGaN
- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor
- Damage - free Deposition on LED devices –Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd
- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Senior executive Thomas Shields resigns from Anadigics

Terrence Gallagher, will take over the positions of Vice President and Chief Financial Officer and hopes to help the business return to profitability.

Anadigics has announced that Thomas Shields had resigned from the positions of Chief Operating Officer, Executive Vice President, Chief Financial Officer and Secretary.

The resignation, which became effective November 14, 2011 will see the semiconductor veteran pursue career advancement opportunities outside of Anadigics.

Terrence Gallagher, who had served as Vice President, Finance and Controller, has been promoted to the positions of Vice President and Chief Financial Officer. Shields has agreed to provide consulting services to the company for a period of time to ensure an orderly transition of all of his current responsibilities.

Ron Michels, Chief Executive Officer, said “Tom advised me today that he is resigning his position at Anadigics to pursue career advancement opportunities outside of Anadigics. I understand and appreciate Tom’s desire to advance his career. He has been instrumental in helping me transition from my previous role to my current Chief Executive Officer role. I would like to thank him for his assistance in that regard as well as for his many years of service and contributions to Anadigics.”

Tom Shields added, “I have great respect and fondness for Anadigics, its shareholders, Board of Directors, and employees. I want to thank all of you for being part of my life, and for allowing me to be part of yours, for the past twelve years. Ron and the Anadigics team have accomplished a great deal in a short period of time. I will miss the team greatly, and I am quite confident in the future of Anadigics.”

Ron Michels said, “I have worked with Terry for many years. He is a seasoned semiconductor industry veteran with an outstanding knowledge of both Finance and the Anadigics business. He will be an outstanding addition to Anadigics’ senior leadership team. I am confident that the breadth and depth of Terry’s financial experience will enable him to make very meaningful contributions as we maintain our focus on a product leadership strategy that delivers improved financial performance as quickly as possible.”

Terry Gallagher added “On behalf of our shareholders, I am committed to working closely with the entire Anadigics management team to return our business to profitability.”

RFMD reveals CATV EDGE QAM surface mount amplifier

The RFAM2790 is an integrated amplifier and employs a gallium arsenide pHEMT die, a GaAs MESFET die, a 20dB range variable attenuator, and a power enable feature.

The RFAM2790 provides high output power, excellent linearity, and superior return loss performance with low noise and optimal reliability.



RFAM2790

With a nominal gain from 8 to 28 dB at 45 to 1003 MHz, the device has a continuously adjustable interstage attenuator with single voltage control line. The module also has a power enable feature, runs off a single +12 VDC supply and is unconditionally stable under all termination. It is CM-SP-DRFI-I09-100115 compliant and best suited to CATV Edge QAM systems and line amplifiers. The RFAM2790 is available in production quantities now. Pricing begins at \$17.70 each for 10,000 pieces.

New GaN CATV surface mount power amplifier has a doubler module

RFMD says the RFCM2680 device, which employs its gallium nitride and gallium arsenide technologies, is the industry’s first surface mount GaN power doubler module aimed at CATV networks.

Employing a combination of GaN HEMT and GaAs pHEMT technologies, the device provides high output capability from 45-1003MHz with excellent distortion performance.



RFCM2680

Features

45 to 1003MHz GaAs/GaN Power Doubler Module
 61dBmV Rated Power
 High Current Mode: 450mA at 24VDC
 Low Current Mode: 350mA at 24VDC
 Min. Gain: 22.5dB at 1GHz
 Saves \approx 50% PCBA Area versus SOT115J (with external baluns) 182 mm² versus 362 mm²²

Applications

CATV Optical nodes
 CATV Line amplifiers

The RFCM2680 is in volume production now.
 Pricing begins at \$15.43 each for 10,000 pieces.

TriQuint modules support ZTE's Skate and Blade smartphones

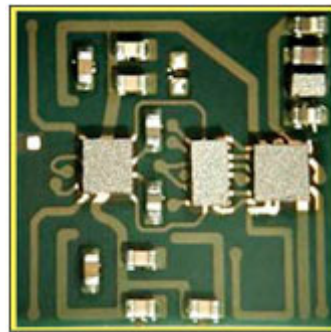
The firm's indium gallium phosphide HBT technology is used in the 3G/4G chipsets which also use TriQuint's patented CuFlip technology. This flip chip interconnect technique uses copper 'bumps' to replace wire bonds.

TriQuint Semiconductor has announced that ZTE has chosen to include its power amplifier modules in the award-winning ZTE Blade and the new ZTE Skate, two standout offerings in ZTE's global line of smartphones. TriQuint's radio frequency solutions offer superior RF performance, compact packaging

and longer battery life.

"For a number of years we have relied on outstanding RF solutions from TriQuint," said Zhaoxiang Zeng, ZTE Vice General Manager, Material Supply & Logistics Division. "Our collaboration allows us to deliver high-end smartphone experiences to the masses." ZTE has named TriQuint its "Best Global Partner" the past four years.

The ZTE Blade and ZTE Skate feature TriQuint's TQM7M5012H and TQM7M5022 modules, respectively. Both products are part of TriQuint's RF front-end line of discrete power amplifier modules. TriQuint's success in 3G/4G chipsets is due in a large part to its CuFlip technology, a strategic differentiator, which the company says enables superior RF performance, design flexibility, faster manufacturing and lower costs.



TriQuint product using CuFlip technology (6mm x 6mm)

The ZTE Skate is expected to build on the success of the ZTE Blade smartphone, which has been the company's flagship product. The Blade was one of the first smartphones priced below € 100 when it launched in the European market in Q4 2010. In Europe, ZTE's Blade was awarded Best Value smartphone by Smartphone Essential magazine, Best Buy by the U.K's Sunday Times, and Editor's Choice by the Geek edition of PC World.

After launching in China this past April, Blade won awards for best market performance and best Chinese-made 3G phone. Built on the success of its Blade model, and an important step forward for ZTE's entry into the middle-to-high end smartphone market, ZTE announced the new "Skate" with Android 2.3. After September launches in Brazil, Spain and Hong Kong, the global rollout of the

Skate will continue this year in European countries including the U.K. and France, in Asian countries including Malaysia, Indonesia and China, and in the United States.

“We congratulate ZTE on becoming one of the world’s top five international mobile manufacturers, and we are pleased to support its broad portfolio of smartphones,” said Ralph Quinsey, TriQuint President and CEO. “More and more consumers are choosing smartphones. TriQuint’s RF technology allows phone vendors to meet attractive cost points while still delivering a feature-rich smartphone experience.”

RFMD reveals amplifier for drop and line

The RFCA8818 is a push-pull amplifier aimed at CATV MDU, drop amplifier, and line amplifier applications.

Operating from a single power supply and containing internal input and output matching, the part provides 17dB gain and +34dBmV output power, and features low noise performance of 2dB.



RFCA8818

Features

Distortion: -72dBc CSO, -70dBc CTB at 34dBmV POUT

Applications

CATV Line Amplifiers and Amplifier Driver Stages
MDU Amplifiers
Drop Amplifiers
FTTH Driver Amplifier

This product is currently available in production quantities. Pricing begins at \$2.57 each for 1000 pieces.

Mesuro appoints Godfrey Ainsworth as chairman

The Cardiff University spin-out which sells RF testing equipment and device measurement services to the semiconductor industry will value this new addition, who has extensive experience in the III-V industry.

Fusion IP, a university IP commercialisation company that turns world class research into business, has announced that Mesuro has appointed Godfrey Ainsworth as non-executive Chairman.

Ainsworth, a Chartered Accountant and corporate financier, has over 20 years of experience in the compound semiconductor industry with the AIM-listed compound semiconductor manufacturer, IQE plc, where he is currently non-executive Chairman. He is also a Board Member of the Cardiff Partnership Fund and Cardiff Business School International Advisory Board.

Fusion IP has a 47.2% shareholding in Mesuro. David Baynes, CEO of Fusion IP, commented, “Godfrey has been working with the Board and management team at Mesuro for the past year and he has already added value to the business. His extensive knowledge of the sector from his 20 year relationship with IQE is proving invaluable and we anticipate an exciting future for Mesuro.”

Godfrey Ainsworth commented, “Mesuro is

an exceptional company, with world beating technology addressing the immediate needs of device manufacturers to obtain the very highest performance from their designs, maximising their efficiency, reducing power consumption and accelerating time to market. I am delighted to be taking on the Chairmanship at a time when the company is building an impressive sales pipeline with leading global players in the semiconductor industry. With sales already made or confirmed to the US, Europe and Japan it is clear that we will need to look for strategic partners to leverage Mesuro's potential. I look forward to building on the relationships with our existing partners and to forging new opportunities for collaborative international partnerships."

Richard Emsley, CEO of Mesuro, added, "Mesuro has had a transformational year and has secured significant sales, released a number of new products, including our VNA-based active load pull system, has a strong order book and a healthy pipeline of sales for 2012. It is a testament to the quality of Mesuro's business, position and prospects that we have been able to attract someone with Godfrey's financial, international and sector experience to head up the Board and I am looking forward to working closely with Godfrey to further expand Mesuro's business."

Accel-RF to aid further development of audioair

Airborne Media, Rock Systems and provider of fully integrated RF accelerated life-test/burn-in test systems for compound semiconductor devices, Accel-RF, are uniting to develop systems that permit smartphone users to privately listen to televisions in public venues.

Colorado based Airborne Media Group has announced the formation of technical strategic partnerships with Durango, Colorado based Rock Systems, LLC and San Diego, California based Accel RF-Corporation to drive further engineering development and manufacturing of its new Audioair "listening experience" systems.

Audioair permits smartphone users to privately listen to televisions in public venues such as

airports, and private businesses such as sports bars, restaurants and casinos which have their audio muted because of noise considerations. The Company introduced its product line to Albuquerque, New Mexico sports bars on September 17, 2011 and is now moving into multiple markets in the last quarter of 2012.



Sports Bar Customers Use Audioair to Listen to Muted Televisions

Rock Systems, LLC is an electrical engineering firm which provides high-technology electronic system solutions to customers worldwide and was instrumental in the initial development of Audioair for electrical mechanical design, software development and patent filings.

Accel-RF Corporation, which shares key management with Rock Systems, LLC, provided initial manufacturing runs of Audioair and is poised to support Airborne's further manufacturing needs for its national product roll-out.

David Sanderlin, President of Rock Systems, LLC and Executive Vice President and CTO of Accel-RF, has been named to the AMG Board of Directors in furtherance of the strategic partnership formations. Sanderlin's career spans thirty-three years and includes engineering assignments for NASA and NASA contractors, as well as the Department of Defence and the founding of his current businesses and other private high-tech engineering work. He received his BSEE and MSEE from the University of Texas at Austin in 1976 and 1978, respectively.

Chip Lile, AMG's Executive Vice-President commented on the formation of the alliances and Sanderlin's appointment to the AMG Board. "Our alliances ensure that we will have the engineering capabilities necessary to realize the tremendous product and service potential created by Audioair,

as well as other products and services we are currently developing.”

Lile added, “Dave Sanderlin’s addition to the Board reinforces our commitment to innovative product design and development. In addition, Accel-RF brings precision manufacturing capabilities to the table that are critical for the flawless operation of our systems and emerging network, especially as it becomes more far-reaching.”

Sanderlin stated that “Audioair is one of the more interesting projects I have worked on in my career, and it appears that it has great market appeal.” He added, “I am also delighted to be appointed to the AMG Board of Directors, as this company is poised to develop a number of innovative products and services. Being on the Board makes the alliances we have formed highly effective.”

One of the key objectives of the strategic partnerships will be the filing of additional patents arising from the original development work undertaken for Audioair. Under contract to AMG, Rock Systems developed a new digital audio codec that was required to correct certain deficiencies in the Google Android audio decode processing capabilities which hampered the operation of Audioair because of poor audio quality.

Chip Lile added, “With all of the myriad challenges our start-up company faces, it is tremendously important to have these strategic technical partnerships in place so that we can achieve maximum value for our emerging technologies.”

Airborne Media Group is a Durango, Colorado based privately held corporation founded in 2010. Its newly invented Audioair technology is designed to deliver an entirely new entertainment and news and information distribution experience by permitting the users of Smartphones to privately listen in to televisions in all types of venues where they must be muted for noise considerations. The company is currently developing other new products and services and it is expanding a team of strategic partners to further develop its technology and achieve its ambitious sales and marketing goals.

Rock Systems, LLC is a Colorado business entity which provides high-technology electronic system solutions to a variety of engineering needs. Their technical knowledge covers a broad range of

electronics, from complex system development to component-level performance at DC to millimetre-wave frequencies.

Accel-RF Corporation is a provider of fully integrated RF accelerated life-test/burn-in test systems for compound semiconductor devices, which are used in the implementation of broadband wireless infrastructures and networks.

Skyworks Q4 revenues soar at \$402.3 million, beating target

The firm improved operating margin by 110 basis points year-over-year to 19.3 percent on a GAAP basis.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, has reported fourth fiscal quarter and year end 2011 results.

Revenue for the quarter was \$402.3 million versus guidance of \$400 million, and was up 28 percent year-over-year and 13 percent sequentially. For fiscal year 2011, revenue was \$1.419 billion versus \$1.072 billion in fiscal 2010, a 32 percent increase.

On a GAAP basis, operating income for the fourth fiscal quarter of 2011 was \$77.7 million and diluted earnings per share was \$0.34. Operating income for fiscal 2011 was \$295.3 million and diluted earnings per share was \$1.19. The company generated \$123 million in cash flow from operations and exited the quarter with \$411 million in cash.

“Skyworks’ solid performance demonstrates the strength of our diversified business model, continued share gains and operational leverage,” said David J. Aldrich, president and chief executive officer of Skyworks.

“At a higher level, despite the current economic environment, we believe that long-term industry fundamentals remain strong as analogue content and complexity continue to increase. Given our differentiated product portfolio, technology leadership, broad customer engagements and

scale, Skyworks is strategically well positioned to capitalize on the growing number of platforms that are becoming wirelessly enabled and, in turn, to outperform our addressed markets.”

Q4 Business Highlights

Over the last quarter, Skyworks expanded gross margin by 90 basis points year-over-year to 43.4 percent on a GAAP basis. It ramped 3G/LTE multimode, multiband solutions for Samsung’s next generation Galaxy S II smart phone platforms and also supported ZTE’s launch of tablets and notebooks with EDGE and WCDMA/LTE front-end solutions.

The firm also introduced a family of low noise amplifiers for wireless infrastructure and networking applications and designed into a leading manufacturer’s platform for hearing aids using ultra low power amplifiers.

Skyworks shipped switch matrix solutions to Siemens Healthcare for deployment in their Magnetic Resonance Imaging (MRI) scanners and also commenced volume shipments of ZigBee-enabled solutions to multiple ODMs in support of home security applications.

First Fiscal Quarter 2012 Outlook

“We anticipate revenue in the first fiscal quarter of 2012 to be up 16 percent year-over-year in the \$390 million range,” said Donald W. Palette, vice president and chief financial officer of Skyworks. “Our guidance reflects near term market weakness largely offset by new program ramps. Operationally, we expect to deliver non-GAAP diluted earnings per share of \$0.50. Note, our outlook excludes any contribution from Advanced Analogic Technologies.”

Skyworks hosted a conference call with analysts to discuss its fourth fiscal quarter 2011 results and business outlook last week. The replay will be available on Skyworks’ website or by calling

888-203-1112 (from U.S.) or 719-457-0820 from outside U.S.) using pass code: 1214860.

TriQuint honoured with Global Supplier Award from Sony Ericsson

The firm has been awarded for its innovative RF technology solutions and Sony Ericsson considers the TriQuint to be an important partner in delivering its mobile communications products.

TriQuint Semiconductor, a leading RF solutions supplier and technology innovator, recently received the “Special Recognition Supplier Award” in the field of electronics from Sony Ericsson at the company’s Annual Global Supplier Conference.



“TriQuint has demonstrated a strong management commitment and flexible support in securing supply for Sony Ericsson’s portfolio,” said Peter Carlsson, Sony Ericsson Vice President, Head of Sourcing and Partner Management. “We consider TriQuint and its innovative RF technology solutions an important partner for delivering our mobile communications products.”

TriQuint was one of 11 award recipients from the 300 suppliers that were invited to attend the 10th Sony Ericsson Annual Global Supplier Conference in Malmö, Sweden.

“We are honoured by this recognition from Sony Ericsson,” said Ralph Quinsey, TriQuint President and CEO. “We will continue to deliver next generation RF solutions and outstanding support, to enable Sony Ericsson’s high-performance communications and entertainment devices for the global market.”

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible

Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-V on 200 mm Si for VLSI - Richard Hill, Sematech
- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : "CS Europe 2012: LEDs, lasers, PV and electronics Conference"

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow
- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF
- Ammonon's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonon S.A.
- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable «on-silicon» solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.
- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company
- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU
- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR- Professor Rik Jos, NXP
- Holistic Approach to MOCVD vacuum & Abatement –Dr. Mike Czerniak, EdwardsVacuum Ltd
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- Large diameter GaN-on-Si epiwafers for power electronics – Dr. Mariane Germain, EpiGaN
- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor
- Damage - free Deposition on LED devices –Dr. Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd
- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

Samsung's latest Galaxy phones go into orbit with Skyworks

Skyworks says it is providing the first multimode, multiband solutions supporting all leading baseband architectures, meeting customer needs for size and performance.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, is enabling Samsung's Galaxy S II LTE and Galaxy Note next generation smart phones with multimode, multiband power amplifier modules.

Skyworks says this is the first solution supporting all leading baseband architectures.

According to the September 2011 Equity Research Industry Update report published by Oppenheimer, an investor research firm, the proliferation of 3G bands and complexity, coupled with the start of the 4G LTE ramps is playing a key role in handset manufactures and smart phone providers' migration towards smaller, less power hungry and more cost-effective multimode, multiband architectures.

"Size and performance are the leading drivers for today's smart phone platforms," said Gregory L. Waters, executive vice president and general manager of front-end solutions at Skyworks. "Given our deep understanding of complete system solutions, Skyworks has the ability to offer customers design flexibility and customization, regardless of integration specifications. We offer the highest performance and most integrated solutions in the industry."

The SKY77606 is a fully integrated multimode, multiband power amplifier module supporting Quad-Band GSM/EDGE and Bands I, V, and VIII for WCDMA/HSDPA/HSUPA and HSPA+ handsets. Extremely low leakage current maximises handset standby time. The module is fully controllable via three line logic and band-enabled interfaces. In addition, the SKY77606 is a compact, low profile, surface mount technology package, which allows for a highly manufacturable, cost-efficient solution.

The SKY77604 is a fully integrated multimode, multiband power amplifier module supporting Quad-Band GSM/EDGE and Bands I, II, IV/X, V, and VIII for WCDMA/HSDPA/HSUPA and HSPA+ handsets. The module delivers best-in-class DG09 current consumption and is fully controllable through a Serial Peripheral Interface (SPI). Extremely low leakage current maximises handset standby time.

The Samsung Galaxy S II LTE features 4G and dual-core processing for a number of applications including fast Web browsing and premium movie

and TV downloads with Samsung Media Hub, high-definition console gaming, etc. The noticeably bigger 4.52" wide video graphics array Super AMOLED Plus Screen enables vivid and colourful images in a compact size.

The 9.5 millimetre smart phone also has an 8 megapixel camera with built in flash and QIK(R) preloaded for video chats, along with a 1080p HD camcorder. WiFi, Bluetooth, GPS, a 1.5 gigahertz processor, 16 Gb internal memory, near field communication, TV-out via mobile high-definition link, and a 1,850 milliamp-hour (mAh) battery are also included.

The Samsung Galaxy Note features the world's first 5.3" HD Super AMOLED display, making it the largest screen size with smart phone portability. This expansive, high-resolution screen enables an immersive viewing experience, allowing users to view more in one glance with minimum scrolling and screen transitions. Consumers can also draw and send ideas, emotions, and more via text messages, emails, and Samsung's ChatON communication service. In addition, it has an advanced 8 megapixel powerful camera, a strong 2500 mAh battery, and HSPA up to 21 Mbps or 4G LTE 1.4 GHz dual-core processor equating to ultra fast network speed.

RFMD recognised for superb service by Huawei

The prestigious award was accepted by RFMD's president and CEO, Bob Bruggeworth, at an awards ceremony held on 3 November in Shenzhen, China.

Designer and manufacturer of high-performance RF components and compound semiconductor technologies, RF Micro Devices, has been honoured with Huawei's 2011 "Best Supplier Award."

Huawei Technologies is a global information and communications technology solutions provider.

Bruggeworth commented following the ceremony, "It is a distinct honour to receive this award from Huawei in recognition of RFMD's commitment to excellence in on-time product delivery, local customer support, and product and technology leadership. RFMD is proud to support Huawei

across multiple product applications, including cellular handsets, smartphones, wireless infrastructure, and point-to-point cellular backhaul."

Anders Karlborg, Vice President of Huawei Supply Chain Management, said, "RFMD is a strategic partner to Huawei whose dedication to customer service and support contribute directly to our success, especially in the areas of technology development and performance, field applications support, and product delivery."

RFMD reveals new device for W-CDMA handsets

The converter has been optimised for high efficiency at light current load conditions.

The RF6650 is a pulse-width modulated (PWM), voltage-mode controlled DC-DC converter unit designed to supply power to W-CDMA power amplifiers.

The output voltage is continuously programmable through the VSET analogue input pin. The converter has been optimised for high efficiency at light current load conditions, fast transient response times to meet W-CDMA 25µs slot-to-slot transition specifications, and low noise by maintaining a constant switching frequency, while supplying up to 650mA in PWM-controlled or bypass modes.



RF6650

With over 95% efficiency and a transient response < 25ms, the module has a programmable output voltage.

The device, suitable for W-CDMA handsets, is currently available in production quantities. Pricing begins at \$1.43 each for 25 pieces.

Multipurpose GaN PA for 50MHz to 1000MHz

RFMD's 15W gallium nitride wideband power amplifier achieves high efficiency, flat gain and power over a large instantaneous bandwidth in a single amplifier design.

RFMD's RFHA1000 GaN Power IC (PIC) is a wideband power amplifier designed for continuous wave and pulsed applications such as military communications, electronic warfare, wireless infrastructure, radar, two-way radios and general purpose amplification.

Using an advanced high power density GaN semiconductor process, this high-performance amplifier achieves high efficiency, flat gain and power over a large instantaneous bandwidth in a single amplifier design.



This GaN discrete amplifier is 50Ω input-matched, and packaged in a small form factor 5x6mm SOIC-8 outline air cavity ceramic package that

provides excellent thermal stability through the use of advanced heat sink and power dissipation technologies.

Ease of integration is accomplished through the incorporation of an optimised input matching network within the package that provides wideband gain and power performance in a single amplifier. An external output match offers the flexibility of further optimising power and efficiency for any sub-band within the overall bandwidth.

The advanced GaN HEMT employs heat sink technology and operates at 28V and an output power of 15W. With a gain of 17dB, a power added efficiency of 60% and EAR99 export control, large-signal models are available.

TriQuint revenues down 9% to \$216.0 million

The firm was another to take a hit on its quarterly financial results compared to the same period last year although it fared better over the equivalent previous nine month periods.

TriQuint Semiconductor has announced its financial results for the quarter ended October 1, 2011.

Revenues for the third quarter of 2011 were \$216.0 million, down 9% from the third quarter of 2010 and down 6% sequentially. Revenues for the nine months ended October 1, 2011 were \$669.1 million, up 7% from the nine months ended October 2, 2010. Mobile Devices revenue grew 14% over last year on a year to date basis. GAAP net income for the quarter was \$16.2 million, or \$0.09 per diluted share.

Gross margin for the third quarter of 2011 was 34.9%, down from 41.3% in the third quarter of 2010 and down sequentially from 40.3%. Gross margin for the nine months ended October 1, 2011 was 38.1%, compared to 40.3% for the same period in 2010.

Operating expenses for the third quarter of 2011 were \$63.3 million, or 29% of revenue, up from \$59.1 million in the third quarter of 2010 but down from \$70.9 million in the previous quarter. Operating expenses for the nine months ended October 1,

2011 were \$201.3 million, up from \$173.1 million for the nine months ended October 2, 2010.

Net income for the third quarter of 2011 was \$16.2 million, or \$0.09 per diluted share, relatively consistent with the second quarter of 2011. Net income for the nine months ended October 1, 2011 was \$45.2 million or \$0.26 per diluted share.

Commenting on the results for the quarter ended October 1, 2011, Ralph Quinsey, President and Chief Executive Officer, stated "TriQuint's long term growth story remains intact. Mobile broadband and high performance RF are some of the most exciting growth markets in the world today. At TriQuint we are helping customers define the next generation of RF solutions. Additionally, we are investing in the capacity and capability required for future growth. I firmly believe these investments will lead to superior and sustainable long term financial performance for the company."

The Company believes fourth quarter revenues will be between \$215 million and \$225 million. During the fourth quarter, it expects lower factory utilisation as it burns through excess inventory and weak product mix to drive gross margin of 32% to 34%. Fourth quarter non-GAAP net income is expected to be between \$0.06 and \$0.08 per share. The Company is 90% booked to the midpoint of revenue guidance.

RFMD net income plummets by almost 60%

Although the firm's financial results are significantly lower than the same quarter last year, RFMD is confident about the increasing customer adoption of its gallium nitride technology in strategic market segments like military radar and CATV line amplifiers.

RF Micro Devices has reported financial results for its fiscal 2012 second quarter, ended October 1, 2011.

Compared to the same period last year, the firm's second quarter revenue decreased from \$285.8 million to \$243.8 million. On a GAAP basis, gross margin equalled 37.1%, quarterly operating income totalled \$23.0 million, and quarterly net income

was \$14.3 million, or \$0.05 per diluted share. This was again a reduction compared to fiscal Q2 2010 where operating income was \$42.4 million, net income was \$35.4 million and diluted EPS was \$0.13.

During the second quarter, RFMD generated approximately \$38.4 million in cash flow from operations and \$30.6 million in free cash flow. The firm repurchased approximately 1.7 million shares of common stock during the quarter.

Shipments of PowerSmart surpassed \$25 million in quarterly revenue, in support of Samsung, LG, and Research In Motion. Quarterly shipments of switch and signal conditioning products exceeded \$20 million.

RFMD continued to ramp its 3G/4G PAs in support of HTC, Research In Motion, Lenovo, and others. The company also secured major design wins in Smart Energy/Advanced Metering Infrastructure (AMI), point-to-point (P2P) radio for cellular backhaul, and GaN-based military radar products.

For the December 2011 quarter, RFMD expects revenues to be approximately \$250 million. It also expects CPG revenue to outpace the cellular market, driven by anticipated 3G/4G share gain and expects a sequential decline of approximately 10% in MPG revenue.

Bob Bruggeworth, president and chief executive officer of RFMD, said, «Today's overlapping macro trends of mobility, broadband data and energy efficiency present the RF industry with a significant, long-term growth opportunity, while RFMD's industry-leading products and technologies position us to outpace our industry and deliver market share gains.

«In the markets served by MPG, we continue to broaden our customer base and expand our product offerings. We are particularly enthusiastic about the increasing customer adoption of our industry-leading GaN technology in strategic market segments like military radar and CATV line amplifiers.»

«In the cellular market, we are expanding our customer relationships and winning additional content at the world's leading smartphone manufacturers. Our newest design wins set

up continued dollar content expansion in both smartphones and 3G entry handsets, while leveraging our already significant exposure to the industry's leading baseband providers. Today these include Qualcomm, Intel, ST Ericsson, MediaTek, Spreadtrum, and others.»

Dean Priddy, CFO and vice president of administration of RFMD, said, «During the September quarter, RFMD delivered approximately 14% sequential growth in revenue and nearly 50% sequential growth in non-GAAP operating income, as 3G/4G market share gains more than offset a double-digit sequential decline in MPG. In the December quarter, we expect to deliver sequential revenue growth and improved financial performance, as 3G/4G share gains are anticipated to once again more than offset a sequential decline in MPG.»

RF Micro Devices conducted a conference call to discuss its latest financial results. A telephone playback of the conference call may be accessed by dialling 303-590-3030 and entering pass code 4478096.

RFMD appoints industry veteran as corporate VP

Hans Schwarz brings more than 30 years of technology industry expertise to RFMD as well as wide-ranging involvement in successful business development and M&A activity.

RF Micro Devices, a global designer and manufacturer of high-performance radio frequency components and compound semiconductor technologies, has appointed technology veteran Hans Schwarz, age 54, as corporate vice president, business development.

With over 30 years of technology industry expertise, Schwarz also brings to RFMD a wide-ranging involvement in successful business development and M&A activity. In this newly created position, Schwarz will report to Bob Bruggeworth, president and CEO of RFMD, with responsibility for RFMD's corporate business development initiatives, including strategic planning, M&A strategy and execution, and IP-based acquisition and licensing. Schwarz will be based in RFMD's West Coast

office, in California's Silicon Valley.

Bruggeworth, said, "Hans is an exceptional leader with deep semiconductor industry experience, and we are very pleased to welcome him to RFMD. In previous positions at other semiconductor industry leaders, Hans successfully developed and executed large-scale business development programs that drove growth. As part of the RFMD team, we expect him to contribute immediately to our strategic efforts to deliver incremental growth and profitability."

Jerry Neal, co-founder and executive vice president of corporate marketing of RFMD, said, "I am pleased with the successes our corporate development team achieved in the past through several strategic business and manufacturing asset acquisitions. These corporate development successes have enabled RFMD to become a diversified growth company with an extremely bright future. I am pleased that the organisational changes announced today will allow me to continue my focus in the areas of RFMD's branding, strategic marketing and other corporate marketing initiatives."

Before joining RFMD, Schwarz served as managing director for a \$300 million late stage venture capital crossover fund, where he was responsible for searching for and investing in innovative, market-leading late-stage companies in semiconductors, storage, networking and telecom, cleantech, and other industries.

Prior to that, Schwarz spent 15 years at Xilinx, a market leader in programmable logic, serving most recently as VP of Business and Strategy Development. While at Xilinx, his responsibilities included global strategy development, managing a \$300 million strategic investment fund, corporate partnerships, and developing and implementing an industry-leading M&A process.

Prior to Xilinx, Schwarz held various management, marketing and engineering positions at Chips and Technologies ; LSI Logic and Fairchild Semiconductor.

Schwarz holds a BS in Electrical Engineering and Computer Science from Santa Clara University, in Silicon Valley. He is an independent board member of Lattice Semiconductor Corporation.

Integrated DVGAs for optimal performance in transceiver systems

TriQuint's new amplifiers are suited for public safety, 3G/4G wireless base station transceivers, remote radio heads, point-to-point microwave links and satellite communications terminal applications.

TriQuint Semiconductor has released a family of broadband, digitally-controlled variable gain amplifiers (DVGAs) that combine high linearity, gain and output power with a low noise figure and a broad range of output gain control.

These integrated products are internally matched at 50 Ω and can reduce BOM's, increase efficiency and reduce overall costs.

TriQuint's new DVGAs are suited for public safety, 3G/4G wireless base station transceivers, remote radio heads, point-to-point microwave links and satellite communications terminal applications.

The new TQM8M9075, TQM8M9076, and TQM8M9077 DVGAs combine a high-performance gain block with a precision digital step attenuator to amplify input signals in 0.5-dB steps from 0 to 31.5dB based on commands delivered through a 6-bit serial control interface.

They can be employed in the IF and RF sections of a receiver to amplify or attenuate incoming signals, especially to levels desirable for analogue-to-digital converters. They can also be used in the transmit chain to vary gain levels to amplifier stages.

A broad operating range of 500 MHz to 4 GHz and integrated performance advantages make TriQuint's DVGAs a good choice for many wireless communications systems, enabling RF designers to use one device across multiple applications. Their noise figure (as low as 2.9dB) and high linearity (OIP3 up to 38.5dB) can be critical to ensuring the best possible overall performance. In addition, their state-to-state attenuator accuracy (0.3 + 4% of attenuation setting) provides precision gain control throughout their 31.5-dB range.

The TQM8M9075, TQM8M9076 and TQM8M9077 operate from a single 5 VDC power supply at

between 87 and 125 mA, have an operating temperature range of -40 to +85°C, and have a minimum MTTF of 1,000 years at a mounting temperature of +85°C.

Technical Details: (All three DVGAs operate from 500 MHz to 4 GHz)

TQM8M9075

+20.5dBm P1dB output power, +36.5dBm OIP3, 18dB gain, 2.9dB noise figure.

TQM8M9076

+22dBm P1dB output power, +38.5dBm OIP3, 19.5dB gain, 2.9dB noise figure.

TQM8M9077

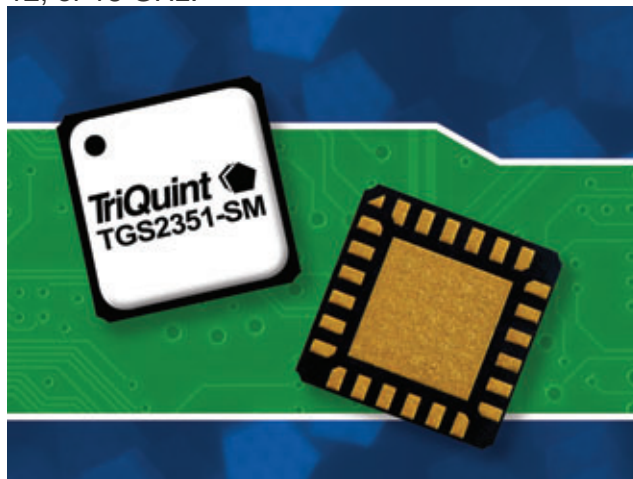
+21.5dBm P1dB output power, +38.5dBm OIP3, 13dB gain, 3.7dB noise figure.

Samples of the three new DVGAs as well as evaluation boards are now available.

TriQuint's GaN RF MMIC switches reach 18 GHz

The firm's compact gallium nitride on silicon carbide switches handle up to 40 W CW and the firm says they set new standards in solid-state performance for use in defence and aerospace applications.

TriQuint Semiconductor has introduced a family of reflective MMIC RF and microwave SPDT switches that combine the higher power-handling ability of GaN with high speed, low insertion loss, high isolation and broad frequency coverage of DC to 6, 12, or 18 GHz.



The GaN switches allow designers of defence, aerospace, or high-performance commercial systems to use a tiny semiconductor device in many applications where the only alternative previously was to utilise larger, heavier electromechanical devices.

The RF innovator's GaN switch family includes: TGS2351-SM packaged in a 4x4-mm, 24-lead, air-cavity ceramic package, and three die-level switches, the TGS-2351 (DC to 6 GHz, 40 W CW), the TGS2352 (DC to 12 GHz, 20 W CW) and the TGS2353 (DC to 18 GHz, 10 W CW).

The TGS2351-SM's air-cavity ceramic package utilises proprietary techniques to offer enhanced protection for the GaN die while also effectively dissipating more heat in a way not achievable with fully-encapsulated plastic packaging form factors. Packaged versions of the 12 GHz and 18 GHz die-level devices are in development.

GaN has a unique power-handling advantage over GaAs FETs and PIN diodes when employed in switches - GaAs FETs, although solid-state, can handle only a few watts of power, whereas PIN diodes can handle higher power, but typically consume more DC energy.

In contrast, TriQuint's HEMT GaN-on-SiC process enables its MMIC switches to handle up to two and a half times more on-state power and eight times more off-state power than a GaAs FET switch fabricated in a typical 0.25 µm GaAs process. They do so while consuming minimal current, remaining highly stable over temperature, and delivering performance comparable to or better than that of GaAs FETs or diodes. GaN switches are orders of magnitude smaller than some electro-mechanical switches.

"TriQuint innovation and GaN product development has led to another break-through device that offers performance advantages in size, weight and power that should be of particular interest to defence and aerospace designers," said Grant Wilcox, GaN Product Manager. "GaN switches have the potential to shrink the size of the host product and lower its power consumption with performance not previously offered by a solid-state switch solution."

Technical Details:

TGS2351-SM DC to 6 GHz, 40 W CW, 35 ns switching speed, 1dB noise figure, 40dB isolation, less than 1 dB insertion loss, 4x4-mm, 24-lead, air-cavity ceramic QFN package.

TGS2351 DC to 6 GHz, 40 W CW, 25 ns switching speed, 0.8dB noise figure, 35dB isolation, less than 1dB insertion loss, die-level device

TGS2352 DC to 12 GHz, 20 W CW, 25 ns switching speed, 1dB noise figure, 35dB isolation, less than 1dB insertion loss, die-level device

TGS2353 DC to 18 GHz, 10 W CW, 25 ns switching speed, 1.5dB noise figure, 30dB isolation, less than 1.5dB insertion loss, die-level device

TriQuint's new GaN switches are in production and samples are available now.

TriQuint's GaN HEMT power transistor reduces costs

The new wideband gallium nitride HEMT delivers 18-W in defence / commercial applications to 6 GHz and can reduce costs through high efficiency, output and power gain.

TriQuint Semiconductor has released the T1G6001528-Q3 GaN packaged HEMT RF power transistor which operates over a wide bandwidth of DC to 6 GHz.



TriQuint says it is an excellent choice for defence

and commercial wireless communications, avionics, radar systems, electronic warfare jammer amplifiers, test equipment and any application in which high power, broad frequency coverage, and high efficiency are critical.

Commercial and defence systems today place stringent demands on RF power devices. They must combine high RF output power with high-efficiency and gain across a wide bandwidth. The T1G6001528-Q3 is fabricated using TriQuint's proven 0.25- μm GaN on SiC process that is optimised to meet these challenges.

It incorporates advanced field plate techniques that enhance RF output power and efficiency at high drain bias operating conditions. This has significant benefits for system designers because overall costs can be reduced as fewer RF power transistors and amplifiers are required to deliver a specific power level, which can decrease the system's bill of materials and reduces thermal management requirements.

"Nearly every application today requires RF power devices that are optimised for not just one, but all performance parameters," said Richard Martin, TriQuint Defence & Aerospace Transistor Marketing Manager. "The T1G6001528-Q3 is an excellent example of how gallium nitride technology can be applied to meet these challenges without trading off a key performance metric just to satisfy another."

"Compared to even robust technologies like GaAs, GaN provides superior wideband power, efficiency and gain. Our new packaged transistor delivers its 18 Watts output power with extremely high-efficiency, greater than 60% at 6 GHz, while providing the high gain and ruggedness today's applications require," he continued.

The T1G6001528-Q3 operates from a 28 VDC power supply, will deliver its rated output power into a 10:1 VSWR without damage, and is housed in TriQuint's compact, low-thermal resistance earless solder-down package.

T1G6001528-Q3 has a typical linear gain of 10 dB, and drain efficiency >60% at 6 GHz, maximum VSWR of 10:1, from 28 VDC supply.

Samples of the T1G6001528-Q3 and evaluation boards are available now.

SETi grows AlInN materials on bulk GaN substrates

The epitaxially grown aluminium indium nitride technology will allow the firm to further develop next generation high power, very high-frequency RF components.

Sensor Electronic Technology, Inc. (SETi) has announced that it has been awarded an STTR (Small Business Technology Transfer) Phase II program to further develop AlInN/GaN based HFETs on free standing bulk GaN substrates.

The Phase II program was awarded through the Missile Defence Agency (MDA) following successful demonstration of the epitaxial growth of an entirely strain-free HFET structure, comprising of lattice matched AlInN on bulk GaN substrates in the Phase I program. During Phase I, AlInN/GaN heterostructures were deposited on bulk GaN substrates with Indium compositions ranging from 0-25%, with minimum sheet resistances of ~235 ohm/square.

This new program will target further reductions in defect density in the epitaxial GaN and AlInN layers and demonstrate increased device reliability over conventional AlGaIn/GaN HFETs. Increased reliability in GaN HFETs is essential in the defence and satellite markets, which account for over a quarter of the entire GaN RF device market.

SETi, famous for its deep UV LED products UVTOP and UVClean emitting light shorter than 365 nm, is a leader in Al(In)GaN semiconductor material technologies and with its patented process MEMOCVD has a very novel process for defect reduction in AlGaIn-based epitaxial structures on sapphire substrates.

SETi says the application of MEMOCVD in UVLED structures enabled it to become the first UV LED company to offer LEDs with wavelengths shorter than 365nm on the commercial market and continues to ensure its lead in this market today.

SETi has now demonstrated the benefits of its Al(In)GaN materials growth technologies on bulk nitride substrates and through further development from programs such as this MDA funded program, will push AlInN material technology further to the

development of next generation high power, very high-frequency RF components.

TriQuint one of 100 fastest-growing companies

The firm's growth partly to large design wins across markets including smartphones, tablets, 3G/4G base stations, optical networks and cable systems.

TriQuint Semiconductor, an RF solutions supplier and technology innovator, was named as one of Fortune Magazine's annual 100 fastest-growing companies.

The list features innovators in all aspects of the global economy.

TriQuint ranked 49th in profit growth based on several financial performance metrics over a three year period. TriQuint's growth was due in part to significant design wins across several high-growth markets including smartphones, tablets, 3G/4G base stations, optical networks and cable systems.

"This recognition is confirmation that the passionate, devoted efforts of our employees and the products and solutions that we create have become a foundation for many of our customers," said Ralph Quinsey, TriQuint President and CEO. "We will continue our focus on RF innovation and manufacturing technology to simplify our customers' designs, and help them meet the demand for more connectivity now and in the future. This is an incredibly exciting time for TriQuint and our industry."

To qualify for Fortune Magazine's annual 100 Fastest-Growing Companies list, a company - foreign or domestic - must be trading on a major U.S. stock exchange; report data in U.S. dollars; file quarterly reports with the SEC and have a minimum market capitalisation of \$250 million.

The companies that meet these criteria are ranked by revenue growth rate, EPS growth rate and three-year annualised total return for the period ended June 30, 2011. The data was provided by Zacks Investment Research. The data process was aided by information provided by Compustat, Hoover's, Thomson Reuters, and Morningstar Document

Research.

TriQuint honoured with Huawei Green Partner certification

The firm has been acknowledged for eliminating banned or controlled hazardous materials and promoting the use of environmentally friendly materials.

RF product supplier, TriQuint Semiconductor has received the "Huawei Green Partner" award in recognition for its ability to provide an environmental management system that ensures product content and manufacturing processes meet or exceed Huawei's stringent green requirements.

Huawei commits to providing innovative and customised telecom products, services and solutions, and has always embraced environmental protection as a crucial part of its sustainable development; the Huawei GP program was established to encourage suppliers to produce components with minimal environmental impact.

Huawei's Green Partner certification demands the elimination of banned or controlled hazardous materials, the use of environmentally friendly materials, and the development of environmental audits and action plans. Suppliers can achieve Huawei Green Partner status by meeting these requirements and by demonstrating compliance via an on-site audit.

"We recognise Huawei's Green Partner program is among the most highly regarded of such programs, and we are extremely proud and honoured to have been certified by Huawei for the very first time," says Steven R. Grant, TriQuint Vice President, Worldwide Operations. "Certification as a Huawei Green Partner highlights TriQuint's strong commitment to quality products and environmental responsibility."

Lasers

Soraa secures \$88 million in funding

Funding by Khosla Ventures and NEA will help to develop and commercialise blue and green lasers grown on non-polar and semi-polar gallium nitride substrates.

Soraa, a developer of laser diodes for consumer, biomedical, defence, and industrial applications, has closed on \$88.6 million in fresh capital, according to a SEC regulatory filing.

The funding for the Fremont, California-based laser start-up has come from Khosla Ventures and NEA. Soraa lists its director and NEA general partner Ravi Viswanathan on the new filing.

Soraa, which was founded by the UCSB academics Shuji Nakamura, Steve DenBaars, and Jim Speck, is developing lasers on semi-polar and non-polar GaN substrates.

The benefits that these new planes deliver, in terms of device performance and architecture, will be discussed during a talk given by James W. Raring, VP Laser Engineering of Soraa, at the CS Europe Conference 2012. At this meeting in Frankfurt he will be presenting a talk entitled "*III-Nitride Lasers Based on Nonpolar/Semipolar Substrates*".

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

GaN nanowires have a bright future

Gallium nitride nanowires grown by PML scientists may only be a few tenths of a micron in diameter, but they promise a very wide range of applications, from new LEDs and diode lasers to ultra-small resonators, chemical sensors, and highly sensitive atomic probe tips.

In the two decades since GaN was first employed in a commercially viable LED, ushering in a dazzling future for low-power lighting and high-power transistors, the III-V semiconductor has been produced and investigated numerous ways, in both thin-film and nanowire form.

At PML's Quantum Electronics and Photonics Division in Boulder, Colorado, much of the recent effort has been devoted to growing and characterising extremely high-quality GaN nanowires – "some of the best, if not the best, in the world," says Norman Sanford, co-leader of the Semiconductor Metrology for Energy Conversion project.

GaN emits light when holes and electrons recombine at a junction created by doping the crystal to create p-type and n-type regions. These layers are formed by a variety of deposition methods, typically on a sapphire or SiC substrate. Conventional methods produce crystals with relatively high defect densities. Unfortunately, defects in the lattice limit light emission, introduce signal noise, and lead to early device failure.

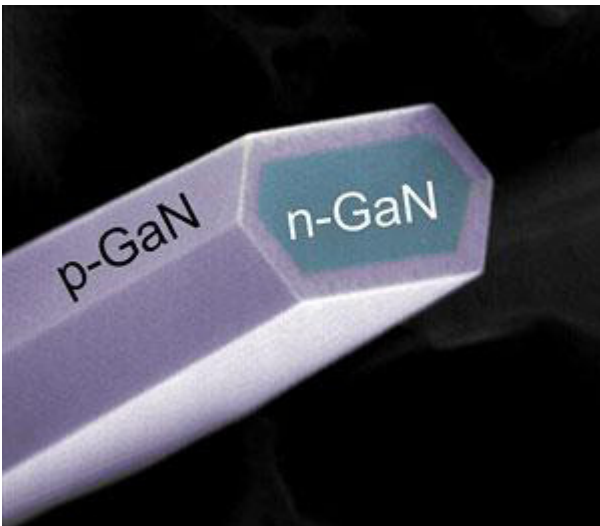
The Boulder team, by contrast, grows virtually defect-free hexagonal GaN nanowires very slowly from a silicon base. Their MBE deposition method allows the nanowires to form spontaneously without the use of catalyst particles. Although catalyst particles are widely used for nanowire growth, they leave behind trace impurities that can degrade GaN. It takes two to three days for the structures to reach a length around 10 microns (about one-tenth the thickness of a human hair), but the wait pays off because the crystal structure is very nearly perfect.



Optically pumped GaN nanowire laser shown

glowing orange. The actual laser output is UV (≈ 370 nm) and invisible to the unaided eye. The length of the lasing nanowire is roughly 10 microns and the diameter is roughly 200 nm. The metal probe tip at the top of the image is used to examine proximity effects on the lasing properties of the nanowire. Other (non-lasing) nanowires are also seen in the image.

Among other advantages, flawless crystals produce more light. «Now, for the first time, the electroluminescence from a single GaN nanowire LED is sufficiently bright that we can measure its spectrum and track the spectrum with drive current to see evidence of heating,» says project co-leader Kris Bertness. «There are no other examples of electroluminescence spectra from a single MBE-grown GaN nanowire in the literature.»



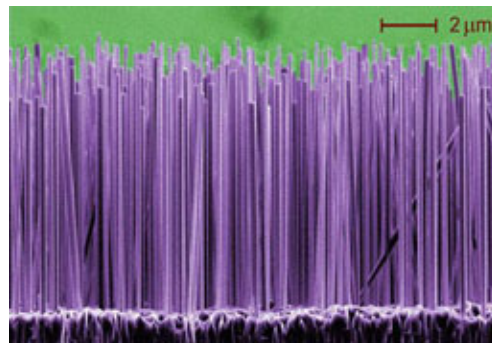
Structure of an n-type GaN nanowire grown by MBE and coated in a thin-shell of p-type GaN grown by halide vapor phase epitaxy. (Credit: Aric Sanders and Albert Davydov/MML)

GaN and its related alloy system (including semiconductors containing indium and aluminium) form the basis of the rapidly expanding solid state lighting industry. It could move faster, experts believe, if industry could develop an economical method to grow low-defect-density material.

“Conventional GaN-based LEDs grown on cost-effective but non-lattice-matched substrates (such as sapphire) suffer from unavoidable strain and defects which compromise efficiency,” Sanford says. “Additionally, light extraction from conventional planar (flat) LED structures is impeded by total internal reflection resulting in wasted

photons which are trapped in the device rather than radiating outward as useful light.”

GaN nanowire LED technology offers significant improvements since the wires grow essentially free of strain and defects and should thus enable fundamentally more efficient devices. What’s more, the morphology provided by a “forest” of densely arrayed nanowire LEDs offers improvements in the light-extraction efficiency of these structures compared with their planar counterparts.



A “forest” of nanowires

Testing and measuring those and other properties, however, poses significant challenges. “P-type GaN is difficult to grow by any common growth method,” Bertness says. “And what turns out to be very hard is making good electrical contacts to the nanowire, because it is not flat, and its thickness is larger than most of the metal films used to contact planar films.

“This 3D geometry encourages void formation and trapping of chemical impurities near the contacts, both of which degrade the contact, sometimes to the point of being unusable. This is an area we are actively investigating.”

The team is looking at ways to grow nanowires in regular arrays, with careful control of the spacing and dimensions of each individual wire. Recently they found that by creating a grid-like pattern of openings on the order of 200 nanometres wide in a SiN “mask layer” placed over the substrate, they could achieve selective growth of highly regular wires. The ability to produce ordered patterns of uniform GaN devices, Bertness says, “is essential for reliable manufacturing.”

GaN is not only a light source. It also has multiple uses in different fields. “Another nice thing about GaN is that it’s insensitive to high temperatures,” says Robert Hickernell, leader of the Optoelectronic

Manufacturing Group, which includes the Semiconductor Metrology project. "That's an advantage for high electrical power applications." The Group is also studying nanowire field effect transistors (FETs) to accurately measure carrier transport properties. "And we've got GaN nanowire FETs that are some of the best research devices in the world."

In addition, GaN nanowires are mechanically robust. Very robust: Four years ago, a PML-University of Colorado collaboration made headlines by producing nanowires with extraordinarily high quality factors that make them potentially excellent oscillators. "In the distant future," Hickernell says, "they might be used in cell phone applications as micro-resonators."

The combination of high mechanical quality factor and tiny mass also makes them capable of detecting masses in the sub-attogram range. PML collaborators at the University of Colorado are confident that they can extrapolate the present experiments to roughly 0.01 attograms, or 10 zeptograms sensitivity. (For comparison, the mass of a virus is on the order of 1 attogram, or 10

Earlier this year, Bertness, Sanford and CU collaborators used GaN's native piezoresistance to measure frequency response in nanowires stretched across a 10 micron gap. The results showed that the devices had "immediate utility in high-resolution mass and force sensing applications," the researchers wrote in their published report.

The team thinks it is possible to make "a new class of electrically-addressable multifunction scanning-probe tools," Bertness explains. "For example, conventional NSOM relies on a scanning optical tip with an aperture diameter in range of 10 to 100 nanometres which is formed at the tapered end of a passive optical fibre. Those tips are mechanically and chemically fragile and have a very short service life – hours to days. On the other hand, GaN nanowire based NSOM tools can potentially offer electrically-addressable multifunction operation that combines optical emission, optical detection, AFM and RF-AFM functionality."

Finally, GaN nanowires are also well suited for use in chemical, biological, and gas sensing. Ongoing collaborative work between the team and NIST's

Material Measurement Laboratory is producing interesting results with GaN nanowires used in tandem with nanoclusters of TiO

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on "The Market for LEDs in Lighting".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist,

Ibec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable "on-silicon" solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Soraa Inc.

Markets and Applications for SiC Transistors

- Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound

Semiconductor Markets: Current Status and Future Prospects”.

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : “CS Europe 2012: Markets and III-V CMOS Conference”

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-V on 200 mm Si for VLSI - Richard Hill, Sematech

• III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : “CS Europe 2012: LEDs, lasers, PV and electronics Conference”

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow
- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree
- Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.
- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.
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tuneable laser assemblies designed to be optimised for narrow linewidth with up to 35mW launch power in the C band and 20mW in the L band. The products' narrow linewidth and frequency stability are enabled by a NeoPhotonics phase-shifted DFB laser chip and a proprietary packaging technology, while the ITLA assembly also includes an integrated wavelength locker as well as industry standard electrical and firmware interfaces. The narrow linewidth tuneable laser has been available to customers since April 2010 and has become one of the leading lasers used in coherent systems.

“Our narrow linewidth tunable lasers are key components for coherent transport in telecommunications systems, which we believe is rapidly emerging as a dominate architecture for 40 and 100 Gbps networks,” said Tim Jenks, CEO of NeoPhotonics. “We believe there is currently a shortage of these critical products while demand continues to grow. We are in the process of more than doubling our production capacity of narrow linewidth tuneable lasers with minimal expected additional capital expenditures. We anticipate our added capacity to be on-line in the first quarter of 2012.”

NeoPhotonics doubles capacity for tuneable laser manufacturing

The firm is responding to increased demand for its narrow linewidth tuneable lasers for coherent DWDM systems used in high speed 40 and 100 Gbps coherent systems.

NeoPhotonics Corporation, a designer and manufacturer of photonic integrated circuit, or PIC, based modules and subsystems for bandwidth-intensive, high speed communications networks, is in the process of doubling capacity for production of narrow linewidth tuneable lasers.

NeoPhotonics offers these lasers in an OIF MSA standard ITLA form factor and the products are designed to provide the low noise and narrow linewidths required for 40 and 100 Gbps coherent applications.

The NeoPhotonics products are compact, widely-

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be “An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program.”

Defining the next steps for the Compound Semiconductor Industry

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix of quality speakers making it the must attend industry event for 2012.

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• SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

• Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

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InnoLas and Advanced Optical collaborate on laser product line

The German laser company will acquire the complete ACE short-pulse product line of the English specialist company.

InnoLas Laser and Advanced Optical Technology have agreed terms for the German laser company to acquire the complete ACE short-pulse product line of the English specialist company.

Reinhard Kelnberger from InnoLas Laser and Clive Ireland of AOT noted that the agreement provides an excellent opportunity for the growth of the product line and expansion of market penetration. Starting in January 2012 the manufacturing of the lasers will be relocated to the InnoLas Laser headquarters in Krailling, Germany and at the same time sales and service will be organised from Germany as well.

The AOT products are compact and unique efficient high repetition-rate short-pulse solid state lasers (nano- and picosecond) operating with high energy in the UV, visible and near infra-red. Proprietary high speed switching technology allows the E-O Q-switched laser products to deliver kHz pulses below 1ns duration that are synchronisable to external events with sub-nanosecond accuracy.

They are intended for a wide range of R&D, scientific and high precision industrial applications.

The technology will form a very valuable and complimentary addition to the existing products of InnoLas Laser, and will greatly enhance the range of solutions that the company can offer to customers in the near-term and future.

Diode lasers to battle it out with LEDs

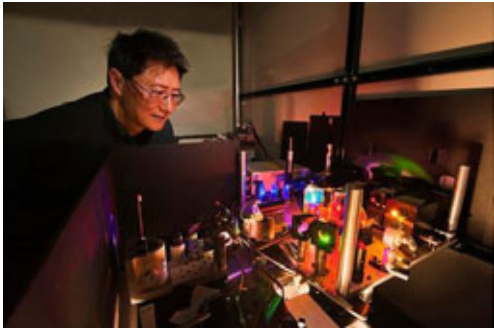
The new kids on the block, diode lasers, can produce high-quality white light using a four-colour laser source and could challenge LEDs for home and industrial lighting supremacy.

The human eye is as comfortable with white light generated by diode lasers as with that produced by increasingly popular LEDs, according to tests conceived at Sandia National Laboratories.

Both technologies pass electrical current through material to generate light, but the simpler LED emits lights only through spontaneous emission. Diode lasers bounce light back and forth internally before releasing it.

The finding is important because LEDs, widely accepted as more efficient and hardier replacements for century-old tungsten incandescent bulb technology, lose efficiency at electrical currents above 0.5 amps. However, the efficiency of a sister technology, the diode laser, improves at higher currents, providing even more light than LEDs at higher amperages.

“What we showed is that diode lasers are a worthy path to pursue for lighting,” said Sandia researcher Jeff Tsao, who proposed the comparative experiment. “Before these tests, our research in this direction was stopped before it could get started. The typical response was, ‘Are you kidding? The colour rendering quality of white light produced by diode lasers would be terrible.’ So finally it seemed like, in order to go further, one really had to answer this very basic question first.”



Sandia researcher Jeff Tsao examines the set-up used to test diode lasers as an alternative to LED lighting. Skeptics felt laser light would be too harsh to be acceptable. Research by Tsao and colleagues suggests the skeptics were wrong. (Photo by Randy Montoya).

Little research had been done on diode lasers for lighting because of a widespread assumption that human eyes would find laser-based white light unpleasant. It would comprise four extremely narrow-band wavelengths – blue, red, green, and yellow - and would be very different from sunlight, for example, which blends a wide spectrum of wavelengths with no gaps in between. Diode laser light is also ten times narrower than that emitted by LEDs.

The laser diodes (LDs) were composed of the following materials :

Red : 635nm, 800mW maximum power, multiquantum well AlGaInP LD.

Yellow : 589 nm, 500 mW maximum power, sum frequency generation of 1064 nm and 1319 nm from 808 nm LD pumped Nd:YAG.

Green : 532 nm, 300 mW maximum power, frequency doubled 1064 nm from 808 nm LD pumped Nd:YVO4.

Blue : 457 nm, 300 mW maximum power, frequency doubled 914 nm from 808 nm LD pumped Nd:YVO4.

The tests, a kind of high-tech market research, took place at the University of New Mexico's Centre for High Technology Materials.

Forty volunteers were seated, one by one, before two near-identical scenes of fruit in bowls, housed

in adjacent chambers. Each bowl was randomly illuminated by warm, cool, or neutral white LEDs, by a tungsten-filament incandescent light bulb, or by a combination of four lasers (blue, red, green, yellow) tuned so their combination produced a white light.

The experiment proceeded like an optometrist's exam; the subjects were asked "Do you prefer the left picture, or the right? All right, how about now?"

The viewers were not told which source provided the illumination. They were instructed merely to choose the lit scene with which they felt most comfortable. The pairs were presented in random order to ensure that neither sequence nor tester preconceptions played roles in subject choices, but only the lighting itself. The computer program was written, and the set created, by Alexander Neumann, a UNM doctoral student of CHTM director Steve Brueck.

Each participant, selected from a variety of age groups, was asked to choose 80 times between the two changing alternatives, a procedure that took ten to twenty minutes, said Sandia scientist Jonathan Wierer, who helped plan, calibrate and execute the experiments. Five results were excluded when the participants proved to be colour-blind.

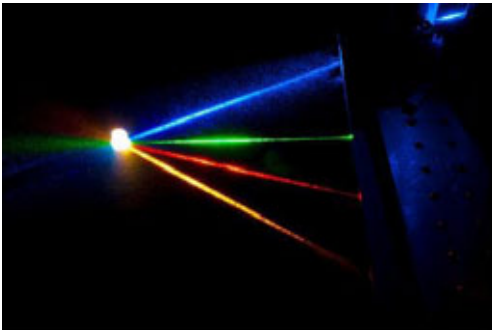
The result was that there was a statistically significant preference for the diode-laser-based white light over the warm and cool LED-based white light, Wierer said, but no statistically significant preference between the diode-laser-based and either the neutral LED-based or incandescent white light.



In the test setup, similar bowls of fruit were placed in a lightbox with a divider in the middle. In this photo, the bowl on one side was illuminated by a diode laser light and the

other was lit by a standard incandescent bulb. The aesthetic quality of diode laser lighting (left bowl) compares favourably with standard incandescent lighting (right). (Photo by Randy Montoya).

The results probably won't start a California gold rush of lighting fabricators into diode lasers, said Tsao, but they may open a formerly ignored line of research. Diode lasers are slightly more expensive to fabricate than LEDs because their substrates must have fewer defects than those used for LEDs. Still, he said, such substrates are likely to become more available in the future because they improve LED performance as well.



Four laser beams — yellow, blue, green and red — converge to produce a pleasantly warm white light. Results suggest that diode-based lighting could be an attractive alternative to increasingly popular LED lighting, themselves an alternative to compact-florescent lights and incandescent bulbs. (Photo by Randy Montoya).

Also, while blue diode lasers have good enough performance that the automaker BMW is planning their use in its vehicles' next-generation white headlights, performance of red diode lasers is not as good, and yellow and green have a ways to go before they are efficient enough for commercial lighting opportunities.

Still, says Tsao, a competition wouldn't have to be all or nothing. Instead, he said, a cooperative approach might use blue and red diode lasers with yellow and green LEDs. Or blue diode lasers could be used to illuminate phosphors — the technique currently used by fluorescent lights and the current generation of LED-based white light — to create desirable shades of light.

The result makes possible still further efficiencies

for the multibillion dollar lighting industry. The so-called "smart beams" can be adjusted on site for personalised colour renderings for health reasons and, because they are directional, also can provide illumination precisely where it's wanted.

Colourimetric and experimental guidance was provided by the National Institute of Standards and Technology.

Further details of this research is available in the paper, "Four-color laser white illuminant demonstrating high color-rendering quality" by Neumann *et al*, *Optics Express*, 19, Issue S4, pp. A982-A990 (2011)

<http://dx.doi.org/10.1364/OE.19.00A982>.

This work was conducted as part of the Solid-State Lighting Science Energy Frontier Research Centre, funded by the U.S. DOE Office of Science.

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

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- Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

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Kevin Laughlin becomes CEO at Intense

The laser industry expert has previously held senior positions at Nuvonyx, PRC Laser and Stripit/LVD.

Developer of next generation semiconductor lasers, systems and solutions, Intense, Inc., has appointed Kevin Laughlin to the position of Chief Executive Officer.

A 26-year veteran of the industry, Laughlin has a broad array of experience, from laser design and optics applications to senior level positions in product management, sales, and marketing. Most recently, he was Chief Commercial Officer at Intense where he worked with the management team and investors to consolidate the company's Glasgow, Scotland and North Brunswick, NJ business units. They now form a single US site that provides global manufacturing, sales, and service for a wide range of laser diode components, electro optical sub-modules, and fully integrated, turnkey laser systems.



Kevin Laughlin has been appointed to the position of Chief Executive Officer at Intense

“With Intense’s individual business units and investor base now consolidated, we are well positioned to take advantage of the new growth opportunities in the industry,” stated Kevin Laughlin, CEO, Intense. “Post-consolidation we will continue to invest in technology, people, and product development that will keep us at the forefront of the diode laser market space. These are very exciting times. Our world class engineering and manufacturing capabilities, innovative QWI technology, and highly skilled employees combine to produce unique packaged laser solutions that are paving new paths in defence, print, medical, and industrial applications.”

Laughlin began his tenure at Intense as their first US employee when he was hired as VP of Sales in 2006. In 2007, with Intense’s acquisition of New Jersey-based High Power Devices, he took on the role of VP of Global Sales and Business Development for both the UK and US business units. Prior to Intense, Laughlin worked at Nuvonyx (St. Louis, MO) as VP of Sales and Marketing. He’s also held management positions at PRC Laser (Landing, NJ) and Stripit/LVD (Buffalo, NY).

Laughlin is Former Chairman of the Industrial Laser Advisory Board for the Laser Processing Consortium at Penn State Applied Laser Research Lab. He is also a Former Chairman of the AMT’s Laser Products Systems Group and has acted as Chairman of numerous technical laser conferences. He is an active member of the Fabricators Manufacturers Association (FMA), Association of Manufacturing Technology (AMT), Society of Manufacturing Engineers (SME), and Laser Institute of America (LIA). Laughlin has published more than 40 technical papers and articles, and graduated with a degree in Electrical Engineering and Robotics.

Optical communications & laser solutions provider Oclaro Issues Statement on Thailand Flooding

Oclaro, a tier-one provider of innovative optical communications and laser solutions, today issued a statement regarding the impact on its operations of the Thailand flooding and also provided an update to its expectations for first quarter, fiscal year 2012 financial results which are consistent with guidance provided on July 28, 2011.

Statement on Thailand Flooding:

Oclaro's primary contract manufacturer, Thailand-based Fabrinet, manufactures approximately 30 percent of Oclaro's total finished goods in two factories: Chokchai and Pinehurst. Due to flooding in Thailand, both factories suspended operations on October 22, 2011. As a result, Oclaro immediately began to deploy its contingency planning to assess alternative manufacturing options. Subsequently, on October 24, Fabrinet announced its Chokchai factory suffered extensive flood damage and is now largely inaccessible due to high water levels inside and surrounding the manufacturing facility. Oclaro's assessment of the damage to equipment and inventory on site is affected by the limited site accessibility at this time. Oclaro and Fabrinet management are actively investigating alternative production locations and have enacted business continuity plans. Fabrinet's Pinehurst facility remains secure from flood water at this time, but remains closed. Shipments continue from Oclaro's Shenzhen, China manufacturing facility, and other locations which account for approximately 70 percent of Oclaro finished goods output. However, Oclaro is still evaluating the broader supply chain implications of the flooding in Thailand across its entire manufacturing operations. All Oclaro employees in the region remain safe.

"Our thoughts are with the Thai people who have been personally affected by the flooding in Thailand," said Alain Couder, chairman and CEO, Oclaro. "In addition, we would like to thank our Thai employees and the Fabrinet team who are undertaking extraordinary efforts to assess and contain flood damage."

Couder continued, "Due to the ongoing assessment of flood damage and recovery plans, Oclaro is postponing the announcement of its first quarter FY 2012 financial results. However, we are pleased to report that our preliminary results are within our previous guidance range and that our profitability was near the upper end of the range."

Updated Expectations for Q1 FY2012 Financial Results, Ending October 1, 2011:

Revenue for the first quarter of fiscal 2012 is anticipated to be approximately \$106 million, compared with a guidance range of \$103 million to \$113 million.

Non-GAAP gross margin is anticipated to be approximately 23%, compared with a guidance range of 18% to 24%.

Adjusted EBITDA is anticipated to be approximately \$(4.5) million, compared with a guidance range of \$(8.5) million to \$(2.5) million.

These guidance ranges were provided by the Company on July 28, 2011.

Oclaro cautions that its anticipated financial results are preliminary and based on the best information currently available and are subject to completion of the financial statements for the first quarter of fiscal 2012.

Eurazeo acquires 3S Photonics

The firm will also be investing in a capital increase of €10 million to finance 3S Photonics' growth, for a total equity investment of €37 million by Eurazeo. Following the equity increase, Eurazeo will hold close to 83% of 3S Photonics' capital.

Eurazeo has signed the acquisition of 3S Photonics, a French high technology company, specialising in opto-electronic components.

This second investment by Eurazeo Croissance, following its investment in Fonroche, is part of Eurazeo's policy to support the development of French SMEs. Eurazeo is purchasing the holdings

of several investors, including those of Fonds Stratégique d'Investissement (FSI) for which 3S Photonics had been one of its first investments.

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3S Photonics, formerly Alcatel Optronics, manufactures optical and opto-electronic components for submarine telecoms applications, the company's historical core business, as well as for terrestrial telecoms applications. The company is active in two high-growth global markets, high-speed telecoms networks and industrial fibre lasers, supplying products for industrial, medical and defence applications.

The company has two production centres, virtually unique in the world; one in France specialised in the manufacture of laser chips and the other in Canada producing optical fibres.

3S Photonics generated revenues of €51 million in Fiscal 2011 (ended June 30, 2011) and employs approximately 400 people.

Eurazeo will help 3S Photonics consolidate its position in its traditional telecoms markets and broaden its presence in the industrial laser market. It will be supporting the company's external growth policy, including through future reinvestment.

Fabrice de Gaudemar, Eurazeo Executive Board member responsible for Eurazeo Croissance, said, "We are pleased to be making this investment which reflects our intention to contribute to accelerating the growth of high potential companies. Eurazeo continues to play its role as a professional and responsible shareholder supporting strong SME development. We will be supporting Alexandre Krivine and his team, continuing the work begun with the help of FSI to make 3S Photonics a true global leader in the opto-electronic components market."

Alexandre Krivine, President of 3S Photonics, added, "We are gratified by Eurazeo's entry into our capital structure. With their support, we look forward to accelerating our organic and external growth and seizing opportunities offered by the international

consolidation of our industry."

Thierry Sommelet, Director of Investment of FSI, commented, "FSI's intervention in 2009 facilitated a first round of financing, helping to enable 3S Photonics' acquisition of Avensys. We are pleased that 3S Photonics will be able to continue its development with the support of a recognized leader in France's private equity industry."

Northrop Grumman announces QCL for Its CIRCM offering

The Quantum Cascade Laser (QCL)-based solution, which is composed of III-V compound semiconductors, is claimed to offer warfighters the most mature aircraft protection available in an open architecture package.

Northrop Grumman Corporation and Daylight Solutions have announced the successful integration and test of the Solaris QCL-based system into the Northrop Grumman offering for the United States Army's mission-critical Common Infrared Countermeasures (CIRCM) program.



Timothy Day, chairman and CEO of Daylight Solutions, Paul Larson, president, COO, Daylight Solutions, Carl Smith, vice president of infrared countermeasures for Northrop Grumman, and Jeffrey Palombo, vice president and general manager of Northrop Grumman's Land and Self Protection Systems Division, unveil the companies' CIRCM laser and pointer-tracker offering.

The result of a multiyear effort by a Northrop Grumman-Daylight Solutions team, the Solaris laser is part of a fully compliant and mature CIRCM

system solution. The capabilities of Daylight Solutions' QCL-based laser solution have been validated through multiple government tests to protect both fixed and rotary wing aircraft against missile threats, such as man portable air defence systems.

"With Daylight Solutions, we are adding the leaders in QCL-based laser technology to the Northrop Grumman CIRCM solution," said Jeffrey Palombo, sector vice president and general manager of Northrop Grumman's Land and Self Protection Systems Division. "Our candidate system offers the warfighter the most mature aircraft protection available in an open architecture package. Open architecture provides efficiency, economy and long-term platform protection as new threats emerge."

The Northrop Grumman-led CIRCM team also includes SELEX Galileo, which will provide the Economic Compact Lightweight Pointer-Tracker System (ECLIPSE) jam head. Northrop Grumman and SELEX Galileo have been working in partnership on advanced IRCM systems for more than 15 years.

Northrop Grumman Corporation is the industry leader in Directional Infrared Countermeasures (DIRCM) laser design and production, with over 2,400 lasers fielded to date. Its IRCM systems have been installed on over 750 aircraft representing 50 different aircraft types, including large and small fixed-wing, rotary-wing and tilt-wing platforms.

IPG exonerated from IMRA patent infringement

To reach this verdict, the jury heard testimonies from two of the inventors of the patent in question, experts in lasers, amplifiers and optics, and employees from both IPG and IMRA.

High-power fibre lasers and amplifier manufacturer, IPG Photonics has announced that a jury in the District Court for the Eastern District of Michigan has determined that the Company does not infringe on IMRA America's (IMRA) patent number 5,818,630 in a suit originally brought by IMRA in 2006.

In its ruling, the jury found that the Company did not

infringe on the claims asserted by IMRA. To reach this verdict, the jury heard testimony from two of the inventors of the '630 patent, experts in lasers, amplifiers and optics, and employees from both IPG and IMRA. The testimony and evidence put forth to the jury failed to prove that IPG in any way infringed.

"For IPG, I am happy to report we have successfully defended the claims asserted against IPG by IMRA in the lawsuit," said IPG Chairman and Chief Executive Officer Valentin Gapontsev. "We will continue to aggressively defend IPG against claims relating to intellectual property."

Solar Could CIGS hold the key to solar manufacturers' survival?

Manz believes CIGS thin-film technology is the last step toward solar power, being able to compete with other sources of solar energy without subsidies.

On November 15, 2011, Manz signed a letter of intent to acquire the innovative production line for CIGS solar modules from Würth Solar, headquartered in Schwäbisch Hall.

Dieter Manz, founder and CEO of Manz AG, provides five important answers about the upcoming deal.

1. The Big Picture: What was the state of the industry when Manz acquired the Innovation Line of Würth Solar in Schwäbisch Hall in the middle of November?

Political instability in Western industrialised nations, particularly in Germany, concerning the further development of feed-in tariffs led to considerable worldwide overcapacities at solar module manufacturers and, as a result, a rapid decline in prices for end products.

This trend, which is painful for manufacturers, did have a positive effect on the industry as a whole, however – at current prices, photovoltaics (PV) is

becoming increasingly interesting for large markets with lots of sun, such as the United States, India, and China.

In these markets, solar power will soon be viable without large subsidies. That's why I expect the current sales crisis to end in approximately nine to twelve months. Until that time, module manufacturers need to cut their costs in order to maintain their market position, since the prices for modules are definitely not going to go up.

2. The Technology: Manz has collaborated with Würth Solar in the field of CIGS thin-film technology for the past year and a half. Why this technology exactly?

CIGS (based on a semiconductor made of copper, indium, gallium, and selenium) has the greatest potential to cut costs and increase efficiency of all the thin-film technologies. Our partner ZSW, the Centre for Solar Energy and Hydrogen Research Baden-Württemberg, located in Stuttgart, Germany, has already achieved efficiencies of over 20 percent in a laboratory setting. That is the world record and almost as good as the top efficiency of polycrystalline silicon cells.

At the same time, CIGS modules can be produced extremely affordably, and not just compared to crystalline silicon technology. We believe CIGS thin-film technology is the last step toward solar power, being able to compete with other sources of energy without subsidies. This is called grid parity, and it has already been reached in individual markets, such as California, and will soon be reached in Germany as well.

3. The Timing: Why did Manz acquire the production line from Würth Solar now?

Würth Solar decided not to invest in expanding its production, and in the future wants to focus on the sale of solar modules – after all, based on its strategy, Würth is a commercial enterprise and not a manufacturer. Together with Würth Solar, in the past one and a half years, we have developed CIGS into a record-breaking technology when it comes to the efficiency of thin-film modules – in Schwäbisch Hall, we achieved a module efficiency of 14 percent in a mass-produced panel.

Now we are converting Würth Solar's production

line with a capacity of 30 MW into an "innovation line" with a capacity of 6 MW. In the future, we will use this line to test new machines, new materials, and new processes. Such process optimisation shouldn't only be carried out in a lab, what we need is an environment similar to a mass production setting. Due to the long-term growth of the photovoltaic industry and grid parity being achieved in large markets, global players such as electronics companies will soon enter the PV market. And we want to be ready when that happens – with a technically mature complete package.

4. The Customer Benefit: What added value can potential customers gain from your acquisition of the Würth Solar Innovation Line?

We have cut the CIGSfab's production costs by 25 percent since the beginning of our partnership with Würth Solar in July of 2010. And we can go much further, as our technology road map shows. Our goal is to develop CIGS thin-film technology into the most affordable solar technology.

In order to achieve this goal, we are acquiring a mature technology from Würth Solar as well as 118 CIGS specialists. As a result, we have the largest team dedicated to this technology in the entire industry. We can help potential customers quickly begin production in their new factories and minimise their investment risk.

This combination is one-of-a-kind in the engineering sector and will secure Manz's lead over the competition in the future as well. As an engineering firm, with CIGS fab we have an important key to solar module manufacturers' survival during the upcoming consolidation. Most solar manufacturers do not have any other choice – either they give up or invest in a new future technology such as the CIGSfab. Business as usual in the solar industry is not an option.

5. The By-Product: Will Manz now become a module manufacturer itself and be forced to sell solar panels?

That's a legitimate question, but we are reducing production capacity in Schwäbisch Hall to a fifth of its original size, which will hardly make us a serious module manufacturer. Our focus is on innovation, not production. The modules produced in Schwäbisch Hall will either be sold through Würth

Solar or to potential buyers of our CIGSfab. For the latter, this is an ideal way to prepare for their own market entry with identical modules, so they are ready when their own line begins operation.

Soitec wins first order from China for CPV systems

The firm will provide systems which use III-V-based triple-junction solar cells incorporating gallium indium phosphide, gallium indium arsenide and germanium, to Focusic.

Fulfilling its first order for solar-energy systems from the People's Republic of China, Soitec has shipped its GaInP/GaInAs/Ge Concentrix concentrator photovoltaic (CPV) systems to Focusic (China) New Energy Holding, a Chinese developer of renewable-energy power plants. This initial order is part of a partnership agreement between the two companies.

"We are impressed by the ultra-high efficiency of Concentrix technology and by the experience that Soitec has amassed through extensive research and development work, dating back to the technology's origin at Fraunhofer ISE," said Ma Wenxing, managing director at Focusic.

"The renewable-energy market in China presents exciting prospects for our CPV technology, and we are delighted to seize this opportunity together with Focusic," said Hansjörg Lerchenmüller, senior vice president, customer group for Soitec's Solar Energy Business Unit.

Soitec's equipment will be used to build a 3-MW CPV solar power plant in Hami, a city on the edge of the Taklamakan desert in the Xinjiang province. Soitec's CPV technology is ideally suited for installations in ecologically sensitive desert areas because the land does not need to be graded and the indigenous plant life is not negatively impacted by shading. In addition, Concentrix systems do not require water for cooling.

With its power-generating module efficiency of up to 30 percent and low installation and maintenance costs, CPV technology is the most cost-efficient solution for high-volume power generation in regions with high direct normal irradiance (DNI). China contains an estimated 500,000 square

miles of area with high DNI ratings as well as an enormous and growing demand for energy.

Headquartered in Zhengzhou, China, Focusic (China) New Energy Holding provides low-cost clean energy in solar-rich regions of China. The company is currently developing utility-scale power plants up to 50-MW using concentrator photovoltaic (CPV) systems.

David Brady to head investor relations at First Solar

With almost 20 years of financial experience, Brady will serve as liaison between the cadmium telluride solar cell manufacturer and its investors.

First Solar has appointed David Brady as Vice President, Treasury and Investor Relations.

In this expanded position, Brady will add responsibility for Investor Relations to his current role as Vice President of Treasury, and will serve as a liaison between First Solar and its investors. Brady will continue to report to Mark Widmar, Chief Financial Officer.

Brady joined First Solar in July 2007 to lead the Treasury department. He has almost 20 years of international corporate and banking experience at companies, including eBay, Salesforce.com, Chiron and Securitas.

Brady earned his Bachelor of Business Studies degree from Dublin City University in Dublin, Ireland, and has been a Chartered Financial Analyst (CFA) charterholder since 2004.

Emcore multi-junction panels power NASA's mission to Mars

The firm's III-V compound semiconductor solar cells have a beginning-of-life conversion efficiency nearing 30% and the option for a patented, onboard monolithic bypass diode

Emcore has announced that its solar panels were successfully launched on November 26, 2011 onboard the Mars Science Laboratory (MSL) spacecraft.

The panels, delivered earlier this year under contract with NASA's Jet Propulsion Laboratory (JPL) Centre in Pasadena, CA, will power the MS) spacecraft during its cruise stage to Mars. The spacecraft is designed to carry the MSL rover "Curiosity" and communicate with the entry vehicle that will carry the rover to the surface of the planet. The solar panels for this mission were designed and manufactured exclusively by Emcore's Photovoltaic Division, located in Albuquerque, NM.

"We are very proud to contribute to NASA's latest mission to Mars and are committed to supporting NASA with other future missions," said Christopher Larocca, Chief Operating Officer for Emcore.

"Emcore has previously delivered, or is in the process of delivering, solar panels for several other NASA missions including the Lunar Atmosphere and Dust Environment Explorer (LADEE), Commercial Resupply Services (CRS) to the International Space Station, Lunar Reconnaissance Orbiter (LRO), and the Magnetospheric Multi-Scale (MMS) missions," he continued.

Emcore is a manufacturer of highly-efficient radiation-hard solar cells for space power applications. The firm's multi-junction solar cells provide power to interplanetary spacecraft and earth orbiting satellites.

Magnolia Solar flying high with \$750,000 from US Air Force

The award will fund a two-year program for the firm's flexible, III-V compound semiconductor multi-junction solar cells.

Magnolia Solar has recently received a \$750,000 Phase II award from the United States Air Force Research Laboratory as part of the Small Business Innovative Research (SBIR) program.

The award will fund a two-year project to develop

flexible, lightweight, ultra-high efficiency multi-junction solar cells for space power applications. This award follows a Phase I program that demonstrated that Magnolia's approach to simultaneously increase the current and voltage output of photovoltaic devices for space power applications. The Phase II award is to optimize the device and apply advanced anti-reflective coatings to build ultra-high efficiency flexible solar power solutions for defense applications.

Magnolia is building a patent portfolio around its proprietary technologies for this award and other work with government funding from the New York State Energy Research and Development Authority and the National Aeronautical Space Administration.

Recently Magnolia announced demonstration of several significant milestones and this award provides a pathway to support its ultimate goal of developing low-cost, high-efficiency, thin-film solar cells for commercial and defence requirements.

Ashok K. Sood, President and CEO of Magnolia Solar Corporation, stated, "Photovoltaic devices can provide a mobile source of electrical power for a variety of military applications in space and terrestrial environments. Many of these applications can directly benefit from enhancements in the efficiency of the photovoltaic devices. In particular, flexible, lightweight, high-efficiency solar cells are needed to maximise the power-generating capability of space, ground-based, and air-based defense applications."

"The patent-pending technology developed during this program is expected to have immediate market opportunities for defense applications. We look forward to continuing our partnerships with MicroLink Devices and Rensselaer Polytechnic Institute during this Phase II program."

Roger E. Welsler, Magnolia's Chief Technical Officer, observed, "Current approaches to increase the efficiency of multi-junction structures typically used for space power generation are reaching practical limitations due to fundamental constraints in conventional multi-junction device design. By combining wide and narrow bandgap material within each *p-n* junction, quantum-structured solar cells can overcome these constraints and increase the current and the voltage output of each subcell within a multi-junction solar cell.

The Phase I effort leveraged the epitaxial liftoff process developed at MicroLink Devices in Niles, IL, and has demonstrated the validity of Magnolia's extended heterojunction photovoltaic device concept. Ultimately our approach provides a pathway for obtaining thin, flexible, multi-junction solar cells with efficiency approaching 40%.»

MiaSolé appoints new CEO and President

The addition of former executives from First Solar and Intel emphasises MiaSolé's commitment to strategic growth and industry advancement.

MiaSolé, a manufacturer of CIGS thin-film photovoltaic solar panels, has announced the appointment of two seasoned executives to lead the company into its next phase of growth.

John Carrington assumes the role of Chief Executive Officer, effective immediately, and Bob Baker continues as President of the company. Carrington previously served as executive vice president of global marketing and business development at First Solar, where he directed the company's global sales, marketing, and product management initiatives, and supported its targeted expansions in Europe, Middle East, Asia and the U.S. Prior to this, he spent 16 years at General Electric in a variety of global leadership roles, including four years in Japan running the Asian marketing and business development team.

Baker is a 32-year Intel veteran who brings deep experience across technology development, manufacturing, business and management. While at Intel, Baker managed the Technology and Manufacturing Group and also grew its NAND and SSD business to a profitable \$1B+.

"MiaSolé is entering into an important time in its evolution," said Martin Lagod, Managing Director and cofounder of Firelake Capital Management, on behalf of the MiaSolé board of directors. "Both John and Bob bring a wealth of experience and the right combination of skills. Their joining speaks volumes to the potential opportunities that we see in the solar market."

This latest addition to the company's management leadership is part of MiaSolé's strategy to scale its capacity and continue building a sustainable and scalable business through innovation and manufacturing improvements.

MiaSolé recently announced a new volume production milestone at 13% module efficiency, and are on track to meet their ambitious cost per watt goals. The company also recently announced the production of its 50 millionth cell. This underscores the viability of MiaSolé's distinctive manufacturing process which has enabled the production of low cost, high efficiency, flexible solar cells at volume scale.

Joseph Laia will step down as CEO to pursue other interests. Under Laia's leadership, MiaSolé doubled its module efficiency, and today MiaSolé says its CIGS panels are superior to leading thin film and approaching c-Si performance.

"We thank Joe for his contributions to MiaSolé and look forward to continuing our path to global leadership," said Lagod.

Solar3D appoints Nadir Dagli as chief scientific advisor

The expert in photonics and nanophotonics and has made significant contributions to compound semiconductor electro-optic modulators that are critical to high-speed telecommunication systems.

Solar3D, the developer of a breakthrough 3-dimensional solar cell technology to maximise the conversion of sunlight into electricity, has appointed Nadir Dagli as Chief Scientific Advisor to guide the development of the company's technology and prototype.

Over his career, Dagli has pioneered many novel breakthrough technologies in photonics and made significant contributions to compound semiconductor electro-optic modulators that are critical to high-speed telecommunication systems. Dagli chaired and served on the technical program committees and advisory committees of numerous leading conferences. He has also authored and coauthored over 150 journal and conference

publications.

“As we press to move our technology closer to commercialization, we are extremely pleased to have someone of Dr. Dagli’s caliber on our team,” said Jim Nelson, CEO of Solar3D. “He brings years of direct and complimentary experience to bear on the issues that we will face as we develop our technology. He has the knowledge and creativity to help us optimise the efficiency of our new solar cell design.”

Solar3D’s breakthrough technology uses low-cost processes and innovative 3D light trapping structures to increase the efficiency of solar cells in order to decrease the overall cost per watt of electricity. Through revolutionary solar cell engineering, Solar3D’s approach will tip the solar cost curve in the direction of massive scalability, thus allowing the global deployment of a non-polluting energy technology that produces electricity from an unlimited power source, the Sun.

“I am honoured to be part of an innovative company that is determined to make solar energy more cost-effective,” said Dagli. “Solar3D’s technology has the potential to change the way people think about energy by making it economically feasible to dramatically increase the use of photovoltaics to generate electricity.”

Dagli received his Ph.D. in electrical engineering from the Massachusetts Institute of Technology, and has been a professor of electrical and computer engineering at the University of California at Santa Barbara (UCSB).

CIGS cells reach record efficiency of 17.4%

Q-cells says this sets a world-record for the entire thin-film sector catching up with crystalline technology.

Solibro GmbH, a subsidiary of Q-Cells SE, says it has marked a ground-breaking world record with its thin-film CIGS technology.

The firm says its thin-film Q.SMART module technology is now the first in the entire thin-film

sector to achieve a solar module efficiency of 17.4% (aperture area). The new record has been confirmed by the independent Fraunhofer ISE Institute, located in Freiburg, Germany.

The record test module, with size 16 cm², was fabricated using processes fully scalable to cost-effective mass production. The co-evaporation CIGS process uses metal flux profiles, temperature profiles as well as process time similar to Solibro’s current production.

“We are very proud of this result as it demonstrates the leadership of the CIGS technology produced by Q-Cells’ subsidiary Solibro. The current record verifies the feasibility of the efficiency roadmap of the Q.SMART module targeting an average aperture efficiency out of series production of up to 16.7 % in 2016”, said Lars Stolt, CTO of Solibro.

Already in March 2011, a Q.SMART thin-film module, marked a world-record, with an independently confirmed efficiency rating of 14.7% which the firm says is still the world-record for monolithically integrated CIGS thin film modules in series production, today.

Q.SMART’s CIGS technology harnesses a “light-soaking” effect unique in the thin-film sector to generate an average of 2.5 percent power boost above nominal power at standard test conditions. Q.SMART is also claimed to outperform in diverse environmental conditions, including low-light periods of the day and high-heat climates. Ideal for residential, commercial and utility-scale settings, Q.SMART comes along with a positive sorting; i.e. customers always receive what they pay for - and more. In October 2011 Q-Cells realised a lighthouse project by delivering around 200.000 Q.SMART modules into the world’s largest CIGS solar power plant located in Ammerland, Germany.

The CIGS technology behind Q.SMART was developed in 1983 by the Ångström Solar Centre at Uppsala University, Sweden, commercialised by the spin-off company Solibro in 2006, and acquired by Q-Cells in 2009. Q.SMART is produced in Thalheim, Germany, at the company’s own factory with a total nominal production capacity of 135 MWp.

With this world-record Q-Cells has marked the fifth world record in 2011 underpinning the technological

leadership of its products. Next to the two world-records in the CIGS sector, a polycrystalline solar module from Q-Cells' in-house research centre achieved a module efficiency of 18.1% related to the aperture area in July 2011. Recording this efficiency, Q-Cells has beaten its own world record of 17.8%, set in spring 2011. In April 2011, a cell produced on the basis of the Q.ANTUM technology had already set a record for major polycrystalline solar cells, achieving an efficiency of 19.5%.

CdTe panel manufacturer First Solar signs 2°C Challenge Communiqué

Communiqué calls on leaders to promote green growth and a climate resilient economy.

First Solar have signed the agreement as global leaders converge on Durban, South Africa for the next round of United Nations climate change debate.

“Our mission is to power the world with clean, affordable solar electricity. Price reductions in photovoltaics just since Copenhagen have put renewables on a trajectory to reach parity with unsubsidized fossil fuels. To promote further progress towards a low carbon and 100% renewable energy society, we urge the leaders at Durban to stop subsidizing fossil fuels and ultimately to set a price on carbon that is sufficient to dissuade people from burning it,” said David Eaglesham, First Solar’s Chief Technology Officer.

Initiated by The Prince of Wales’s Corporate Leaders Group on Climate Change (CLG) and managed and developed by the University of Cambridge Program for Sustainability Leadership, the 2°C Challenge Communiqué calls on governments to break the deadlock in the international climate negotiations and take the necessary action at the national level to ensure a successful transition to green growth and a climate resilient economy.

The Communiqué notes that, if they fail to act, governments “risk permanent damage to their credibility”, but the right action would “secure a low carbon-emission economy that is more resilient,

more efficient and less vulnerable to global shock”. Without an international deal, “business will have insufficient clarity or certainty of action to invest to its full potential”.

First Solar, for its part, recently announced the achievement of a cumulative production milestone of 5 GW of its advanced CdTe thin-film solar modules, which collectively displace 3.3 million tons of CO2 emissions and represent the equivalent of planting 84 million trees or removing 650,000 cars from the road.

Demand for solar energy remains constrained in many markets, however, by artificially low prices for conventional energies based on fossil fuels, which emit CO2 when they are burned to provide energy. The International Energy Agency’s latest estimates indicate that fossil-fuel consumption subsidies worldwide amounted to \$409 billion in 2010, up from \$300 billion in 2009, with subsidies to oil products representing almost half of the total.

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on “The Market for LEDs in Lighting”.

Following the success of CS Europe 2011, next year’s conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN

substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Soraa Inc.

Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

ISET ships non-vacuum CIGS modules

The company reverses industry trends by exporting PV modules to Asia.

International Solar Electric Technology, Inc. (ISET), a manufacturer of printed thin-film CIGS solar panels, has shipped full-sized modules to initial customers in South Korea from its pilot production facility in Los Angeles. Initial products were designed and assembled to meet the specifications of distributed power markets as ISET targets growth in an underserved industry segment.

The CIGS modules will supply off-grid electricity for green LED lighting applications in agricultural, industrial, and transportation markets. ISET raised just under \$18 million to develop a pilot facility in Southern California capable of manufacturing CIGS modules from bare glass to final module assembly.

ISET says it is the first PV company to ship monolithically-integrated CIGS products based on a printed ink process. ISET's CEO and President Vijay K. Kapur identified this milestone as "the product of thinking globally and competitively," pointing out that "global competition has pushed prices to a level which we had anticipated from the start. For that reason, I am extremely proud that we have begun to export American-made PV products based on ISET's manufacturing platform which can be truly cost competitive."

The company's first shipments follow closely upon recent announcements of efficiency and yield

milestones in preparation for expansion to volume manufacturing.

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound Semiconductor Markets: Current Status and Future Prospects".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec

- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

- III-V on 200 mm Si for VLSI - Richard Hill, Sematech

- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : “CS Europe 2012: LEDs, lasers, PV and electronics Conference”

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

- Ammono’s ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

- Tomorrow’s RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors

- Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.

- Markets and Applications for SiC Transistors

- Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company

- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU

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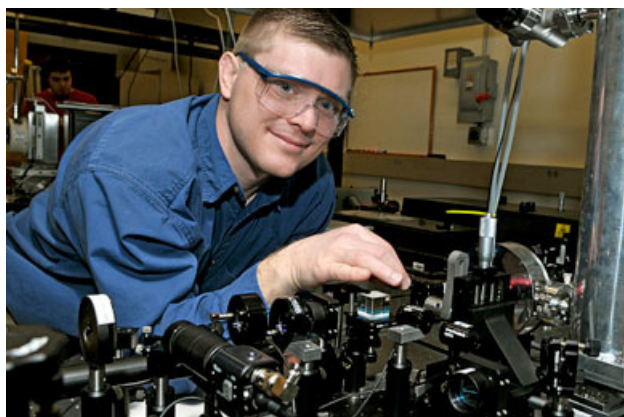
- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

How to assemble InAs quantum dots

Researchers at the University of Delaware have explored novel methods for assembling indium arsenide quantum dots for use in next generation computing devices and solar energy capture.

Matthew Doty, assistant professor in the University of Delaware Department of Materials Science and Engineering, is co-author of two papers exploring novel methods for assembling quantum dots to control how electrons interact with light and

magnetic fields.



Matthew Doty, a co-author of two papers exploring novel methods for assembling quantum dots to control how electrons interact with light and magnetic fields.

The papers recently appeared in Physical Review B, a journal of the American Physical Society (APS). Both papers were selected as “Editor’s Suggestions,” a designation reserved for only five percent of articles submitted to the journal.

A team led by the University of Delaware has received a Department of Energy grant to study the effects of adding wind power to the electric grid in the Mid-Atlantic region.

Doty’s group studies quantum dots, tiny semiconductors that can trap single electrons in a manner comparable to atoms like hydrogen and helium. Quantum dots are often referred to as “artificial atoms” because they have electronic properties similar to natural atoms.

Doty’s group explores the way these “artificial atoms” can be assembled to create “artificial molecules.” Unlike natural molecules, the properties of these quantum dot molecules can be tailored to create unique and tuneable properties for the electrons trapped in the molecules.

The first paper, entitled “*In situ tunable g factor for a single electron confined inside an InAs quantum dot molecule,*” documents a new strategy for engineering the spin properties of single confined electrons.

Doty’s team demonstrates this strategy by designing, fabricating and characterising a quantum

dot molecule that allows the electron properties to be tuned with a small change in the voltage applied to the molecule. The success of the strategy validates a new approach to engineering optoelectronic devices with dramatically improved computational power.

The second paper, entitled “*Spectroscopic signatures of many-body interactions and delocalized states in self-assembled lateral quantum dot molecules,*” describes a different molecular design, in which the two quantum dots are placed side by side instead of one on top of the other. The lateral geometry changes the way in which electrons are trapped in the molecule and creates more complex electronic molecular states.

These new electronic states of the lateral molecular design provide a template for new computing architectures that overcome scaling limits of conventional charge-based computing by mediating interactions between single confined spins.

Doty’s work with quantum dot molecules is supported, in part, through funding from the National Science Foundation, which awarded him the prestigious Faculty Early Career Development Award in 2009. The highly competitive NSF Career Award is bestowed on researchers deemed most likely to become the academic leaders of the 21st century.

Doty, who joined the UD faculty in 2007, previously served as a National Research Council research associate at the Naval Research Laboratory after earning his bachelor’s degree in physics from Pennsylvania State University and his doctoral degree in physics at the University of California, Santa Barbara.

Ascent Solar CIGS panels stand the tests of TIME

TIME magazine has honoured Ascent Solar Technologies flexible CIGS panels with one of its “50 Best Inventions of 2011” awards

Ascent’s solar technology was one of six ‘green’ inventions to be recognised in this year’s list, featured in the November 28 TIME issue.

For the past 10 years, TIME has recognised the top 50 breakthroughs in science, technology and the arts. Previous honourees have included the iPad, Nissan Leaf, 3-D cameras, and the world's first synthetic cells.

"We are honoured to be recognised by TIME as one of this year's top 50 inventions," said Ascent Solar President and CEO, Ron Eller. "Our flexible solar panels integrate seamlessly with countless applications across a wide variety of markets. TIME's recognition further validates the transformational aspects of Ascent's technology."

TIME refers to Ascent's solar panels as "ingenious" for their ability to be directly integrated with building materials without the limitations of standard, glass solar panels.

First Solar achieves 5GW CdTe PV production milestone

The cadmium telluride modules made by the firm to date are capable of generating enough clean electricity to power approximately 2.5 million homes.

First Solar has announced cumulative production has reached 5 gigawatts (GW), or 66 million CdTe photovoltaic solar modules.

The company began commercial production in 2002 and has since grown to become one of the world's largest solar module manufacturers, with 36 production lines on three continents.

"This milestone helps advance our mission of providing clean solar electricity at affordable prices. Our ability to scale high-volume production has been a key factor in reducing the cost of renewable energy," said Tymen DeJong, First Solar Senior Vice President of Global Manufacturing.

First Solar recently announced that implementing technologies and processes derived from its research and development (R&D) program produced a world-record 17.3 percent efficient CdTe solar cell in July, resulting in average module conversion efficiency of 12.4 percent from its best-

performing production lines during the third quarter.

Efficiency gains have also enabled the company to begin production of 87 watt modules, which produce higher amounts of electricity when installed in the field.

Five GW of solar generation displaces 3.3 million metric tons of CO₂e annually, the equivalent of taking 650,000 average cars off the road or planting 84 million trees each year.

On a life cycle basis, systems using First Solar modules also have the lowest carbon footprint and fastest energy payback time—the amount of time a system must operate to recover the energy that was required to produce it—of any other photovoltaic technology. This enables systems using First Solar modules to provide the greatest and fastest environmental benefits.

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be "An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program."

Defining the next steps for the Compound Semiconductor Industry

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix of quality speakers making it the must attend industry event for 2012.

The CS Europe 2012 Conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor

industry.

Conference schedule:

12th March 2012 am : “CS Europe 2012: Markets and III-V CMOS Conference”

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-V on 200 mm Si for VLSI - Richard Hill, Sematech
- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : “CS Europe 2012: LEDs, lasers, PV and electronics Conference”

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow
- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power &

RF, Cree

- Ammono’s ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.
- Tomorrow’s RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief Technology Officer, Translucent Inc.
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.
- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.
- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company
- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU
- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR- Professor Rik Jos, NXP
- Holistic Approach to MOCVD vacuum & Abatement - Mike Czerniak, EdwardsVacuum Ltd
- Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning
- Large diameter GaN-on-Si epiwafers for power electronics –Dr Mariane Germain, EpiGaN
- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

•Damage - free Deposition on LED devices –Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

•Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Manz to acquire CIGS modules innovation line from Würth Solar

With the takeover to be concluded by early 2012, Manz plans to integrate the current production site, and a total of 116 Würth Solar employees, into its own Group.

Manz AG, one of the world's leading providers of production systems for the photovoltaic and flat panel display (FPD) industry, has signed a letter of intent to acquire the innovation line for CIGS solar modules from Würth Solar in Schwäbisch Hall.

The aim is to establish an innovation factory that focuses on the rapid further development of already leading CIGS technology. This technology has the potential to deliver the lowest cost per watt compared to all other technologies, thereby optimally serving current market demands. The Centre for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW) will continue to intensively support the R&D activities. The takeover is set to be concluded prospectively by early 2012.

This step represents a consistent further development of many years of successful cooperation. The line has been used to date both by Würth Solar for CIGS module production, and by Manz as part of a licensing and co-operation agreement for the further development of CIGS system solutions. With this new agreement, the line is solely intended to serve future research and development activities.

This will allow the further development of the technology to be accelerated considerably, and the enormous cost-reduction and efficiency-enhancement potential of CIGS technology to be fully exploited. As a consequence, Manz is

making a significant contribution to quickly reducing costs per watt - one of the central topics in the photovoltaic industry.

It will also allow the milestones that have been planned to date to be reached earlier than planned. These include the optimisation of manufacturing processes, boosting efficiency, savings in terms of materials, and with them the reduction of production costs. Manz AG is thereby exercising its pioneering technological role in the photovoltaic industry, offering global solar manufacturers an economically attractive production solution.

Dieter Manz, Manz AG's CEO, explains the takeover's significance for the company, "Operating our own research line allows us to qualify our innovations directly in ongoing production operation. By contrast with a conventional pilot line, our innovation line, with its capacity of up to 6 MWp, will produce significantly more solar modules, which Würth Solar will continue to sell in the future."

Manz goes on to add, "The agreement that we have now reached is the right response to the solar market's requirements. We are firmly convinced that CIGS will prevail on the market in the medium term due to its high cost-reduction potential. Together with Würth and the ZSW, we have developed a world record module, entailing an aperture efficiency of 15.1% in production format, within a short period of time. We can further accelerate development and expand our advance in technology with the CIGS innovation line that we are creating."

Manz is to acquire the production site without incurring any further one-off costs. The CIGS technology licenses will also transfer to the company on an unrestricted basis. The know-how licensing and cooperation agreement that was concluded in 2010 will be replaced when the new contract is concluded. Manz will adopt most of the on going costs for the operation of the line to offset this. With this step, Würth Solar will focus entirely on its core competency of selling photovoltaic systems and components, as well as complete photovoltaic plants and turnkey solar power plants.

"In overall terms, we have developed an optimal solution to enable CIGS technology to realise an even more rapid breakthrough. We are particularly pleased that we will bundle our know-how with that

of the employees at the Schwäbisch Hall location, thereby setting new benchmarks as a high-tech engineer for CIGS technology,” commented Dieter Manz.

HelioVolt CIGS modules certified by UL and IEC

The firm’s HVC-170X modules have received ANSI/UL-1703, IEC-61646, and IEC-61730 certifications, as tested and certified by Intertek-ETL.

HelioVolt says its high efficiency panels offer outstanding energy yield with unprecedented reliability and performance. These monolithically integrated panels are manufactured in Austin, TX, utilising the company’s proprietary CIGS technology platform.

“The rigorous outdoor testing and reliability programs we have invested in over the past three years have given us great confidence in the superior performance of our modules. We are pleased to offer the first in a rapidly developing series of commercially available products to our strategic customers,” said Stanbery, HelioVolt’s founder and Chairman.

In September, SK TIC and SK Innovation, members of the SK Group, invested \$50M to expand HelioVolt’s Austin operations and launch global manufacturing expansion to accelerate delivery of cost-effective and reliable solar energy solutions to numerous market segments.

Miller William John pays tax liability with Veeco stock

MMD Newswire says that over the past 12 months, over 220 thousand shares of Veeco Instruments Inc. stock were sold by insiders, totalling over \$11.2 million, but that no shares have been purchased by insiders over the same time frame.

Miller William John performed a payment of a tax liability by selling 604 shares of Veeco Instruments Inc. (VECO) stock as noted in an SEC Filing yesterday. Miller William John’s title was listed as

“EVP LED & Solar” at Veeco Instruments Inc. within the filing.

Over the past 12 months, John has not sold or purchased any shares of Veeco Instruments stock. He has however performed other transactions including grants or awards and payment of tax liabilities.

MMD Newswire also says that a high-level look at insider trading at Veeco revealed that over the past 12 months, a total of 220,264 shares of Veeco Instruments Inc. stock were sold by insiders, totalling \$11,235,869. It adds that over the same time 12 month time period, no shares of Veeco Instruments Inc. were purchased by company insiders.

InGaAs nanowires on silicon a hot solar cell development

The geometry of the indium gallium arsenide nanowires provides the additional benefit of enhancing solar cell performance through greater light absorption and carrier collection efficiency.

Tiny wires could help engineers realise high-performance solar cells and other electronics, according to University of Illinois researchers.

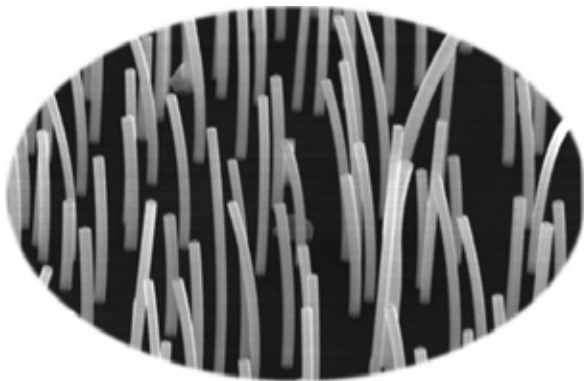
The research group, led by electrical and computer engineering professor Xiuling Li, have developed a technique to integrate compound semiconductor nanowires on silicon wafers, overcoming key challenges in device production.

Semiconductors in the III-V group are promising for devices that change light to electricity and vice-versa, such as high-end solar cells or lasers. However, they don’t integrate with silicon seamlessly, which is a problem since silicon is the most ubiquitous device platform. Each material has a specific distance between the atoms in the crystal, known as the lattice constant.

“The biggest challenge has been that III-V semiconductors and silicon do not have the same lattice constants,” Li said. “They cannot be stacked on top of each other in a straightforward way without generating dislocations, which can be thought of as atomic scale cracks.”

When the crystal lattices don't line up, there is a mismatch between the materials. Researchers usually deposit III-V materials on top of silicon wafers in a thin film that covers the wafer, but the mismatch causes strain and introduces defects, degrading the device performance.

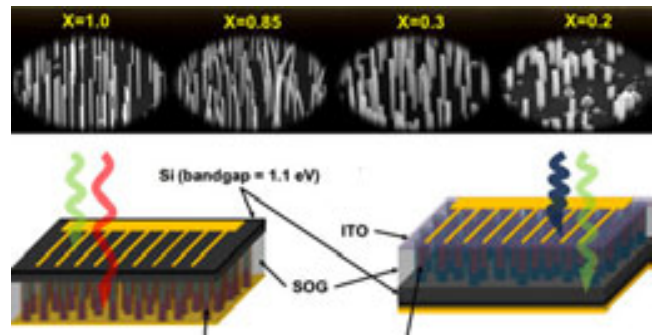
Instead of a thin film, the Illinois team grew a densely packed array of nanowires, tiny strands of III-V semiconductor that grow up vertically from the silicon wafer.



Professor Xiuling Li's group developed a method for growing semiconductor nanowires on silicon wafers that holds promise for advanced device applications, including solar cells. (Graphic by Xiuling Li)

"The nanowire geometry offers a lot more freedom from lattice-matching restrictions by dissipating the mismatch strain energy laterally through the sidewalls," Li said.

The researchers found conditions for growing nanowires of various compositions of the III-V semiconductor indium gallium arsenide. Their methodology has the advantages of using a common growth technique without the need for any special treatments or patterning on the silicon wafer or the metal catalysts that are often needed for such reactions.



InGaAs: Solar cells (bottom) made with arrays of nanowires. Engineers can tune the performance by using nanowires of differing composition and thickness (top). (Graphic by Xiuling Li)

The nanowire geometry provides the additional benefit of enhancing solar cell performance through greater light absorption and carrier collection efficiency. The nanowire approach also uses less material than thin films, reducing the cost.

"This work represents the first report on ternary semiconductor nanowire arrays grown on silicon substrates, that are truly epitaxial, controllable in size and doping, high aspect ratio, non-tapered, and broadly tuneable in energy for practical device integration," said Li, who is affiliated with the Micro and Nanotechnology Laboratory, the Frederick Seitz Materials Research Laboratory and the Beckman Institute for Advanced Science and Technology at the U. of I.

Li believes the nanowire approach could be applied broadly to other semiconductors, enabling other applications that have been deterred by mismatch concerns. Next, Li and her group hope soon to demonstrate nanowire-based multi-junction tandem solar cells with high quality and efficiency.

The Department of Energy and the National Science Foundation supported this work.

More details of this work have been published in the paper, "In_xGa_{1-x}As Nanowires on Silicon: One-Dimensional Heterogeneous Epitaxy, Bandgap Engineering, and Photovoltaics," by Jae Cheol Shin *et al*, *Nano Letters*, Articles ASAP (As Soon As Publishable), Publication Date (Web): October 3, 2011 (Letter). DOI: 10.1021/nl202676b

Ascent Solar appoints new board member

The CIGS solar cell manufacturer has appointed Vincent Lee to the Board as the designee of TFG Radiant Investment Group.

Ascent Solar Technologies, a developer of state-of-the-art, flexible thin-film photovoltaic modules, has appointed Victor Lee as a member of its Board of Directors.

Lee, age 44, is currently the managing director of Tertius Financial Group Pte, a boutique corporate advisory and private investment firm he founded in February 2009. He brings more than 17 years of experience in corporate banking, real estate finance and investment management, and corporate advisory services at leading worldwide financial institutions.

As a Class 3 director for Ascent Solar, Lee will stand for election at the Company's 2014 stockholder meeting. Lee was appointed to the Board as the designee of TFG Radiant Investment Group pursuant to the Stockholders' Agreement between the Company and TFG Radiant Investment Group, dated August 12, 2011.

Lee began his career at Citibank N.A. handling small- and medium-sized corporate finance and progressed to a vice president position in the International Personal Banking Division. In 1999 he became managing director and Singapore Market Head in the Private Wealth Management Division at Deutsche Bank AG. From 2007 until 2009 he was with Morgan Stanley Private Wealth Management, most recently as executive director and head of Singapore/Malaysia markets. Lee holds a bachelor's degree in accounting from the University of Wisconsin and a master's in wealth management from the Singapore Management University.

"We are pleased to welcome Victor to our Board and look forward to benefitting from his expertise and insights, as well as continued support from TFG Radiant," stated Ron Eller, Ascent Solar president and chief executive officer.

Odersun CIS solar modules meet criteria for higher solar power tariffs in Italy

The Copper-Indium-disulphide semiconductor on long reels of Copper Tape (CISCuT) have been independently tested.

The VDE Institute has confirmed that the thin-film solar cells produced in Germany by Odersun AG will carry the 'Made in Europe' certificate. Solar plant operators using Odersun modules can therefore realise a 10% higher feed-in tariff.

This is based on the latest Italian feed-in law (Conto Energia IV), which introduces new rules for funding solar power in Italy. The energy agency GSE will pay a 10% higher subsidy for projects incorporating European components.

In collaboration with GSE, a certificate has been developed to confirm that at least 60% of a module or its system components have been manufactured in Europe.

Gallium arsenide solar cells break SQ limits

Contrary to conventional ideas, researchers say they have demonstrated that the key to boosting solar cell efficiency is not in absorbing more photons, but emitting more photons.

Scientists in the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) say their research has led to record-breaking sunlight-to-electricity conversion efficiencies in solar cells.

"A great solar cell also needs to be a great Light Emitting Diode," says Eli Yablonovitch, the Berkeley Lab electrical engineer who led this research. "This is counter-intuitive. Why should a solar cell be emitting photons? What we demonstrated is that the better a solar cell is at emitting photons, the higher its voltage and the greater the efficiency it can produce."



The key to solar cell efficiency is not absorbing more photons but emitting more photons. (Image courtesy of DOE NREL)

Yablonovitch holds joint appointments with Berkeley Lab's Materials Sciences Division and the University of California (UC) Berkeley, where he is the James and Katherine Lau Chair in Engineering, and also directs the NSF Centre for Energy Efficient Electronics Science.

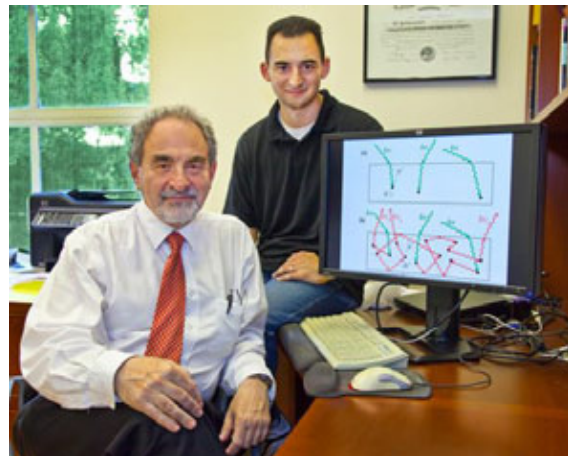
Other scientists who contributed to the ground breaking research are Owen Miller of Berkeley Lab, and Sarah Kurtz, at the National Renewable Energy Laboratory.

Yablonovitch, Miller and Kurtz describe how external fluorescence is the key to approaching the theoretical maximum efficiency at which a solar cell can convert sunlight into electricity. This theoretical efficiency, called the Shockley-Queisser efficiency limit (SQ Limit), measures approximately 33.5 percent for a single $p-n$ junction solar cell. This means that if a solar cell collects 1,000 Watts per square metre of solar energy, the most electricity it could produce would be about 335 Watts per square metre.

Calculations by Miller, who is a member of Yablonovitch's research group, showed that GaAs

is capable of reaching the SQ Limit. Based on this work, Alta Devices, a private company co-founded by Yablonovitch, has been able to fabricate solar cells from GaAs that have achieved a record conversion efficiency of 28.4 percent.

"Owen Miller provided an accurate theory on how to reach the SQ Limit that for the first time included external fluorescence efficiency," Yablonovitch says. "His calculations for gallium arsenide showed that external fluorescence provides the voltage boost that Alta researchers subsequently observed."



Berkeley Lab's Eli Yablonovitch (left) and Owen Miller showed that counter-intuitively, a great solar cell also needs to be a great LED. (Photo by Roy Kaltschmidt, Berkeley Lab)

Solar or photovoltaic cells represent one of the best possible technologies for providing an absolutely clean and virtually inexhaustible source of electricity. However, for this dream to be realised, solar cells must be able to efficiently and cost-competitively convert sunlight into electricity. They must also be far less expensive to make.

The most efficient solar cells in commercial use today are made from monocrystalline silicon wafers and typically reach a conversion efficiency of about 23 percent. High grade silicon is an expensive semiconductor but is a weak collector of photons. GaAs, although even more expensive than silicon, is more proficient at absorbing photons, which means much less material is needed to make a solar cell.

"Gallium arsenide absorbs photons 10,000 times more strongly than silicon for a given thickness but is not 10,000 times more expensive," says

Yablonovitch. “Based on performance, it is the ideal material for making solar cells.”

Past efforts to boost the conversion efficiency of solar cells focused on increasing the number of photons that a cell absorbs. Absorbed sunlight in a solar cell produces electrons that must be extracted from the cell as electricity. Those electrons that are not extracted fast enough, decay and release their energy. If that energy is released as heat, it reduces the solar cell’s power output. Miller’s calculations showed that if this released energy exits the cell as external fluorescence, it would boost the cell’s output voltage.

“This is the central counter-intuitive result that permitted efficiency records to be broken,” Yablonovitch says.



Thin film solar cells fabricated from gallium arsenide have achieved a record sunlight-to-electricity conversion efficiency of 28.4 percent. (Image courtesy of Alta Devices, Inc.)

As Miller explains, “In the open-circuit condition of a solar cell, electrons have no place to go so they build up in density and, ideally, emit external fluorescence that exactly balances the incoming sunlight. As an indicator of low internal optical losses, efficient external fluorescence is a necessity for approaching the SQ Limit.”

Using a single-crystal thin film technology developed earlier by Yablonovitch, called “epitaxial liftoff,” Alta Devices was able to fabricate solar cells

based on GaAs that not only smashed previous solar conversion efficiency records, but can be produced at well below the cost of any other solar cell technology. Alta Devices expects to have GaAs solar panels on the market within a year.

“The SQ Limit is still the foundation of solar cell technology,” says Yablonovitch. “However, the physics of light extraction and external fluorescence are clearly relevant for high performance solar cells.”

Yablonovitch believes that the theoretical work by the group, in combination with the performance demonstrations at Alta Devices, could dramatically change the future of solar cells.

“We’re going to be living in a world where solar panels are very cheap and very efficient,” Yablonovitch says.

This research was funded by a grant from DOE’s Light-Material Interactions in Energy Conversion Energy Frontier Research Centre (LMI-EFRC).

Further details of this work have been published in the paper, “Intense Internal and External Fluorescence as Solar Cells Approach the Shockley-Queisser Efficiency Limit,” by Miller *et al*, published online: arXiv:1106.1603v3 [physics.optics]

First Solar commences construction on Australia’s first utility-scale solar farm

The project, which involves the use of the firm’s cadmium telluride solar modules, will support local businesses and boost the economy in Western Australia.

First Solar has commenced construction on the 10-MW AC Greenough River Solar Farm, located 50km south of Geraldton.

Once completed, the CdTe solar farm will be the first utility-scale photovoltaic (PV) project in Australia and will bring significant investment to the local community through a partnership with local civil contractor WBHO Civil - the company awarded

the Phase 1 construction contract for the project.

The construction program is scheduled to take place over a period of approximately nine months. Following civil work, which commenced on Friday November 4th, the project will progress to on-site construction of structural supports and the completion of above ground electrical works. The installation of First Solar PV modules is anticipated to begin in March 2012, with the solar farm expected to be fully operational by mid-2012.

Western Australian state-owned power utility Verve Energy and GE Energy Financial Services each own 50 percent of the Greenough River Solar Farm, with the WA Government providing A\$20 million (US\$20.7 million) including A\$10 million (US\$10.37 million) from the WA Royalties for Regions program.

First Solar will supply the project with over 150,000 of its advanced thin film PV modules and provide engineering, procurement and construction services. Through the partnership with local contractor WBHO Civil, and in the sourcing of local products, the project is expected to generate millions of dollars for the City of Greater Geraldton's economy. Up to 150 people will be onsite at any one time throughout the construction phase, with jobs lasting for up to nine months.

"First Solar aims to maximise local hiring and enable the project to make a meaningful and lasting contribution to regional communities," said Jack Curtis, Vice President, Business Development & Sales for First Solar. "We are also building our in-country supply chain network by procuring as many materials as possible from local suppliers at all stages of the construction process.

"Increased localisation is critical to the development of a sustainable large-scale solar industry in Australia. Developing a local capability to install utility-scale solar projects, together with stable government policy, will greatly improve the industry's long-term outlook," Curtis added.

WBHO Civil will play a pivotal role in providing site preparation services, underground electrical services and civil works. The company's local expertise and extensive network across WA will ensure that the Greenough River Solar Farm is built to the highest possible standards.

"This is an exciting project for the Midwest and we are very proud to be working with First Solar, who has a reputation for the delivery of world class renewable energy projects internationally," said Michael Librizzi, General Manager - Midwest for WBHO Civil. "The project mitigates harm to the environment and is a sustainable energy resource, and this fits perfectly with our internal mantra of being an environmentally-friendly corporate citizen."

Emcore GaAs panels to go into orbit in NASA's LADEE mission

The firm's gallium arsenide based multi-junction solar cells will be used in a spaceship which is to orbit the moon.

Emcore Corporation has been awarded a contract by ASRC Research and Technology Solutions (ARTS), Greenbelt, Maryland for the design, manufacturing and delivery of solar panels for NASA Ames' Lunar Atmosphere and Dust Environment Explorer (LADEE) mission.

LADEE is a robotic mission designed to orbit the Moon. Its main objective is to study and characterise the lunar atmosphere, including fine dust particles suspended above the lunar surface. The spacecraft is currently scheduled to be launched in early 2013 aboard a Minotaur V vehicle from the Wallops Flight Facility, Wallops Island, Virginia.

A total of 32 solar panels will be built for LADEE at Emcore's state-of-the-art manufacturing facilities located in Albuquerque, New Mexico.

"This contract is an exciting award for Emcore, and we are proud to support NASA's newest lunar mission," said Christopher Larocca, Chief Operating Officer for Emcore. "Emcore has previously been awarded solar panel contracts for several other NASA missions, including the Lunar Reconnaissance Orbiter (LRO) and the Magnetospheric Multi-Scale (MMS) missions. We appreciate NASA's continued confidence in Emcore to supply solar panels for their demanding spacecraft power systems."

Emcore is a manufacturer of highly-efficient radiation-hard solar cells for space power applications. With a beginning-of-life (BOL) conversion efficiency nearing 30% and the option for a patented, onboard monolithic bypass diode, Emcore's industry leading multi-junction solar cells provide the highest available power to interplanetary spacecraft and earth orbiting satellites.

First Solar raises average CdTe cell conversion efficiency to 12.4 %

The firm has however postponed the commissioning of its cadmium telluride solar cell Vietnam factory although total production throughput is expected to reach 70 MW/line annually by the end of 2012.

First Solar has consolidated its manufacturing capacity plan and accelerated progress toward its CdTe module conversion efficiency and production throughput targets.

The company will postpone commissioning of its Vietnam factory until global supply and demand dynamics support the additional capacity. First Solar will continue developing its factory in Mesa, Arizona, in order to supply PV modules for the company's 2.7 GW North American project pipeline. This includes the Agua Caliente, Desert Sunlight, Antelope Valley Solar Ranch and Topaz projects.

In the third quarter, First Solar also began to implement technologies and processes derived from its research and development (R&D) program that produced a world-record 17.3 percent efficient cadmium telluride solar cell in July, resulting in average module conversion efficiency of 12.4 percent from its best-performing production lines during the quarter. Average conversion efficiency for all production lines was 11.8 percent in the third quarter, up from 11.7 percent in the second quarter.

First Solar also expects that continuous improvement programs in its production process, coupled with the efficiency gains, will increase its average manufacturing throughput to 70 MW annually per production line by the end of 2012, up from 63.5 MW per line in the third quarter of 2011.

"Our achievements in R&D continue to showcase the long-term conversion efficiency potential and scalability of our advanced thin-film technology," said Mike Ahearn, Chairman and interim CEO of First Solar. "This consolidation will help us to balance our production with market demand, while still providing local capacity to supply our U.S. project pipeline and the broader American market."

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

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- Ammonon's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonon S.A.
- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable «on-silicon» solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Lebby, General Manager & Chief

Technology Officer, Translucent Inc.

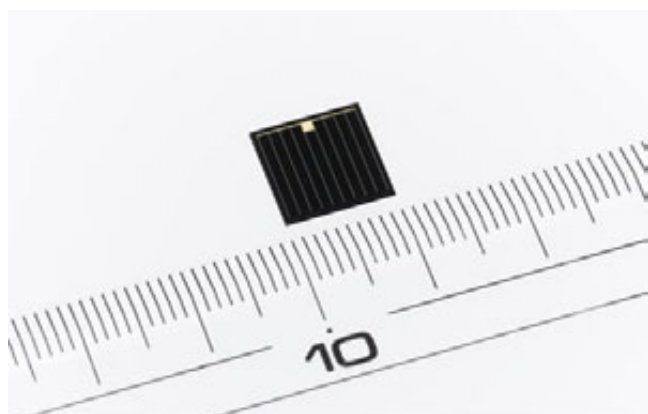
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Sora Inc.
- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.
- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company
- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU
- Commercialisation of GaN on SI based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR- Professor Rik Jos, NXP
- Holistic Approach to MOCVD vacuum & Abatement –Dr. Mike Czerniak, EdwardsVacuum Ltd
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- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

Sharp's III-V solar cell is the brightest at 36.9%

The III-V compound semiconductor solar cell has broken efficiency barriers.

Sharp Corporation has achieved what it claims is the world's highest solar cell conversion efficiency of 36.9% using a triple-junction semiconductor solar cell.



Triple-junction compound solar cell with the world's highest conversion efficiency of 36.9%

Compound solar cells utilise photo-absorption layers made from compounds consisting of two or more elements, such as indium and gallium. Because of their high conversion efficiency, compound solar cells have been used primarily on space satellites.

Since 2000, Sharp has been pursuing research and development of a triple-junction compound solar cell that achieves high conversion efficiency by stacking three photo-absorption layers. In 2009, Sharp succeeded in improving cell conversion efficiency to 35.8% based on proprietary technology that enabled efficient fabrication of a stacked triple-layer structure with InGaAs as the bottom layer.

This latest increase in conversion efficiency was achieved by improving the maximum power output of the solar cell by reducing the resistance of the junction areas necessary to connect the solar cell layers in series.

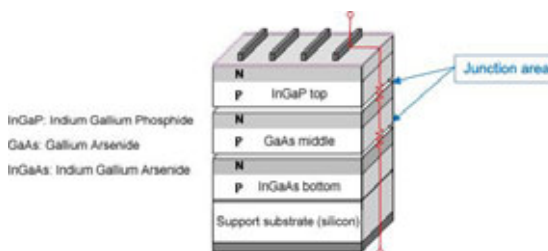
Sharp achieved this latest breakthrough as a result of a research and development initiative promoted by Japan's New Energy and Industrial Technology Development Organisation (NEDO) on the theme of

"R&D on Innovative Solar Cells."

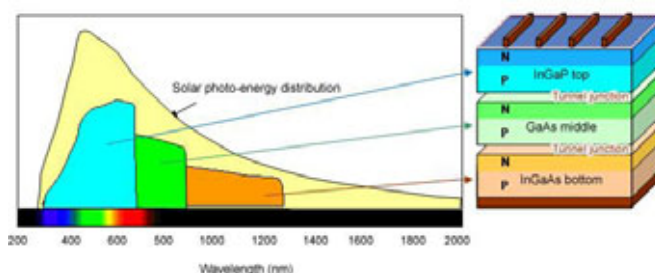
NEDO is Japan's public management organization for promoting research and development as well as for disseminating industrial, energy, and environmental technologies.

The measurement of 36.9% sets a new record for the world's highest non-concentrating conversion efficiency, and was confirmed at the National Institute of Advanced Industrial Science and Technology (AIST), who measured a cell surface of approximately 1 cm².

In the future, processes for transferring ultra-thin photovoltaic layers onto film substrates will make lightweight, flexible solar cells possible. Sharp's goal in the years to come is to take full advantage of this latest development success for use in concentrator-type solar cells, as well as for practical applications such as on space satellites and for flight craft and land vehicles.



Structure of Triple-Junction Compound Solar Cell



Wavelength Distribution of Solar Photo-Energy and Wavelength Sensitivity of Triple-Junction Compound Solar Cell

New Nanometrics system has PL for solar cell process control

The firm has added photoluminescence mapping to its rapid film thickness measurement TSM tool which can be used to analyse CIGS cells.

Nanometrics, a supplier of advanced metrology systems, has announced that a major manufacturer of advanced thin film solar photovoltaic (PV) cells has selected and successfully installed the latest generation of the TSM (Trajectory Solar Monitor) metrology system for in-line process monitoring and control of CIGS films. Established and recognised as a valuable tool for rapid film thickness measurement, the TSM now includes photoluminescence scanning, further expanding its applications and market opportunities.

“Nanometrics’ in-line photoluminescence monitoring tools enable PV manufacturers to improve cell efficiency and production yield by closely monitoring and controlling production processes in a real-time environment,” said Nikos Jaeger, Director of the Materials Characterisation Business Unit at Nanometrics. “The rapid, data rich process control and feedback provided by the TSM leads to lower costs, improved performance and increased competitiveness for our customers.”

The new system incorporates an advanced capability to measure extremely rough films, making it a powerful tool to monitor and further improve yields. “By combining the analytical capabilities of the Nanometrics’ NanoDiffract software analysis engine with the data generated by the TSM, our customers are now able to address the high roughness found in latest generation CIGS solar cells,” said Lior Levin, Director of Engineering.

In the highly competitive thin film solar market, the need for higher cell efficiency and rapid feedback is vital and requires metrology tools that are both fast and accurate. Backed by Nanometrics’ range of technology, applications experience and worldwide support, the TSM product family is aligned to support these requirements, as well as advancements in solar PV manufacturing within the emerging CIGS market. The systems were installed as a complement to TSM reflectometry tools

currently used for in-line buffer, TCO, and CIGS thickness monitoring, providing a comprehensive, integrated process control solution for advanced PV cells.

Paloma solar CdTe power plant now on line

First Solar says the first AZ Sun facility generates power for 4,200 APS customers.

Arizona Public Service (APS) and CdTe solar panel manufacturer First Solar have announced the completion of the 17-MW Paloma Solar Power Plant.

This is the first facility to reach commercial operation as part of the AZ Sun Program.

Earlier this week, APS also placed the Cotton Centre Solar Plant in commercial operation, the second AZ Sun facility to come online. Cotton Centre added an additional 17 MW to the AZ Sun Program. Both plants are located in Gila Bend.

Through the first phase of the AZ Sun Program, APS is investing in the development of 100 MW of turn-key, utility-scale solar photovoltaic power plants across Arizona. Third-party partners, such as Tempe-based First Solar, develop and construct the AZ Sun facilities, which APS will own and operate upon completion. The four-year program is expected to have 100 MW online by 2014 and create more than 1,000 Arizona construction jobs.

“Solar energy is a critical part of our planning to meet the energy needs of APS customers. Our customers embrace solar power, just as we do. That’s why we are so proud of the Paloma facility and our AZ Sun program – we are developing large solar plants that take the amount of solar we provide to customers to a new level,” said Don Robinson, APS President and Chief Operating Officer. “We are also generating more than power from our solar development efforts – we’re creating jobs.”

More than 700 construction jobs were created this year in Arizona as a result of the AZ Sun Program. Paloma contributed 300 of those jobs.

Paloma consists of 275,000 thin-film photovoltaic panels mounted on fixed-tilt steel supports. This installation marks the first time APS is using thin-film technology for one of its solar plants. This project also is the first on which APS has worked with First Solar.

“Paloma is the culmination of a successful partnership between APS, Gila Bend and First Solar,” said Jim Lamon, First Solar Senior Vice President of Engineering, Procurement, Construction, Operations and Maintenance. “First Solar’s efficient and innovative engineering and construction process, along with APS’s leadership and Gila Bend’s commitment in the renewable arena, led to this facility setting development records.”

From the initial contract signing in February between APS and First Solar until the Paloma Plant began producing electricity, this project was completed in the shortest time either APS or First Solar has achieved.

The fast development and construction timeframe also is a testament to the Town of Gila Bend. Gila Bend is quickly becoming the solar hub of Arizona. Along with the Paloma and Cotton Centre solar plants, Gila Bend is home to the Solana Generating Station – which is currently under construction by Abengoa Solar and, once complete in 2013, will be among the world’s largest solar facilities. APS has a contract to purchase all of the output from Solana.

“We are committed to promoting, locating and fast-tracking utility-scale solar in order to bring these projects to Gila Bend,” said Gila Bend Mayor Ron Henry. “The Paloma plant represents another major solar energy investment APS has made in our community. We appreciate this continuing partnership, and we are proud to foster the development of solar energy.”

The first phase of the AZ Sun Program was approved by the Arizona Corporation Commission (ACC) in 2010. The Hyder Solar Plant in south western Arizona is expected to reach commercial operation in the fourth quarter of 2011, making it the third AZ Sun facility to be placed in service. Additionally, APS has an application pending before the ACC for another 100-MW phase of the AZ Sun Program.

MiaSolé manufactures 50 millionth CIGS cell

This highlights the viability of the firm’s distinctive manufacturing process which has enabled the production of low cost, high efficiency, flexible solar cells on a volume scale.

CIGS thin-film photovoltaic solar panel manufacturer MiaSolé has reached a production milestone.

“Manufacturing our 50 millionth cell is a testament to the emphasis we’ve placed on innovative engineering, and the steps we’ve taken to ensure that we are able to deliver repeatable, low-cost, high quality panels at scale to our customers,” said Rob DeLine, Vice President of Marketing, MiaSolé. “This commitment to reliability is reinforced by a growing number of globally bank-financed solar projects that are using MiaSolé technology.”

MiaSolé’s engagement with Intel has further accelerated its production ramp, and improved the repeatability required for high-volume manufacturing, resulting in consistently higher output, yield and equipment utilization.

At the heart of MiaSolé’s panel is a high-performance flexible cell architecture featuring fault tolerant, low resistance UltraWire technology, allowing the company to move beyond traditional glass-glass products into the rolled-roofing and building-integrated photovoltaic markets. These markets are unavailable to leading crystalline silicon manufacturers.

Dow Solar CIGS earn multiple awards

The firm’s POWERHOUSE Solar Shingles have been awarded for product performance and safety.

The Dow Chemical Company has announced that its DOW POWERHOUSE Solar Shingles based on CIGS technology, have received seven certifications.

Three of these include Underwriters Laboratories safety certifications for the solar module, fire,

and uplift resistance; building code certification from the International Code Council Evaluation Service; International Electrotechnical Commission performance certification; California Energy Commission List of Eligible Equipment certification; and performance certification of ASTM wind uplift resistance.



“These certifications confirm the significant advantage and peace of mind our product offers to homeowners,” said Jane Palmieri, Dow Solar Vice President. “The POWERHOUSE Solar Shingles are another example of a safe and reliable building solution available today by Dow.”

To achieve numerous Underwriters Laboratories (UL) certifications, Dow Solar and UL worked cooperatively to identify and perform a series of tests to assess the safety of the POWERHOUSE Solar Shingles against building code standards, including wind and fire resistance, and electrical code requirements, such as proper wiring and photovoltaic (PV) connections.

DOW’S POWERHOUSE Solar Shingle passed numerous UL certifications including: the UL 1703 Third Edition which tests for the National Electrical Code and Model Building Codes; the UL 790 Eighth Edition which tests for fire resistance performance; and the UL 1897 Fifth Edition certification which tests for wind uplift of roofing systems. Additionally, all the necessary CEC and IEC testing was completed at UL’s San Jose PV Lab in California.

UL is a global independent safety science company offering expertise across five key strategic businesses: Product Safety, Environment, Life & Health, University and Verification Services.

“We’re constantly improving our rigorous standards to ensure that UL certified products are safe and reliable,” said Jeff Smidt, Vice President and General Manager for UL’s Global Energy Business. “Working with Dow on a truly game-

changing product that functions as both a roofing and photovoltaic shingle required a unique set of testing disciplines to ensure compliance as both. The collaboration between Dow and UL to define the testing protocols, and ultimately certify the POWERHOUSE as a safe, dual functioning roofing solution is a model for our industry.”

The POWERHOUSE Solar Shingle has obtained the International Code Council Evaluation Service (ICC-ES) certification thereby complying with the International Building and International Residential Codes. The ICC-ES certification requires the fire classification, wind resistance and weather resistance certifications.

ICC-ES is a nonprofit, limited liability company that does technical evaluations of building products, components, methods, and materials.

The POWERHOUSE Solar Shingles also passed the IEC 61646 Second Edition standard requirements for the design of solar modules in open-air climates. The certification confirms the shingles’ ability to withstand prolonged exposure to various climates.

The IEC is one of the world’s leading organisations that prepares and publishes International Standards for all electrical, electronic and related technologies.

The CEC also certified the DOW POWERHOUSE Solar Shingles to be in compliance with the Guidelines for “California’s Solar Electric Incentives Program.” The DOW POWERHOUSE Solar Shingles are listed as eligible per the California Energy Commission’s Senate Bill 1 (SB1) Guidelines.

The California Energy Commission is the state’s primary energy policy and planning agency.

The DOW POWERHOUSE Solar Shingles also passed ASTM International’s D3161-09 standard which tests for wind resistance of asphalt shingles. The POWERHOUSE Solar Shingles passed the standards set for 110 mph winds.

ASTM International, formerly known as the American Society for Testing and Materials, is a globally recognised leader in the development and delivery of international voluntary consensus standards.

Made in the USA, the POWERHOUSE Solar Shingle is a revolutionary new roofing solution that combines the performance and protection of a conventional asphalt roof with an integrated photovoltaic (PV) system that powers the home and saves the homeowner money.

It is designed to install, look and function in a way that has never been done before. Behind a strong brand reputation and warranty, Dow is transforming the residential market by making a solar installation as easy as installing an asphalt rooftop -- all while maintaining the home's attractiveness.

Just last week, Dow announced that the DOW POWERHOUSE Solar Shingle will now be available to homeowners in Colorado.

Q.SMART CIGS modules go global

The plant will cover the electricity needs of more than 6000 households and save about 11,800 tonnes of CO2 emissions annually.

Q-Cells SE has sold approximately 200,000 Q.SMART CIGS thin-film solar modules to the solar company GP Joule, based in the North Frisia area of Germany.

Based on this, GP Joule has constructed one of the world's largest solar power plants using CIGS thin-film technology, which was constructed in the record time of just eight-and-a-half weeks.



Q-Cells delivered the photovoltaic modules needed for the project

The project was developed by the Stuttgart-based project developer Martin Bucher, while the company Module24 selected the premium Q-Cells products for the plant and all the companies involved. Q-Cells provided technical support during the

installation phase. The grand opening of the plant happened on Friday 28th October at Solarpark Ammerland, in the municipality of Wiefelstede in Lower Saxony.

Approximately 100 invited guests attended the opening; they included Lower Saxony's premier, David McAllister. Investor of the project is the bank independent investment company Aquila Capital. Information on the volume of the investment is subject to a confidentiality agreement.

The plant was installed on an area of 57hectares in Wiefelstede, in the Ammerland district, which had formerly served as a military airbase. With a total capacity of over 20.8 MWp, Solarpark Ammerland will cover the electricity needs of more than 6000 households and save about 11,800 tonnes of CO2 emissions annually by producing climate-friendly solar energy.

"We're very pleased to be working with GP Joule and Module24; our cooperation demonstrates that our customers value us as a partner and trust our high-quality product applications and our technical expertise", said Ingo Engelmann, COO of Q-Cells affiliate Solibro. "Solarpark Ammerland is a beacon project in the field of CIGS thin-film technology which proves the top performance and versatility of our Q.SMART modules."

Marc Weißmüller, CEO at Module24 GmbH, and project developer Martin Bucher are in full agreement on their trust in Q-Cells: "Q-Cells adheres to the same high quality standards that we and our investors have upheld without compromises for many years now. The Ammerland plant is proof of the fact that CIGS thin-film modules are eminently suitable for building efficient, profitable solar power plants", said Marc Weißmüller.

"Thanks to Solarpark Ammerland, we'll be able to bring fallow land back to life and take a further stride along with the state of Lower Saxony towards a sustainable electricity system using renewable energy sources", says GP Joule CEO Ove Petersen. "The project clearly shows that there are forward-looking, efficient and economically sound usage ideas available for converted land, and that these ideas can be realised quickly and without too much bureaucratic red tape."

Q.SMART solar modules from Q-Cells, based on

CIGS thin-film technology, are claimed to have the highest efficiency recorded to date in the field of thin-film modules. With efficiency ratings of up to 14.7 % in relation to aperture area, Q-Cells says it holds the world record for series-produced thin-film modules since 2009.

The performance of Q.SMART modules receives a further boost from a "light-soaking effect" which can increase output by an average of 2.5 % above nominal output in standard field test conditions. Their capacity to produce high yields even when light is poor or the climate is hot makes Q.SMART modules suitable for a diverse range of applications, from roof-mounted systems for residential customers to commercial roof-mounted systems and large ground-mounted installations.

Amonix systems power U.S.'s largest CPV solar power plant

The Hatch Solar Energy Centre's Amonix CPV systems incorporate the world's most efficient compound semiconductor multijunction solar cells and advanced optics to convert more sunlight into electricity than conventional solar photovoltaic panels

Amonix, a designer and manufacturer of concentrated photovoltaic (CPV) solar systems, is now powering North America's largest utility-scale CPV power plant, a 5-megawatt facility in Hatch, New Mexico.

The plant is owned and operated by NextEra Energy Resources, LLC, the competitive energy subsidiary of NextEra Energy, and North America's leading generator of renewable energy from wind and sun.

The Hatch Solar Energy Centre generates enough electricity to supply approximately 1,300 homes for El Paso Electric customers per year. The site was built by Blattner Energy, a leading renewable energy contractor in the United States with more than 15,000 operating megawatts to date. El Paso Electric has committed to buying the Centre's power for the next 25 years from NextEra under a long-term contract.

This new plant has 84 Amonix 60-kilowatt systems, and is now the country's largest next to the 2-megawatt power plant in Arizona, also powered by Amonix systems. The Centre is expected to offset more than 9,000 tons of carbon dioxide per year – the equivalent of planting 3,500 trees every year it operates.

The Hatch Solar Energy Centre's Amonix CPV systems incorporate the world's most efficient multijunction solar cells and advanced optics to convert more sunlight into electricity than conventional solar photovoltaic panels. Dual-axis tracking systems maximize energy production throughout the day by allowing the CPV systems to follow the sun.

"The Hatch Solar Energy Centre demonstrates all of solar CPV's advantages, from its scale to its reliability to the stability of its underlying technology," said Amonix CEO Brian Robertson. "Hatch has the ideal conditions for solar energy development, and CPV is exactly the right technology to realize its full potential to provide a steady, long-term energy supply without consuming excessive amounts of land and water."

GE's solar CdTe panels to energise Colorado

In the past two years, more than 20 solar and wind companies have announced expansions or relocations to the state

Last week, GE announced that it plans to build the nation's largest photovoltaic panel factory in Aurora, Colorado.

The 200,000 square-foot plant, which will cost \$300 million to retrofit and will employ 355 workers, will produce thin-film CdTe photovoltaic panels using technology designed by PrimeStar Solar, a Colorado company GE purchased earlier this year.

When running at full capacity, the plant will make 400 megawatts worth of panels a year, enough to support the power demand of 80,000 homes.

Colorado beat out 10 other states to land the investment, including New York, because of its strong workforce, proximity to one of GE's existing

“centres of excellence” and availability of needed infrastructure.

Victor Abate, head of GE’s renewable energy business said that the work the company has done with its Colorado-based solar team allowed them to “achieve efficiencies in our solar panels in record time.”

“The Colorado location will allow us to deliver our technology roadmap faster and commercialise industry-leading panel efficiencies sooner,” he continued.

Solar panels produced in GE’s new Colorado factory will also be more efficient, lighter weight and larger than conventional thin film panels.

“We also look forward to continuing to build our relationships with Colorado’s local, state and federal officials who have been extremely helpful as we moved through the site selection process,” Abate added.

“This is great news for Colorado and further proof that our state is emerging as a centre of innovation,” said Colorado Governor John Hickenlooper. “GE’s move to Aurora takes advantage of Colorado’s clean energy resources and a collaborative business environment that is committed to helping the company succeed.”

GE is the most recent win for Colorado in its long line of clean technology announcements. In the past two years, more than 20 solar and wind companies, including industry giants Vestas and SMA Solar Technology, have announced they would expand or relocate to the state.

“Our state’s strategic location, collaborative spirit and supportive legislation are really attractive to companies in the clean technology industry,” said Tom Clark, executive vice president of the Metro Denver Economic Development Corporation (Metro Denver EDC). “Colorado has created high demand for clean energy with its 30 percent Renewable Energy Standard, the second-highest in the nation.”

While there is abundant sunshine in the state, cleantech companies in Colorado also benefit from the state’s vast intellectual resources including the National Renewable Energy Laboratory (NREL), the Department of Energy’s primary laboratory for

renewable energy and energy efficiency research and development, which is located in Golden, Colorado.

The access to research and development is a key reason why Abound Solar, which just this year received a guaranteed loan of \$400 million from the Department of Energy (DOE), is in the state.

Founded in 2007, Abound Solar is a spinoff of Colorado State University that, during its infancy, received support from NREL. Abound Solar’s next-generation CdTe thin-film modules use a proven technology that performs better than crystalline silicon in low light and high temperature conditions resulting in more energy produced per watt of capacity. Today, the company has grown to more than 350 employees in Colorado and plans to use the DOE loan to increase that number to 300 more at its existing manufacturing plant in Colorado.

Another company in the state that is using partnerships to help drive its commercial growth is Nokero, which designs affordable solar technologies for off-grid communities.

Short for “No Kerosene,” Nokero was formed in June 2010 by Colorado inventor Steve Katsaros who was looking to develop safe and environmentally-friendly products that eliminate the need for harmful and polluting fuels used around the world and, most importantly, are affordable to the communities that need them.

“We’ve found Denver ideal for creating partnerships and sharing ideas,” said Nokero co-founder Tom Boyd. “We have access to venture capitalists in Boulder and our key international customers can easily get here thanks to Denver International Airport, which is a huge benefit as we grow into a leader in small-scale renewable energy.”

In fact, at this week’s Solar Power International 2011 trade show and exposition, Colorado has partnered with Nokero to help shed light on the state’s solar story while at the same time promoting a cause dear to the company’s core – donating Nokero solar light bulbs to people in Third World countries. Attendees can visit Colorado at booth #6201.

Starting today through Thursday, Oct. 20, the Metro Denver EDC will donate five Nokero solar light

bulbs to Project C.U.R.E. for every new 50 likes on its Facebook page or for every 25 #CleantechHub retweets from its Twitter account.

“This is a great example of how Colorado companies are not only innovative in their approach to technology, but in their approach to supporting the global economy,” said the Metro Denver EDC’s Clark. “We’re grateful that Solar Power International gives us the forum to help share Colorado’s light with others who need it.”

Singulus’ new CIGS / CIS processing system selected

The new tool gives Singulus access to a new field of operations in thin-film photovoltaics and adds another production stage to its range of processing systems for the manufacture of CIGS/CIS cells.

Singulus Technologies is unveiling a new processing system for vacuum-coating CIGS/CIS thin-film solar cells.

The new system responds to current demand in the photovoltaic industry for development tools that enhance the efficiency of thin-film solar cells, while cutting production costs. Singulus has already had its first order for such a system.

The main advantage of the new system is that it can be used for vertical vacuum-based coating of glass substrates. This gives Singulus access to a new field of operations in the high-growth market for thin-film photovoltaics and adds another production stage to its range of processing systems for the manufacture of CIGS/CIS cells.

-Ing. Stefan Rinck, CEO of Singulus, remarked, “We are now in a stronger position as a partner of thin-film solar manufacturers. Our ideas and product solutions pave the way for using and developing processes that help significantly reduce the production costs of thin-film modules per watt-peak.

CIGS/CIS technology is regarded as one of the most promising PV technologies. Compared to technologies based on CdTe or monocrystalline or amorphous sulphur, many believe that copper-based semiconductor compounds offer considerable future potential in terms of cost per

watt and efficiency.

In its recently published “PV Status Report 2011” the Joint Research Centre of the European Commission anticipates that the market shares of thin-film technologies will rise to 21 percent (17 GW) in 2012 and reach 26 percent (27 out of 102 GW) in 2015. The current challenges include steadily increasing efficiency, which has already reached around 20 % in pre-industrial production, and reducing the manufacturing costs so that the technology can compete with crystalline modules in the long term.

Through its TENUIS GEN2, VITRUM GEN2 and CISARIS systems, Singulus supplies wet-chemical processing and selenization systems for second-generation CIGS/CIS cells and has thus positioned itself at the vanguard of technology leaders for pioneering development and production systems.

The new vacuum-coating system adds a further production stage to its portfolio, which already spans the key processes of CIGS/CIS cell production. In light of the anticipated volume of investment in production lines for CIGS/CIS thin-film solar cells, Singulus believes the long-term prospects of the solar segment to be bright. Through its new system concepts and innovative processes, the company is promoting the development of solar technology, which will play an increasingly important role in the global energy mix.

Printed CIGS utility panels used in Ohio

Nanosolar thin film solar printing delivers affordable energy for America’s military bases.

Nanosolar has announced the installation of 538 kWp of its CIGS utility panels at the Camp Perry Ohio National Guard Base in Port Clinton, Ohio.

Nanosolar partner Romanoff Electric oversaw engineering, procurement and construction of 2,750 Nanosolar Utility Panels as part of the project.

The panels were pre-assembled into cartridges by mounting systems vendor AP Alternatives at its fabrication facility in Ridgeville Corners, Ohio, and then delivered and inserted into pre-driven

and laser-guided piers at the project site. AP Alternatives' pre-assembly enables a more quick and cost-effective installation with far less panel breakage than with traditional mounting systems.

"The Nanosolar Utility Panel delivers a low-cost, easy to install solar power alternative for America's military bases," said Jerry Heminger, VP of Alternative Energy at Romanoff Electric. "Nanosolar's utility-scale thin film panel design allows us to install equivalent power with fewer panels and less equipment, cabling and people than conventional thin film solar technologies."

Nanosolar also announced that it is on schedule to construct its 1 MWp ground-mount thin film solar installation at the Camp Roberts California National Guard Base near Paso Robles, California with engineering, procurement and construction partner Belectric.

This project is funded by the U.S. Department of Defence ESTCP Program in order to showcase a low-cost, secure renewable energy alternative to fossil-fired power generation. Groundbreaking is scheduled for early January 2012 and the construction of the system is scheduled to take less than three months.

"Solar power is an affordable, reliable and responsible source of energy for America's military," said Geoff Tate, CEO of Nanosolar. "Nanosolar is delivering a stable power source to Camp Perry and other military installations that is independent of supply shortages, grid interruptions, and price fluctuations."



Nanosolar Utility Panel

Nanosolar's innovative, roll-to-roll printing process and utility-scale panel design enables the Nanosolar Utility Panel to significantly reduce both manufacturing costs and balance of systems costs

in multi-megawatt installations. In addition, it is the first solar panel to be certified to operate at up to 1500 system volts. These system design features allow for balance of systems cost savings of up to 30 percent over competing thin film solar panels in utility-scale power plants.

Nanosolar thin film solar cells are printed at the company's headquarters and manufacturing facility in San Jose, California. The Nanosolar Utility Panel can be assembled close to market demand in order to leverage local resources and minimise logistics costs.

Isofoton president inaugurates Chinese school affected by 2008 earthquake

Funded by the AFFIRMA group, which owns Isofoton, the solar cell manufacturer, which uses III-V semiconductors in some of its products, is helping people affected by difficult situations.

The Hispano-Chinese College named St. Francis Xavier will provide primary schooling for 300 pupils between 3 and 6 years old, and also for families in rural areas.

This action is part of the RCS project of the AFFIRMA group among whose objectives is to help people affected by difficult situations, as well as to seek understanding between the Chinese and Spanish cultures.

Funded by the AFFIRMA group, which owns Isofoton, the College has been built in Luojiang City, in northern Sichuan province, less than 100 kilometres from the earthquake epicentre and 80 kilometres from the city of Chengdu. The population of 200,000 inhabit a very beautiful area, whose main sources of income are agriculture and manufacturing.

The college, which will teach the Spanish language and culture, will feature all types of facilities (Internet), as well as a kindergarten, a residence for Spanish teachers, a dining room, library and sports facilities. The AFFIRMA group will also grant college students scholarships to pursue higher studies and

once they complete their school training they will have the opportunity to join the Business Group.

Local authorities representing Sichuan Education Department, the City Council of Luojiang and the Committee of the Communist Party of China attended the opening ceremony along with the President of Isofoton.

During the ceremony, the President of Isofoton Angel Luis Serrano, said, «On behalf of the group that I direct, I am honoured to open this Spanish-Chinese college, the fruit of our commitment to help the disadvantaged. We are confident that it will serve to promote relations between our two countries, Spain and China, with whom we already share so much. In this area there is a great demand for professionals who can speak Spanish, but they are in short supply. This school was a necessity which we are extremely pleased to be able to fulfil».

XsunX to introduce CIGSolar technology to Korea

The firm says it has recently received a lot of interest from South Korean companies regarding its CIGS products.

XsunX says that Korean companies have announced efforts to add or increase their presence and commitment to solar product manufacture.

This important market for CIGSolar has a strong history of mature intellectual property laws, and a large base of well-established multi-national companies with proven track records of aggressive global technology deployment.

To help XsunX aggressively introduce CIGSolar into this Korean marketplace, the firm recently engaged JW Technology, a Korea-based firm representing large manufacturers that plans to target the global solar market.

Samsung plans to invest \$5.5 billion dollars into the development of solar technology and production, and Korean refinery giant SK Innovation plans to invest \$50 million into US based thin film developer HelioVolt. The Korean solar market appears to be preparing to position itself to compete for a growing share of the global solar demand.

Since engaging JW Technology, XsunX has been working to respond to numerous inquiries. Charlie Lee, of JW Technology stated, "XsunX has already made a good impression on potential Korean customers and we are planning a site visit to XsunX in mid-October with senior representatives from two large Korean firms."

Joseph Grimes, XsunX President and COO added, "We are pleased to be working with JW Technology. They bring extensive CIGS background and marketing experience necessary to promote the many benefits of XsunX CIGSolar technology. We are looking forward to the upcoming meetings and the opportunity to establish a manufacturing presence for CIGSolar in the very important Korean market."

Isofoton joins the WIN Atlantic alliance

The solar cell manufacturer, which uses III-V semiconductors in some of its products, will aid development in energy and the environment.

Isofoton has become part of the group of companies that form the alliance of the WIN Atlantic project (Western Internationalisation Network Atlantic).

WIN Atlantic is a project co-financed by the European Regional Development Fund (ERDF). The goal of this project is to support the internationalisation of innovating companies of the Atlantic Area specialised in one of the 4 strategic sectors defined for the zone: Biotechnology, Energy, Environment, and ICTs. Companies participating in this project come from 13 European regions in the United Kingdom, Ireland, France, Portugal and Spain.

In this way, Isofoton will be able to benefit from the actions pursued by WIN Atlantic, which include, amongst others, access to financial resources, support in being present at outstanding international events in the pertinent sector, identification and opening of new markets or access to innovation networks.

Isofoton says being part of this network is one more example of its commitment to the international

development of its business based on enhancing its R&D division, international promotion and the opening of markets as generators of competitiveness.

Nanosolar CIGS achieve 17.1% aperture efficiency

Using a non-vacuum printed process, the firm says it has raised the bar for efficiency and cost savings.

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) has certified an aperture efficiency of 17.1% for a CIGS solar cell fabricated using Nanosolar's non-vacuum, low cost printing on flexible foil technology.

«This achievement demonstrates that a non-vacuum CIGS deposition process can deliver world-class efficiency,» said Nanosolar CEO Geoff Tate. «At the same time, Nanosolar's unique roll-to-roll printing process delivers substantial manufacturing cost benefits.»

Nanosolar's mission is to become the lowest cost solar cell and panel manufacturer, independent of subsidies. The firm says this is possible because of its unique thin film printing process which enables significant cost savings when compared to conventional vacuum based deposition techniques.

In addition, the company says its high-throughput roll-to-roll printing method delivers a higher capital efficiency and better materials utilisation. Together, these advantages could give Nanosolar a path to lower manufacturing costs than competing photovoltaic technologies.

Northrop bags \$8.9 million contract for GaN microscale power conversion

The award is to develop gallium nitride class E power amplifiers that incorporate supply modulation and control enabled by novel power switch technology.

Northrop Grumman Corporation has been awarded

a contract by the Defence Advanced Research Projects Agency (DARPA) to develop more efficient radio frequency (RF) transmitter technology through the Microscale Power Conversion program.

Under the three-year, \$8.9 million contract, Northrop Grumman will conduct research on high-efficiency transmitters with GaN Class E power amplifiers in conjunction with RF wideband contour modulation and sub-banded switching supply modulation. The objective of the program is to develop innovative RF power amplifier designs that incorporate supply modulation and control enabled by novel power switch technology.

The key to this research is to broaden the RF power amplifier's supply modulation bandwidth up to 500 MHz with composite efficiency of no less than 75 percent by employing the contour modulation to maintain efficiency performance of the amplifier. Contour modulation is a technique in which a phase-modulated signal waveform and amplifier output impedance work together to maintain higher efficiency over a sizable output power back-off.

When supply modulation and contour modulation are working in concert, the dynamic range and efficiency of the power amplifier can be further improved. Microscale integration and packaging with thermal design considerations is critical in achieving the efficiency.

«With more innovative RF power amplifier designs, we can produce much more efficient RF transmitters without increasing their size,» said Pat Antkowiak, vice president and general manager of Northrop Grumman's Advanced Concepts & Technologies Division. «This technique can open the door to creating more powerful electronic systems for a wide variety of applications.»

The design work will be performed by Northrop Grumman and its subcontractors, the University of California at Los Angeles (UCLA) and TriQuint Semiconductor. The final integration and demonstration will be done by Northrop Grumman in Linthicum.

UCLA will work on system architecture and co-design, design of the Complementary Metal Oxide Semiconductor circuit and other elements, controls and test support. TriQuint will work on GaN and related process technologies.

IQE and Penn State University to present paper on As/Sb HFETs

The presentation will describe the potential for arsenide/antimonide based materials for integration into future ultra low voltage electronic devices.

IQE plc and Pennsylvania State University will next week present a joint paper on recent key developments in compound semiconductor device technologies for low voltage transistor applications at the International Electron Devices Meeting (IEDM) in Washington, DC.

The paper, *“Demonstration of MOSFET-Like On-Current Performance in Arsenide/Antimonide Tunnel FETs with Staggered Heterojunctions for 300mV Logic Applications,”* will be presented by Dheeraj Mohata at Penn State University.

The results have experimentally demonstrated a vertical hetero tunnel Field Effect Transistor (HTFET) with a record high drive current (ION) of 190 μ A/ μ m and 100 μ A/ μ m at VDS=0.75V and 0.3V, respectively.

The research measured, simulated and benchmarked the performance of compound semiconductor based Tunnel-FET (TFET) with 40nm strained Si MOSFET performance for low voltage (0.3V) logic applications, demonstrating the potential for arsenide/antimonide (As/Sb) based materials for integration into future ultra low voltage electronic devices where high performance and low power consumption is a critical factor.

Tunnel FET is an emerging transistor concept being explored by many groups around the world. In traditional MOSFETs, the building block of digital technology, the transistor channel is turned on by injecting carriers over a gate controlled *p-n* junction.

This results in a gradual turn-on of the transistor and works well as long as we do not reduce the supply voltage of operation too much. In Tunnel FETs, the transistor channel is turned on by injecting carriers through a gate controlled tunnel junction. This results in abrupt turn-on of the transistors which allows us to reduce the supply voltage of operation and hence achieve significant

power saving.

The biggest hurdle facing the adoption of Tunnel FETs by the mainstream semiconductor industry is that the drive current of the Tunnel FET demonstrated to date is quite low due to limitation of the band to band tunnelling rate in known semiconductors. By carefully selecting the proper combination of two different semiconductors and adjusting their composition such that their band alignment results in a staggered configuration, one can significantly increase the tunnelling rate and enhance the drive current, or ION, of the Tunnel FET. This has been achieved in a vertical HFET discussed in the presented paper and offers the potential to enable a new generation of electronics that can operate in highly energy constrained environments.

Established in 1955, the IEDM is one of the world's premier forums for reporting breakthroughs in technology, design, manufacturing, physics and the modelling of semiconductors and other electronic devices. Proceedings of the conference are published by the IEEE.

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on “The Market for LEDs in Lighting”.

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN

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Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

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Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

WIN to boost production with Aixtron MOCVD reactors

The firm will use the systems to manufacture power devices.

Aixtron SE has announced that WIN Semiconductors, an existing customer and a leading manufacturer of microwave devices in Taiwan, placed an order for two MOCVD systems.

The firm is purchasing another AIX 2600G3 system in a 7x6-inch wafer configuration as well as its first AIX 2800G4 system in a 8x6-inch wafer configuration. WIN will use the systems to develop and mass produce various high performance devices.

The reactors will be delivered in the fourth quarter of 2011 and be installed and commissioned by a local Aixtron service support team at the company's state-of-the-art facility located in Kuei Shan Hsiang, Taiwan.

WIN Semiconductors comments, "This is the first Aixtron G4 MOCVD system for us so it is especially important for our further business development. In order to expand our production throughput we have decided that based on very good reactor experience and with an eye on the future we would not only acquire another G3 but also our first G4. As well as bigger wafer capacity, this will give us top performance across all the parameters coupled with features we are familiar with such as ergonomics, versatility plus seamless process compatibility with our existing reactors. As well as being trustworthy, Aixtron equipment also comes with guarantees and full back up thanks to their responsive and

knowledgeable service staff."

WIN Semiconductors is a designer, developer, manufacturer and vendor of GaAs microwave integrated circuits and became one of the first Taiwanese companies to recognise the opportunities in the market for terrestrial compound semiconductor solar cells. In 2007, it installed a dedicated Aixtron AIX 2600G3 IC epitaxy reactor as the foundation for its diversification into solar cell manufacturing.

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound Semiconductor Markets: Current Status and Future Prospects".

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• An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

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This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

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• Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

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Kyma expands AlN template manufacturing capacity

The firm's aluminium nitride based templates act as a replacement for bare and patterned sapphire substrates by manufacturers of blue, green, and white LEDs.

Kyma Technologies has expanded its AlN template manufacturing capacity for both sapphire and silicon based AlN template products.

Kyma's AlN templates are manufactured using its patented plasma vapour deposition of nanocolumns (PVDNC) technology, which provides LED manufacturers with throughput, cost, and performance benefits.

The expansion of Kyma's AlN PVDNC template manufacturing capacity is based on successful customer qualification of products fabricated in its newest high volume PVDNC reactor, the commissioning of which was announced by the company earlier this year.

LED customer feedback indicates significant improvements in LED brightness, reverse voltage, and electrostatic discharge yield. Similar benefits have been previously verified using Kyma's lower volume manufacturing tools which the company has used since it was founded in 1998.

Kyma has also qualified the tool for production of PVDNC AlN on silicon wafers. Several customers report improved device properties for both RF and power switching applications.

Kyma says qualification of this new tool was not a small task and that its design is totally new compared to earlier designs, with key design changes targeting improved tool uptime, shorter process cycle time, and better process repeatability and uniformity.

"We are pleased to qualify our new reactor for both sapphire and silicon based PVDNC AlN template products," said Heather Splawn, Kyma's Chief Operating Officer. "Doing so represents not only a significant boost to our manufacturing capacity; it also validates our improved tool design approach which should prove beneficial for our continued expansion plans going forward."

Kyma believes that the market for nitride semiconductor devices is estimated to be \$9B in 2011 and is expected to reach \$90B over the long term, including \$60B in visible lighting applications and \$30B in power electronics applications.

GaN-on-Si 48V technology cooler than ever

Enabling more reliable RF power, Nitronex has upgraded its 28V NRF1 gallium nitride on silicon technology.

Nitronex has developed a 48V GaN-on-silicon process platform.

Designated NRF2, this new platform delivers double the power density, 1-2dB higher gain, improved broadband performance, higher breakdown voltage and higher supply voltage operation over Nitronex's 28V NRF1 process technology.

The new technology further increases reliability for GaN-on-silicon, with more than one million hours (114 years) mean time to failure (MTTF) at an operating junction temperature of 230°C using a stringent 10% drift failure criteria. In addition, improvements in thermal management in initial 48V products have demonstrated thermal resistance reduction of more than 40% compared to existing Nitronex products.

The NRF2 process platform heavily leverages Nitronex's existing NRF1 platform which has been used to ship more than 500,000 production devices (including more than 50,000 MMICs) since volume shipments began in 2009.

"A robust and reliable high voltage process can deliver superior performance in high-power RF applications. We have developed several semi-custom products for customers with high volume applications using the NRF2 48V technology, and our customers are very pleased with our solution versus alternatives," said Ray Crampton, VP of Engineering. "In addition to increased reliability and RF performance, we have demonstrated robustness to 15:1 output VSWR at all angles at 90°C flange temperature under saturated drive conditions."

Nitronex says its patented SIGANTIC GaN-on-

Si process is the only production qualified GaN process using an industry standard 4" silicon substrate. This results in a robust, scalable supply chain and positions Nitronex well for the growth expected from emerging GaN markets such as military communications, CATV, RADAR, commercial wireless, satellite communications and point to point microwave.

Additional technology under development includes a 48V MMIC process platform.

Initial 48V samples are available now with pre-production and production quantities available in early 2012.

Nitronex NRF1 GaN process qualified at GCS

GCS is adding Nitronex's 100mm gallium nitride on silicon technology to its extensive compound semiconductor capability allowing the firm access to the expanding GaN RF market.

Nitronex, a designer and manufacturer of GaN based RF solutions for high performance applications in the defence, communications, cable TV, and industrial & scientific markets, has successfully completed qualification of its NRF1 discrete process for volume production at Global Communication Semiconductors (GCS).

Under a long-term supply agreement between the two companies, GCS will exclusively provide Nitronex with NRF1 discrete and MMIC foundry services. NRF1 is Nitronex's proprietary 100mm GaN-on-Silicon process and has been used to ship more than 500,000 production devices since volume shipments began in 2009.

Devices fabricated at GCS show equivalent performance across the board to devices fabricated at Nitronex's Durham, N.C. facility. Qualification includes extensive DC, RF, thermal, reliability, and other parametric testing. Nitronex plans to work closely with customers through a Process Change Notification to ensure a smooth transition as it establishes GCS as a qualified wafer source for all of its products.

"When evaluating GaN suppliers, our customers tell

us they want to compare performance, reliability, manufacturability, and cost. We believe that our current NRF1 discrete and MMIC-based processes have enabled us to develop a family of products that, for many market applications, meet or exceed our customers' needs relating to performance and reliability — and we have the data to prove it," said Charlie Shalvoy, CEO of Nitronex.

"Partnering with GCS gives Nitronex a significant increase in capacity, improves our near and long-term cost reduction roadmap and provides access to capabilities that allow us to develop new GaN technologies. The combination of our proprietary 100 mm GaN-on-Si process, and the full suite of production and new process development capabilities at GCS, gives us the ability to be a leader in the rapidly emerging market of GaN RF power devices", he added.

"We are pleased to partner with Nitronex and add GaN-on-Si to our extensive compound semiconductor capability. Nitronex's unique technology gives us access to a new and growing GaN RF market", said Jerry Curtis, CEO of GCS. "Now that NRF1 process is qualified at GCS, we look forward to working closely with Nitronex and moving to volume production."

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be "An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program."

Defining the next steps for the Compound Semiconductor Industry

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix of quality speakers making it the must attend industry event for 2012.

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SemiSouth SiC JFETs raise the bar for output power density

The firm's silicon carbide power modules, featuring a compact, optimised cooling system, can operate at up to 2000C and achieve 30kW/l performance.

SemiSouth Laboratories has announced that its SiC JFETs are being used in small 0.5 litre inverters to achieve an output power density of 30kWh/l. It is claimed that if inverters of this size and capacity are used with PV panels, one inverter could supply enough electricity for up to five households.



A team at the Japanese academia and industry R&D Partnership for Future Power Electronics Technology (FUPET), consisting of participants from Fuji Electric, Nissan Motor, Sanken Electric and Toshiba, aims to deliver power converters that

operate at high temperature with high output power density.

Using SiC JFETs from SemiSouth Labs, the team developed a three-phase 500cc inverter that delivers 15kW output power when connected to a three-phase motor with a conversion efficiency of 99%. Featuring a compact, optimised cooling system, it has been claimed the power modules can operate at up to 2000C. "We believe this is the world's highest output power density for a small-volume inverter," said Satoshi Tanimoto, chief researcher at FUPET's R&D Centre. "SemiSouth's JFETs have been instrumental in helping us maximise efficiency and power density."

SemiSouth's JFETs are compatible with standard gate driver ICs, and feature a positive temperature coefficient for ease of paralleling; extremely fast switching with no 'tail' current at up to a maximum operating temperature of 1500C and a low RDS(on) max. Devices are available in TO-247 packaging and in some cases they are also available in die form for integration into modules.

Jeff Casady, President and CTO, commented, "The FUPET team achieved these results at 50 kHz which is their minimum frequency target, and the module also has a very low inductance module with only 5 nH. It is exciting to see the results that can be achieved using our technology." The FUPET team aims to achieve an inverter with 40kW/l output power density next year.

GaN Systems closes Series A financing round in Canada

The transaction marks an end to the dry period of venture deals in the Ottawa region & sets the gallium nitride product manufacturer on a path to attack the \$14 billion-a-year power devices market.

GaN Systems, a provider of next generation power conversion semiconductors for cleantech applications, has announced the closing of its Series A financing round led by Chrysalix Energy Venture Capital and Rockport Capital.

Chrysalix Energy Venture Capital, was one of the world's most active cleantech venture capital firms in 2010. Rockport Capital is a venture capital firm

that partners with cleantech entrepreneurs around the world.

This builds on GaN Systems' ongoing government support from the National Research Council of Canada and the Ontario Centres of Excellence.

The Company has also received support from Sustainable Development Technology Canada (SDTC) for a project to further develop and demonstrate their patented gallium nitride technology, resulting in more energy efficient and lower cost electronic products and renewable energy solutions.

"Gallium nitride is one of the most exciting new developments in electronics as it overcomes the speed, temperature, and power handling limitations of traditional silicon approaches," said Girvan Patterson, CEO & Co-Founder of GaN Systems. "Cleantech will require a social transition and financial investment unequalled since the Industrial Revolution, and it will take radical electronics innovation to make it happen. That is our mission."

John Roberts, CTO & Co-founder of GaN Systems, added, "We will offer the Cool Switching product line of highly efficient, low-loss diodes, transistors, and integrated systems. We will also partner with other semiconductor companies looking to leverage the strengths of gallium nitride using our patented designs. Our unique island-based topology builds on years of gallium nitride process research at the NRC and will enable power devices that are typically four times smaller (resulting in lighter weight), more efficient, have longer battery life, and are lower cost. In cleantech applications, power conversion efficiency is a universal requirement and our designs dramatically impact the economics of that goal."

"The National Research Council of Canada helps entrepreneurs such as GaN Systems grow. Together, we take ideas from concept to reality, allowing them to commercialise their technologies in a global marketplace", said Ian Potter, Vice-President, NRC Engineering. "Our work in gallium nitride electronics will turn knowledge into innovation and will result in a greener future for Canadians."

"After four hard but exciting years working on the cutting edge of gallium nitride research, we're

excited to now have the opportunity to deliver on our vision of a new generation of power conversion products that contribute directly to solving the world's energy crisis," continued Patterson. "Although venture backing has been slow in the region this year, Ottawa has an astounding talent pool to draw from, something we've been able to take advantage of. In the months and years to come, we plan to revolutionise the power devices market and in the process, help put Ottawa back in the technology spotlight."

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

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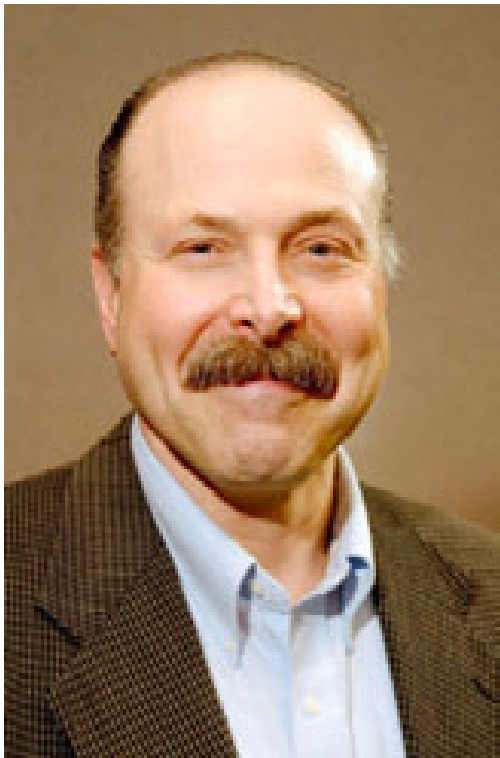
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 - Damage - free Deposition on LED devices –Dr. Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd
 - Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)
- Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.***

Defects in SiC could revolutionise computing

Electrons that become trapped by certain imperfections in silicon carbide meet the requirements for use as a quantum bit.

A discovery by physicists at UC Santa Barbara may earn SiC, a role at the centre of a new generation of information technologies designed to exploit quantum physics for tasks such as ultrafast computing and nanoscale sensing. The research team discovered that SiC contains crystal imperfections that can be controlled at a quantum mechanical level. The research group of David Awschalom made the finding. Awschalom is director of UCSB's Centre for Spintronics & Quantum Computation, professor of physics, electrical and computer engineering, and the Peter J. Clarke Director of the California NanoSystems Institute.



David Awschalom (Credit: Rod Rolle)

In conventional semiconductor-based electronic devices, crystal defects are often deemed undesirable because of their tendency to immobilise electrons by “trapping” them at a particular crystal location. However, the UCSB team discovered that electrons that become trapped by certain imperfections in SiC do so in a way that allows

their quantum states to be initialised, precisely manipulated, and measured using a combination of light and microwave radiation. This means that each of these defects meets the requirements for use as a quantum bit, or “qubit,” which is often described as the quantum mechanical analogue of a transistor, since it is the basic unit of a quantum computer.

“We are looking for the beauty and utility in imperfection, rather than struggling to bring about perfect order,” said Awschalom, “and to use these defects as the basis for a future quantum technology.”

Most crystal imperfections do not possess these properties, which are intimately tied to the atomic structure of a defect and the electronic characteristics of its semiconductor host, explained Awschalom. In fact, before this research, the only system known to possess these same characteristics was a flaw in diamond known as the nitrogen-vacancy centre.

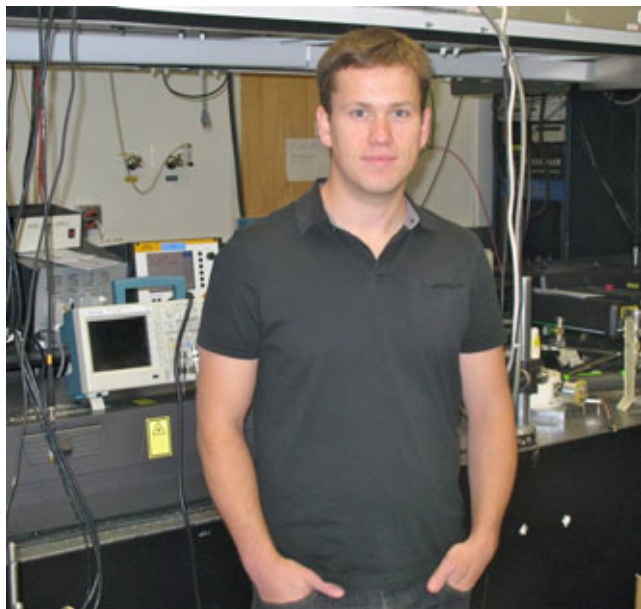
The diamond nitrogen-vacancy centre is renowned for its ability to function as a qubit at room temperature, while many other quantum states of matter require an extremely cold temperature, near absolute zero. However, this centre exists in a material that is difficult to grow and challenging to manufacture into integrated circuits.

In contrast, high-quality crystals of SiC, multiple inches in diameter, are commonly produced for commercial purposes. They can be readily fashioned into a multitude of intricate electronic, optoelectronic, and electromechanical devices. In addition, the defects studied by Awschalom and his group are addressed using infrared light that is close in energy to the light used widely throughout modern telecommunications networks. And while several distinct defect types were studied at a range of temperatures, two of them were capable of room temperature operation, just like the diamond nitrogen-vacancy centre.

The combination of these features makes SiC, with its defects, an attractive candidate for future work seeking to integrate quantum mechanical objects with sophisticated electronic and optical circuitry, according to the scientists. This research fits within a wider effort at UCSB to engineer quantum devices by fostering collaboration between the fields of

materials science and quantum physics.

While defects in SiC may offer many technologically attractive qualities, an immense number of defects in other semiconductors are still left to be explored.



William Koehl, Credit: George Foulsham, Office of Public Affairs, UCSB

“Our dream is to make quantum mechanics fully engineerable,” said William Koehl, a graduate student in the Awschalom lab. “Much like a civil engineer is able to design a bridge based on factors such as load capacity and length span, we’d like to see a day when there are quantum engineers who can design a quantum electronic device based on specifications such as degree of quantum entanglement and quality of interaction with the surrounding environment.”

Further details of this week can be seen in the paper “Room temperature coherent control of defect spin qubits in silicon carbide” by Koehl et al in *Nature*, **479**, p 84–87, DOI: doi:10.1038/nature10562

Power Integrations to sell SemiSouth SiC power products

The deal expands Power Integrations’ product portfolio ; it drives sales for leading silicon carbide

manufacturers in USA, China, Taiwan, Japan, Korea and India.

Power Integrations has signed an agreement with SemiSouth Laboratories to act as a sales representative for SemiSouth’s innovative range of SiC diodes and JFETs worldwide with the exception of Europe.

SemiSouth’s SiC diodes and JFETs deliver significant efficiency and durability benefits in high-power applications such as solar inverters, motor drives, telecom rectifiers, UPSs, three-phase inverters and electric vehicles. In 2010, Power Integrations announced a strategic investment in the Mississippi-based SiC producer, which included an equity investment, a technology license and other financial commitments to support the continued expansion of SemiSouth’s SiC manufacturing operations.

Ben Sutherland, vice president of sales at Power Integrations comments, “SemiSouth’s rugged, ultra-efficient SiC JFETs and diodes are a natural extension of our product line, perfectly complementing products such as TOPSwitch and TinySwitch which are used in standby power supplies for many high-power systems. With the SemiSouth SiC JFET and diode portfolio, we will be able to address the main power conversion and inversion circuits in those same applications by replacing silicon diodes, MOSFETS and IGBTs with higher-performance SiC technology.”

Dieter Liesabeths, vice president of sales for SemiSouth added, “The growth of applications that benefit from extremely high levels of efficiency, such as solar energy and electric vehicles, is creating significant opportunities for our high-efficiency SiC power devices. This agreement with Power Integrations will substantially increase our sales and support bandwidth in regions where PI has a very robust presence.”

SemiSouth devices are available worldwide through Farnell and Newark as well as local distributors. Technical information is available online on the SemiSouth and Power Integrations websites and at Power Integrations’ regional sales offices.

Rubicon ships 200,000th six-inch sapphire wafers to the LED manufacturing industry

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, Semiconductor, and Optical industries, today announced that it has shipped a total of 200,000 six-inch sapphire wafers to the LED manufacturing industry. Sapphire, the base material used for the majority of LEDs, is used in consumer products such as LED-based lighting, HDTVs, laptops, netbooks, smart phones and tablets, and automotive lighting.

Rubicon was instrumental in the development of large diameter sapphire wafers for use in the RFIC market and further developed the process to serve other markets requiring large diameter sapphire wafers, such as LED lighting and other semiconductor applications.

“I believe Rubicon has significantly more experience in producing large diameter sapphire wafers than any of our competitors,” explains Raja Parvez, Rubicon President and CEO. “LED manufacturers understand that migration to a large diameter sapphire wafer platform offers an opportunity to achieve production and cost efficiencies. This is increasingly important as LED manufacturers seek to reduce costs throughout the LED manufacturing process to help the industry lower prices of LED-based lighting and encourage adoption worldwide.”

Bringing down the price of LEDs is a key element in supporting the worldwide commercial adoption of solid state lighting based on LEDs as a light source. Government entities around the world including Australia, Canada and the United States have introduced legislation to require energy efficient lighting. The transition to larger diameter wafers in LED production has started. Several key LED chip manufacturers have announced plans to migrate to and/or test large diameter wafers in 2011/2012.

“There is significant large diameter wafer activity among LED manufacturers with nearly a half dozen working with six-inch in some way,” said Dr. Philippe Roussel, LED Senior Project Manager, Yole Développement. “By 2016, our research projects that large diameter wafers measuring six inches

and greater will capture more than 50 percent of the market.”

According to market research firm DisplaySearch, TV applications currently dominate the LED market, but LED lighting will capture the lead by 2014. The firm said that LED lighting penetration rate in 2010 was 1.4%, and is forecast to reach 9.6% in 2014 with the growth due to government incentive programs, and growth in commercial applications and consumer adoption worldwide.

RFMD's new GaN wideband pulsed PA

The RF3928 is a 50V 280W high power discrete gallium nitride amplifier designed for S-Band pulsed radar, Air Traffic Control and Surveillance (ATCS), and general purpose broadband amplifier applications.

Using an advanced high power density GaN semiconductor process, these high-performance amplifiers achieve high output power, high efficiency and flat gain over a broad frequency range in a single package. High terminal impedance enables wideband operation and minimizes overall PCB real estate. This matched GaN transistor is packaged in a hermetic, flanged ceramic package that provides excellent thermal stability through the use of advanced heat sink and power dissipation technologies.



RF3928

With wideband operation of 2.8GHz to 3.4GHz, the module utilises advanced GaN HEMT and heat-sink technology. Its evaluation board layout is optimised for 50Ω operation and the device has a small signal gain of 12dB and a drain efficiency of 52%.

EPC's demonstration board features eGaN FETs

The EPC9101 demonstrates size reduction and efficiency enhancement for buck power conversion achieved using high frequency switching enhancement mode gallium nitride power transistors.

Efficient Power Conversion Corporation (EPC) is introducing the EPC9101, a fully functional buck power conversion demonstration circuit.

This board is an 8 V-19 V input to 1.2 V, 18 A maximum output current, 1MHz buck converter. It uses the EPC2014 and EPC2015 eGaN FETs in conjunction with the recently introduced National LM5113 100V half-bridge gate driver from Texas Instruments.

The LM5113 is one of the industry's first driver designed specifically for enhancement mode gallium nitride FETs. The EPC9101 demonstrates the reduced size and performance capabilities of high switching frequency eGaN FETs when coupled with this dedicated eGaN driver.

The power stage footprint of the EPC9101 circuit is only 8mm x 16mm (about 0.2 square inches) and about 8mm high when taking components from both sides into consideration. Despite its small size, the board has a peak power efficiency of 88% and is capable of delivering 18 amps of current at 1.2 volts.

To assist the design engineer, the EPC9101 is easy to set up to evaluate the performance of the EPC2014 and EPC2015 eGaN FETs and LM5113 gate driver. The board is intended for bench evaluation with low ambient temperature and convection cooling. Additional heat sinking and forced-air cooling can be used to evaluate beyond

the rated current capability of the demonstration circuit.

A similar fully functional buck power conversion demonstration board, the LM5113LLPEVB, is available from Texas Instruments. This board features the LM5113 driver in operation with 100V EPC2001 eGaN FETs. The LM5113LLPEVB demo board is a 15 V – 60 V input to 10 V, 10 A, 800kHz, buck converter. Like the EPC9101, this board demonstrates the size and performance enhancement that can be achieved using the EPC2001 eGaN FETs and the LM5113 gate driver.

The EPC9101 demo boards are priced at \$150.00 each and are available for immediate delivery from Digi-Key at <http://digikey.com/Suppliers/us/Efficient-Power-Conversion.page?lang=en>.

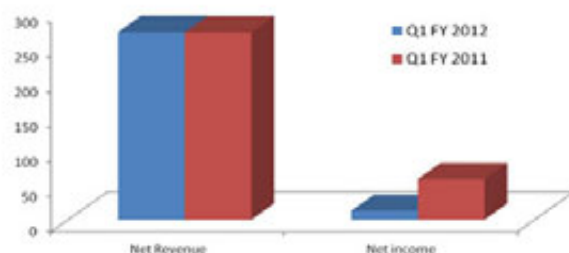
Cree's revenues hit \$269.0 million

For its first quarter of fiscal 2012, ended September 25, 2011, the LED innovator's revenues hardly changed compared to the same time last year.

This represents a 0.2% increase compared to revenue of \$268.4 million reported for the first fiscal quarter last year and a 11% increase compared to the fourth quarter of fiscal 2011.

GAAP net income for the first quarter of \$12.8 million, or \$0.11 per diluted share, decreased 78% year-over-year compared to GAAP net income of \$58.0 million, or \$0.53 per diluted share, for the first quarter of fiscal 2011.

GAAP Financial Results for fiscal years Q1 2012 & 2011



Financial results for the quarter reflect the acquisition of Ruud Lighting on August 17, 2011,

approximately one month before the end of the quarter.

“We got off to a good start in Q1 as results were in-line with our updated targets and our LED lighting and LED components product lines continued to grow,” stated Chuck Swoboda, Cree chairman and CEO. “We also took the next step in our strategy to lead the LED lighting revolution with the acquisition of Ruud Lighting. Although we have seen tremendous growth in LED lighting sales over the last few years, it is clear that we have only scratched the surface of LED lighting adoption and there is growing demand for products that offer innovative solutions and good payback.”

Cash and investments ended the quarter at \$632.2 million, which was a decrease of \$453.6 million from Q4 of fiscal 2011 due to the disbursement of \$457 million as part of the Ruud Lighting acquisition. Cash flow from operations was \$41.6 million. Accounts receivable (net) increased \$47.2 million from Q4 of fiscal 2011 to \$165.7 million, with days sales outstanding of 55. Ruud Lighting receivables were approximately \$22 million at the end of the quarter. Days sales outstanding would have been 50 if Ruud Lighting were part of Cree for the entire quarter. Inventory increased \$27.1 million from Q4 of fiscal 2011 to \$203.6 million and represents 107 days of inventory. Ruud Lighting inventory was approximately \$38 million at the end of the quarter. Days of inventory would have been 96 if Ruud Lighting were part of Cree for the entire quarter.

Business Outlook:

For its second quarter of fiscal 2012 ending December 25, 2011, Cree targets revenue in a range of \$300 million to \$320 million with GAAP gross margin targeted to be in a similar range as Q1 at 37%-38%. GAAP operating expenses are targeted to increase by approximately \$10 million to \$95 million. The increase in targeted operating expenses is primarily related to the addition of Ruud Lighting for an entire quarter. The tax rate is targeted at 21.5% for fiscal Q2. GAAP net income is targeted at \$13 million to \$18 million, or \$0.11 to \$0.15 per diluted share. The GAAP net income target is based on an estimated 118 million diluted weighted average shares.

NEDI to develop power devices and LEDs with Aixtron tools

The Chinese firm will use one of the two reactors to produce 4" arsenide and phosphide based LED materials and the other to produce 4" silicon carbide based epiwafers.

Aixtron SE has announced that Nanjing Electronic Devices Institute (NEDI), an existing customer and a leading manufacturer of electronic components in China, has placed an order for one AIX 2600G3 IC system in a 12x4-inch wafer configuration and one VP2400HW with 6x4-inch wafer capacity.

NEDI will use the systems to investigate power devices and LEDs.

Following delivery in the third and fourth quarter of 2011, the new systems will be installed and commissioned by a local Aixtron service support team alongside the company's already existing Aixtron MOCVD systems at the company's state-of-the-art facility located in the Jiangning Economic & Technological Development Zone, Nanjing China.

Kun Chun Mao, who is in charge of purchasing these systems at NEDI, comments, “These are not our first Aixtron MOCVD systems but they will play a vital part in our planned development of materials for power devices and LEDs. My team is very familiar with the technology and they trust Aixtron's advanced technology with its ease of use, versatility as well as process compatibility with our existing recipes and procedures.”

“We have also been very satisfied with the first-class local support provided by the Aixtron service office and the enlarged spare parts stock in Shanghai. This partnership will serve us well when we begin operations with the new reactors,” he continues.

SETi grows AlInN materials on bulk GaN substrates

The epitaxially grown aluminium indium nitride technology will allow the firm to further develop next generation high power, very high-frequency RF components.

Sensor Electronic Technology, Inc. (SETi) has announced that it has been awarded an STTR (Small Business Technology Transfer) Phase II program to further develop AlInN/GaN based HFETs on free standing bulk GaN substrates.

The Phase II program was awarded through the Missile Defence Agency (MDA) following successful demonstration of the epitaxial growth of an entirely strain-free HFET structure, comprising of lattice matched AlInN on bulk GaN substrates in the Phase I program. During Phase I, AlInN/GaN heterostructures were deposited on bulk GaN substrates with Indium compositions ranging from 0-25%, with minimum sheet resistances of ~235 ohm/square.

This new program will target further reductions in defect density in the epitaxial GaN and AlInN layers and demonstrate increased device reliability over conventional AlGaIn/GaN HFETs. Increased reliability in GaN HFETs is essential in the defence and satellite markets, which account for over a quarter of the entire GaN RF device market.

SETi, famous for its deep UV LED products UVTOP and UVClean emitting light shorter than 365 nm, is a leader in Al(In)GaN semiconductor material technologies and with its patented process MEMOCVD has a very novel process for defect reduction in AlGaIn-based epitaxial structures on sapphire substrates.

SETi says the application of MEMOCVD in UVLED structures enabled it to become the first UV LED company to offer LEDs with wavelengths shorter than 365nm on the commercial market and continues to ensure its lead in this market today.

SETi has now demonstrated the benefits of its Al(In)GaN materials growth technologies on bulk nitride substrates and through further development from programs such as this MDA funded program, will push AlInN material technology further to the

development of next generation high power, very high-frequency RF components.

Cree's Z-Rec SiC Schottky diodes improve efficiency

Designed for use in solar micro inverters, the silicon carbide based TO-252 D-Pak devices are now available in 2A, 5A, 8A & 10A ratings.

Cree continues its mission of advancing the adoption of SiC into mainstream power applications.

Cree says its advances in SiC technology are setting new standards in energy efficiency whilst reducing system costs and improving reliability when compared to silicon-based power devices. Cree's latest addition to its 1200V SiC Schottky diode product offering includes four new surface mount devices in 2A, 5A, 8A, and 10A current ratings and packaged in the industry-standard surface mount TO-252 D-Pak.



The firm says it is the first manufacturer to offer this comprehensive range of current ratings for commercially available 1200V SiC Schottky diodes in the surface mount D-Pak package. Designers of systems, such as solar micro inverters, now have more options to develop smaller, lighter and less costly power conversion circuits. The new surface mount devices deliver the same proven performance as Cree's TO-220 Schottky diodes, but with a smaller PCB footprint and lower profile.

"These new surface mount devices provide all the proven benefits of SiC Schottky diodes – zero reverse recovery losses, temperature-independent switching, higher frequency operation with low EMI, and significantly higher surge and avalanche capability – with a smaller footprint and a lower board-mounted profile," explained Cengiz Balkas, Cree VP and GM, Power and RF.

"The new 2A device is ideally suited for lower

power applications allowing them to benefit from the advantages of SiC while providing the best performance and cost option. With the addition of the 8A and 10A devices, the same space and cost savings can be extended to higher power applications,” he remarked.

“There are significant design advantages to implementing SiC power devices in high efficiency power electronics systems, including the ability to achieve higher current and voltage ratings with fewer components. By reducing the component count, designers can achieve lower overall system costs with increased reliability and maximum efficiency,” continued Balkas.

“When used in conjunction with Cree’s new series of 1200V SiC Power MOSFETs in an all-SiC design, these Schottky diodes make it possible to achieve high-efficiency power electronics systems with switching frequencies that are 5x to 8x higher when compared to conventional silicon solutions. The higher switching frequencies enable smaller magnetic and capacitive elements, thereby shrinking system size, weight and cost,” concluded Balkas.

Cree’s C4D02120E Series Schottky diodes are rated for 2A/1200V; the C4D05120E Series diodes are rated for 5A/1200V; the C4D08120E Series diodes are rated for 8A/1200V; and the C4D10120E Series diodes are rated for 10A/1200V. Operating junction temperature for all C4DXX120E devices is rated for -55°C to +175°C.

The C4DXX120E surface mount Schottky diodes are fully qualified and released for production use.

Si/SiC hybrid IGBT modules from Powerex

The low profile modules which feature a silicon carbide Schottky diode are designed for use in high frequency applications.

Combining the NFH-Series Powerex IGBT and a zero recovery Schottky diode, Powerex is now offering split dual Si/SiC hybrid IGBT modules.

The QID1210005 and QID1210006 are designed for use in high frequency applications above 30kHz

for hard switching applications and 60 to 80 kHz for soft switching applications.

Each module consists of two IGBT transistors, with each transistor having a reverse-connected zero recovery free-wheel SiC Schottky diode. A 30% decrease in switching losses result from this innovative design. All components and interconnects are isolated from the heat sinking baseplate, offering simplified system assembly and thermal management.

QID1210005 and QID1210006 boast a very low profile and can be easily reconfigured. In total, five different configurations are possible: independent; as a dual; in parallel; common collector; and common emitter.

Rated at 100A/1200V, the QID1210005 and QID1210006 feature a low ESW (off), AIN isolation and a low internal inductance. With two individual switches per module, the device has an isolated baseplate for easy heat sinking. The QID1210005 has a copper baseplate and the QID1210006 has an AlSiC baseplate for an extended thermal cycle life.

These hybrid modules can be used in applications, including energy saving power systems, such as fans, pumps and consumer appliances and high frequency type power systems, such as UPS, high speed motor drives, induction heating, welder and robotics. Other applications include high temperature power systems, such as power electronics in electric vehicle and aviation systems.

Standard Powerex NFH gate drivers can be used with the split dual Si/SiC Hybrid IGBT modules.

Equipment and Materials

Wales awards SPTS with technology prize

The firm impressed judges with its continuously changing product range which have adapted to the international market over the past three years.

SPTS Technologies, a supplier of advanced wafer processing solutions for the global semiconductor industry and related markets, has been recognised as the Technology category winner at the inaugural 2011 “Made in Wales” awards.

Honoured by media organisation Wales Business Insider, the award recognises Wales-based companies who have achieved business excellence in eight categories. When announcing the Technology winner, the judging panel stated that SPTS “impressed judges with the international reach of its product range and the way it has adapted to changing markets over the past three years.”

“We are delighted to be named the technology winner by Insider’s Made in Wales,” said Kevin Crofton, executive vice president and chief operating officer of SPTS. “This result honours SPTS’ market-leading products that have been developed here in Newport. I am very proud to accept this on behalf of the team.”

More than 240 employees work in SPTS’s Newport division, working across technical, manufacturing, R&D and operational departments.

LayTec retains position in fastest 500 growing technology companies

For the third time in a row, LayTec was awarded with Deloitte’s Technology Fast 50 Award for Germany and the Deloitte’s Technology Fast 500

EMEA Award.

With a sales growth of 1062% in the period 2006-2010 LayTec achieved place 8 in Germany and place 144 among the fastest growing technology companies in Europe, the Middle East and Africa!

CEO, president and founder of LayTec, Thomas Zettler, explains the successful concept: “To receive this award three years in succession shows that we have successfully positioned LayTec in the market. We have created an organisation which is able to adapt to the dynamic market requirements and to develop innovative products within a short time.”

He continues, “LayTec did successfully overcome the challenges coming along with fast growth and we owe this to the engaged and unremitting commitment of our staff, their excellent knowledge and our close collaboration with our national and international partners!”

Founded in October 1999 as a spin-off of the Technical University Berlin, LayTec quickly became a market leader in compound semiconductor process metrology, especially for LED, but also for laser and high power electronic production.

Since 2009, LayTec’s integrated metrology solutions are also applied in solar cell production as well as other large area deposition processes.

The implementation of LayTec metrology systems in production processes significantly shortens development cycles and enables an efficient quality control that helps to considerably reduce production and development costs. LayTec’s new developments are generated in close cooperation with our customers. Supported by a global distribution and service network, LayTec products are used worldwide in leading research institutions and industrial enterprises.

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on “The Market for LEDs in Lighting”.

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of

Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable "on-silicon" solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Sora Inc.

Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering, Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound Semiconductor Markets: Current Status and Future Prospects".

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research

presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-V on 200 mm Si for VLSI - Richard Hill, Sematech
- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : "CS Europe 2012: LEDs, lasers, PV and electronics Conference"

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

• SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

• Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

• Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

• Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors

• Scalable "on-silicon" solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

• III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.

• Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

• Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company

• The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU

• Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

• GaN the enabler for true SDR- Professor Rik Jos, NXP

• Holistic Approach to MOCVD vacuum & Abatement - Mike Czerniak, EdwardsVacuum Ltd

• Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning

• Large diameter GaN-on-Si epiwafers for power electronics –Dr Mariane Germain, EpiGaN

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Technology Director, TriQuint Semiconductor

•Damage - free Deposition on LED devices –Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

•Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

MOCVD shipments see first year-over-year decline in 2.5 years

A growing oversupply of LEDs and expiring subsidies in China have contributed to the reduction. On the upside, shipments for GaN-on-silicon reactors saw an upsurge.

IMS Research released the MOCVD chapters of its 300-page "Quarterly LED Supply and Demand Report" in November 2011 which revealed significant changes in MOCVD market share and the MOCVD market outlook.

MOCVD shipments for all applications fell Q/Q and Y/Y to 170 units. It was the first Y/Y decline in at least 2.5 years.

The decline can be attributed to depressed utilisation in the GaN LED space along with a growing oversupply in LEDs, tight credit, facility readiness and expiring subsidies in China. A bright spot was rising shipments of MOCVD systems for GaN on silicon.

MOCVD revenues were down sequentially for the 3rd consecutive quarter and Y/Y for the first quarter in at least 2 years, falling to \$340 million.

Veeco led in total MOCVD unit and revenues for the first time, earning a 63% share of tool shipped, shown in Figure 1, and 65% share of revenues. Aixtron's share fell from 50% to 34% in units and 52% to 32% of revenues.

Veeco did benefit from the recognition of previously shipped MaxBright reactors to the GaN LED market. However, if those were excluded, Veeco still

would have enjoyed a commanding 56% to 40% unit share advantage indicative of the acceptance of this new platform and Aixtron's customer delays

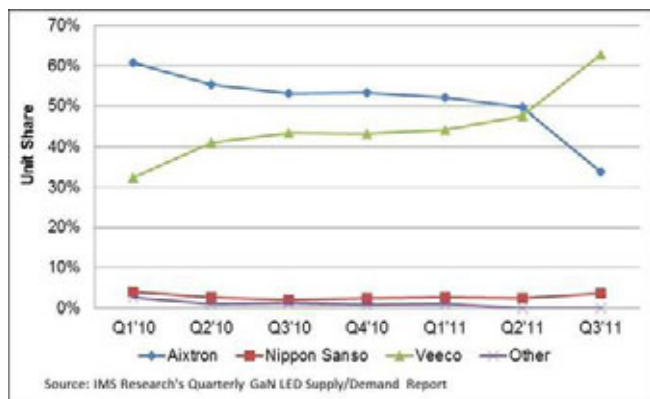


Figure 1: Total MOCVD Unit Share

GaN is the dominant application for MOCVD tools which are used to produce blue/green LEDs.

In Q3'11, GaN MOCVD tools accounted for 90% of the total MOCVD market with shipments of 152 units, down 18% Q/Q and 34% Y/Y. It was the lowest total since Q1'10. If previously shipped but unrecognised reactors from Veeco weren't included, shipments would have been the lowest since Q4'09.

What's more, GaN MOCVD revenues were down sequentially for the 3rd consecutive quarter, falling 21% Q/Q and 37% Y/Y to \$308 million.

China earned its highest share to data at 82% of unit shipments. No other region had a double-digit share. India took its first MOCVD system for GaN in at least 3 years.

Eleven of the top 13 customers in Q3'11 installed tools in China. Elec-Tech was the #1 customer in Q3'11 followed by Epilight and Tongfang Opto.

By region, Veeco led in China for the 4th consecutive quarter and also led in Taiwan for the first time.

Two inch systems once again dominated due to China's dominance, earning an 87% share of tools installed in Q3'11. Including all of Epistar's majority owned subsidiaries in China, Epistar had the highest number of merchant MOCVD systems installed followed by Samsung LED and San'an tied for #2.

As a result of the Q3'11 weakness, reduced guidance from MOCVD manufacturers and discussions with LED manufacturers, we have reduced our 2011 forecast to < 700 tools, a 9% reduction vs. the most recent forecast.

This quarter, IMS Research provided LED manufacturers' optimistic, base and pessimistic forecasts for 2012 GaN MOCVD installations, producing an interesting range. The base forecast is now less than 400 tools, a 43% reduction from 2011. However, the firm still sees 2012 as the 3rd best year ever for GaN MOCVD installations due to additional players entering from China, the existence of multi-year MOCVD subsidy agreements between certain Chinese provinces and local MOCVD suppliers and existing players buying new, more cost effective tools with wider process windows to go after new markets.

China is expected to account for a 71% share of the 2012 market, down from 77% in 2011. Taiwan's share is expected to rise from 12% to 13% with Korea's share rising from 6% to 8%.

MOCVD supplier share is forecasted for 2012 based on interviews with LED manufacturers.

The market research firm also expects to see 4" and 6" installations surge as companies prepare for the growth in lighting market demand.

According to IMS Research SVP Ross Young, "The remainder of the Q4'11 issue of our Quarterly GaN LED Supply and Demand Report will be distributed shortly and will include updated forecasts for lighting demand given China's recent incandescent ban announcement and the latest backlighting results and forecasts factoring in new, low cost direct LED backlights introduced into developing markets. We will also be updating our forecasts through 2016 for packaged LED revenues, LED supply, LED and MOCVD supply/demand and sapphire supply, demand and pricing. As we have heard from many of our subscribers, this report continues to be the most comprehensive and valuable quarterly report on the LED industry."

Avantes spectrometers can now plug into the Ethernet

The firm's spectrometers, which can be used to analyse LEDs and solar cells, can now be controlled and data acquisition conditions altered through a gigabit Ethernet connection.

Netherlands based firm Avantes is introducing the AvaGigE, a USB to Ethernet converter device which enables the firm's entire line of Avaspec USB controlled spectrometers to plug into the Ethernet.

The AvaGigE converter device enables instrument control and data acquisition of Avantes full line of spectrometers through a gigabit Ethernet connection.

Spectrometers manufactured by the company can be used in LED sorting. This is needed to provide uniform lighting which requires that LEDs used in components are matching in colour. These so-called colour parameters of LEDs can be determined by a radiometric calibrated fibre coupled spectrometer, such as the AvaSpec-2048-USB2.

Since it is possible to manufacture LEDs in a wide variety of colours and brightness, it is also necessary to accurately measure their optical characteristics. Avantes says the simplest and quickest way to measure the total luminous flux from an LED is to use an integrating sphere, coupled to an Avantes spectrometer.

Other applications of spectrometry include analysing solar cell performance.



The AvaGigE consists of a hardware device which enables connection of a single or up to eight spectrometers (via USB hub) and a web-based configuration utility. The tool handles all

synchronisation between channels. Once the connection has been configured, the AvaSpec spectrometers can be addressed via Avantes proprietary AvaSoft operating software or the AS5216 DLL interface. The AvaGigE device supports data transfer speeds which are nearly equivalent to direct USB 2.0 communication.

Features:

- IP-based spectrometer control
- Field upgradable and network settings through web interface
- Can connect multiple AvaGigE to a single network
- No Windows drivers needed; controlled directly through Avantes DLL with Ethernet support
- Maximum network cable length up-to 100 metres

Hardware

Power input: 110-240VAC/50-60Hz Max. 20W
Dimension: 110cm (L) x 69.5cm (W) x 48.5cm (H)
Communication input:

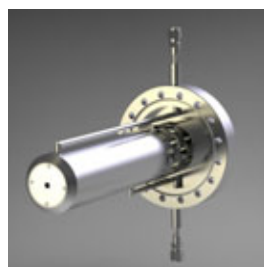
1 Gigbit Ethernet

1 USB 2.0

Hidden puts 3FD fast-response mass spectrometer into the limelight

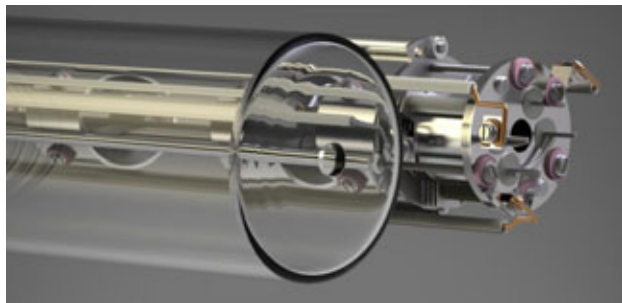
Addressing the needs of researchers operating in the UHV/XHV vacuum regime, the firm's latest tools are specialised for fast-event gaseous studies at pressures to atmosphere and beyond.

Hidden Analytical's latest 3F-series of quadrupole mass spectrometers now feature direct digital signal detection for its fastest response and most sensitive detection levels.



HAL3F cyro shroud

The firm say they address the needs of the researcher operating in the UHV/XHV vacuum regime through to specialised fast-event gaseous studies at pressures to atmosphere and beyond.



HAL301 3F quartz cover

The system integrates triple-stage mass filter technology with digital data acquisition by direct positive ion counting (pulse counting) to combine a continuous detection range of seven full decades with a detection rate from just 1 ion per second and abundance sensitivity measurements to the parts per billion regime. The integral data accumulation mode enables operation with time-functioned data acquisition for suppression of fundamental ion statistical noise. Vacuum partial pressures to $5 \times 10E-15$ mbar are detectable.

Ionisation source options are available for conventional residual gas analysis, for surface desorption studies and for molecular/laser beam measurements. Single-stage and multiple-stage pressure reduction systems are available for operation at higher pressures beyond the UHV range. Requirements for measurement of externally generated positive ions and for measurement of both positive and negative ions are addressed by the alternative EP/EQ series. A custom design service is available for specialised applications.

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be “An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program.”

Defining the next steps for the Compound Semiconductor Industry

Following the success of CS Europe 2011, next year's conference is expanding to 2 days and offers a fantastic mix of quality speakers making it the must attend industry event for 2012.

The CS Europe 2012 Conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

It will feature a mix of insightful market research presentations and cutting-edge research destined to shape tomorrow's compound semiconductor industry.

Conference schedule:

12th March 2012 am : “CS Europe 2012: Markets and III-V CMOS Conference”

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-V on 200 mm Si for VLSI - Richard Hill, Sematech

• III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day
: “CS Europe 2012: LEDs, lasers, PV and electronics Conference”

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

• Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

• SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF, Cree

• Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

• Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

• Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors

• Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

• III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Soraa Inc.

• Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

• Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company

• The CPV Market, following the acquisition of Qantasol technology - Jan-Gustav Werthen, JDSU

• Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

• GaN the enabler for true SDR- Professor Rik Jos, NXP

• Holistic Approach to MOCVD vacuum & Abatement - Mike Czerniak, EdwardsVacuum Ltd

• Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning

• Large diameter GaN-on-Si epiwafers for power electronics –Dr Mariane Germain, EpiGaN

• Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

• Damage - free Deposition on LED devices –Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

• Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

OIPT releases White Paper on ion beam etching

The publication considers the main applications and advantages of using ion beam etch technology for etching processes when compared to technologies such as plasma etching.

As one of the leaders in Ion Beam technology and system manufacture, Oxford Instruments Plasma Technology's Applications and Technology teams regularly produce technical White Papers, and the latest, on Ion Beam Etching, is now available.

Authored by Sebastien Pochon and Dave Pearson, Senior Ion Beam Application and Technology Specialists at the company, the White Paper presents a review of Ion Beam Etch Technology. It considers the main applications and advantages of using this technology for etching processes when compared to technology such as plasma etching. An overview of how an ion beam is generated is first described, and is then followed by a presentation and discussion of the process applications of ion beam technology.

The white paper is available by contacting Oxford Instruments, at process.news@oxinst.com.



Comments Robert Gunn, Applications Team Manager at Oxford Instruments Plasma Technology, "In order to offer the very best in ion beam and plasma systems, our experienced teams of applications engineers and technologists continue to develop and research into their areas of expertise, and as a result we offer our customers many technical papers, such as this White Paper, in addition to a process library of over 6000 recipes."

Oxford Instruments' range of ion beam tools includes the Ionfab300Plus offering the flexibility to perform etch and/or deposition while maximising system utilisation, the Ionfab500Plus designed for ultrahigh quality optical thin films, and the Optofab3000, specifically developed for high quality optical applications.

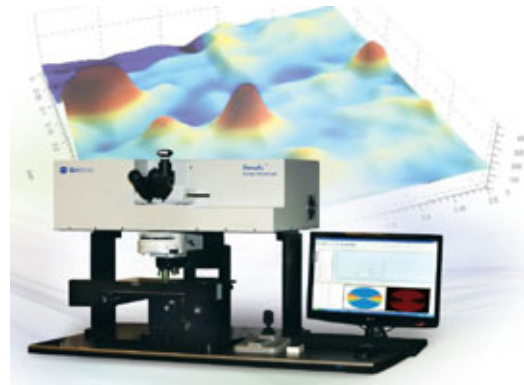
BaySpec introduces enhanced Raman microscope

The fully automated tool is available in 532, 785, 1064nm or custom wavelengths and can be used to characterise compound semiconductor materials.

BaySpec, a provider of throughput spectral engines for small and large molecular sample identification, has made enhancements to its Nomadic Raman Microscope product.

Customers can select from popular 532, 785, 1064nm or custom wavelengths with automated laser switching at a touch of the keyboard. The system features BaySpec's high throughput

Volume Phase Gratings and is configured with optimal cooling of the detector arrays allowing for greatly improved low-light spectral measurements delivering superior price/performance over other conventional systems on the market.



The integrated research grade confocal microscope is dispersive, with no moving parts and comes with complete software for data and image analysis (PLS, MIA).

Bayspec will also provide quotes on retrofitting microscopes with its OEM Raman engines.

Rubicon's sapphire fires revenues up 64%

The increased revenues, compared to the same quarter last year, were mainly due to strong sales of the firm's six inch polished sapphire wafers which totalled \$24.9 million in the quarter.

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, Semiconductor, and Optical industries, has reported financial results for its third quarter ended September 30, 2011.

The Company reported third quarter revenue of \$33.6 million, which was at the high end of previously provided estimates due to strong sales of its six inch polished wafers which totalled \$24.9 million in the quarter, a 79 percent sequential increase.

Gross margins in the third quarter were 48%, which was the top of management's previously provided guidance. Net income for the quarter totalled \$8.2 million, resulting in diluted earnings per share of

\$0.35, driven by a favourable product mix and higher than anticipated pricing on two through four inch cores sales. Approximately \$5.5 million of Rubicon common stock was purchased under the share repurchase program announced in the last quarter.

Raja Parvez, President and CEO of Rubicon Technologies, commented, "Although overall substrate demand from the LED market declined in the third quarter, major LED chip manufacturers continue to focus on migrating to larger diameter substrates in order to gain efficiencies. As a result, we had strong growth in revenue from our six inch polished wafers which helped to compensate for reduced orders of two through four inch sapphire cores."

The Company ended the third quarter with \$72.6 million in cash and short-term investments and no debt. In the third quarter, the Company repurchased approximately 425,000 shares of its common stock at an average price of \$12.90 per share. At the end of the third quarter, the company had \$19.5 million authorised for future repurchases of its common stock under the current program.

Fourth Quarter 2011 Guidance

Commenting on the outlook for the fourth quarter of 2011, Parvez said, "Previously, we had anticipated improved demand for sapphire products by the end of the third quarter. However, we now expect to see continued softness in the LED market at least through the fourth quarter. Although inventory levels at our customers are in decline, there continues to be excess inventory throughout the supply chain limiting our visibility on future orders for two through four inch sapphire cores."

"As a result, we expect prices for those products will decline further in the fourth quarter. Additionally, the prolonged weakness in the LED market could also impact six inch polished wafer volumes and pricing making projecting fourth quarter results particularly challenging. As a result of these challenging market conditions, we expect revenue in the fourth quarter to be between \$20 and \$23 million, gross margins in the low to mid-thirty percent range, and diluted EPS to be in the range of \$0.07 to \$0.10," Parvez concluded.

5N Plus expands Asian activities

The firm expects its Laos and new Korean facilities will be instrumental in allowing 5N Plus to meet increasing demand for its products in this part of the world.

5N Plus, a producer of specialty metal and chemical products has reached an agreement to acquire the remaining 40 percent ownership interest in the joint venture company Lao Industrial Resources Co Ltd., that focuses on metal refining.

5N Plus also announced that it will be setting up a gallium chemicals plant in Korea in conjunction with Hong Kong based Golden Harvest, a leading producer of primary gallium. 5N Plus and Golden Harvest have been joint venture partners in a gallium refining facility located in Shenzhen, China since 2009. The new Korean facility will produce gallium chemicals for the growing LED market and is expected to be operational by mid-2012.

5N Plus President and Chief Executive Officer Jacques L'Ecuyer said, "Expansion of our activities in Asia is part of our growth strategy as we expect to see increasing demand for our products in this part of the world. Our Laos and new Korean facilities will be instrumental in allowing us to leverage this demand and the corresponding business opportunities."

OIPT provides dedicated training facilities in Bristol, UK

Customers will gain knowledge on how to maintain and run their own machines on a day-to-day basis.

Oxford Instruments Plasma Technology has recently created a dedicated Training Facility at its Bristol, UK headquarters and extended its training course schedule as part of an on-going programme of expansion and facility improvements.

The company fully recognises the importance to customers of maximising their machine uptime and process knowledge, and aims to provide the

very best training, in order to ensure machines are maintained and used to their full capabilities. While Oxford Instruments offers extensive Customer Support maintenance & service packages, it is always beneficial for customers to have enough knowledge to maintain and run their own machines on a day-to-day level. These courses aim to assist Customers in achieving this.

The new course schedule includes training on PlasmaPro System 80/800, PlasmaPro System 100/133, PlasmaPro NGP 80, PlasmaPro NGP1000, plus the HINE/EMS Robotic transfer arm, and End point detection.

Pete Hunt, Oxford Instruments Customer Service and Support Manager comments, "As a leader in system manufacture for both the Production and R&D markets, we realise the importance of machine maintenance and uptime. Our courses are designed to improve process knowledge and system maintenance techniques for engineers and technicians. They are given by our experienced Training Officer, Nick Curtis, with the support of the Company's process and system engineers, who not only know the systems but understand our Customers' individual requirements."

OIPT says customer feedback on training has been excellent, with participants finding both the theory and practical sessions beneficial and well organised. As Hilary Tanner of L-3 EOS commented, "You supplied good, solid, thought-provoking information"

In order to provide the very best training packages, course numbers are limited so that participants gain a real insight at first hand into the machines.

Johnson Matthey purge systems popular in U.S. and Europe

China and Taiwan are still the largest markets for the firm's products used in compound semiconductor manufacturing. JM expects its GPT PureGuard V-Purge System sales to be strong in 2012 based on the fact that long-term LED market opportunities remain very positive.

Johnson Matthey's Gas Purification Technology (GPT) group announced that 2011 sales of its PureGuardTV-Purge System to compound semiconductor manufacturers are up in the U.S. and Europe.

Johnson Matthey, a designer, manufacturer and distribution of point-of-use gas purification equipment to the global electronics industry, has shipped its PureGuard V-Purge Systems, hydrogen purifiers and other offerings to new and expanding fabs for sensitive semiconductor and analytical applications, including compound semiconductor, crystal growth and PV deposition processes.

"While China and Taiwan are still the largest markets for our products," said Jeff Lucht, GPT group Business Manager, "V-Purge System sales are strong in the U.S. and Europe. These systems are designed to meet the needs of today's largest MOCVD production platforms, particularly for manufacturing high brightness (HB) and other types of LEDs."

Lucht said that he expects GPT PureGuard V-Purge System sales to be strong in 2012 "based on the fact that long-term LED market opportunities remain very positive."

The V-Purge System enhances the performance of Johnson Matthey and other hydrogen purifiers for higher flow rates typical in production fabs. The patented system employing palladium membrane technology offers flow rates between 1 and 200 slpm and removes water, oxygen, carbon monoxide, methane, nitrogen, carbon dioxide and THC to produce the purest possible hydrogen.

The system provides heat management capable of handling any flow change, superior protection from power failure and pressure surges and can switch from full nitrogen to full hydrogen immediately. When the automated purge is activated, it takes the V-Purge System minutes to remove all hydrogen.

Earlier this year Johnson Matthey's GPT group reported that 2010 Asia sales increased dramatically for its leading and highly reliable bulk and point-of-use PureGuard PSH Series hydrogen purifiers, thanks largely to the continuing rapid growth of LED production using MOCVD tools.

Lucht said the GPT group is committed to

supporting the growth of the global semiconductor industry, especially in Asia, the area of greatest expansion for electronics. Palladium membrane technology is preferred by semiconductor fabs for use with the compressed hydrogen supply common in Asia and particularly in China. MOCVD processes are the most common application for palladium purifiers

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

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- Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

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Riber sees strong commercial momentum in Europe and Asia

The firm has accepted orders for tools to grow III-V and II-VI compound semiconductors and nitrides for use in optoelectronics and for use in research and development.

French firm Riber, a manufacturer of MBE reactors, has announced the sale of several research systems in Europe and Asia.

The University of Rzeszow has just ordered a double chamber Compact21 research system. It will enable the Institute of Physics to strengthen its development capacities for designing III-V and II-VI component-based semiconductor systems.

In Asia, Riber completed the sale of two research systems to two major research laboratories.

In China, the order to supply a Compact 21 MBE system will allow the Chinese laboratory to increase its research capabilities on nitride optoelectronic technologies design.

In Singapore, a leading research laboratory made the acquisition of one MBE412 system in order to complement its fleet of equipments. With its capacity to process large size substrates, the MBE412 system is a highly competitive and flexible R&D resource.

Ammono cuts prices of smaller GaN substrates

The manufacturer of high quality ammonothermal gallium nitride products is offering customers discounts for the final quarter of 2011.

Ammono, as part of the build up to the January 2012 launch of its new 2-inch *c*-plane *n*-type substrates, has introduced discount prices in Q4 for its smaller size GaN wafers which are currently in the company's stock.

For this special offer Ammono has introduced a simplified purchase procedure which results in a

prompt shipment.

Quotations may be obtained from the firm's website at www.ammono.com. After selecting the preferred size and quantity of Ammono-GaN wafers in the online ordering system under 'Buy Now', a quotation will follow within 48 hours.

EVG launches ZoneBOND open platform for temporary bonding

EVG's EZR (Edge Zone Release) and EZD (Edge Zone Debond) modules enable a flexible choice of adhesives for bonding compound semiconductor materials and can be easily integrated in EVG's high-volume manufacturing equipment platforms.

EV Group (EVG), a supplier of wafer bonding and lithography equipment for the MEMS, nanotechnology and semiconductor markets, has launched a suite of groundbreaking temporary bonding and debonding (TB/DB) equipment modules that support ZoneBOND technology.

In parallel, EVG has opened its TB/DB equipment platform to enable the use of a wide range of adhesives from various suppliers to give customers the most flexible choice of bonding materials. The announcement comes on the heels of an agreement between EV Group and Brewer Science, which allows both companies to commercialise ZoneBOND technology.

EVG's new EZR and EZD modules can be easily integrated in EVG's high-volume manufacturing equipment platforms such as the EVG850 Series automated temporary bonding and debonding systems. The new EVG EZR (Edge Zone Release) and EZD (Edge Zone Debond) modules will begin shipping to industrial customers before the end of 2011.

Fraunhofer IZM ASSID (All Silicon System Integration Dresden), a developer of advanced semiconductor R&D, already received EZR and EZD modules earlier this year for ZoneBOND processes and materials qualification as part of a joint development agreement with EVG.

In an equally important move, EVG will, through an open materials platform approach, establish a stronger supply chain for its market leading TB/DB technologies. EVG plans to qualify a wide range of adhesives from various materials suppliers for the ZoneBOND process. In support of this effort, EVG has defined standard test procedures that allow for fast and reliable qualification of additional adhesives. EVG will disclose the initial, new materials suppliers supporting the ZoneBOND process shortly.

"Integrating ZoneBOND technology into our field-proven, high-volume temporary bonding/debonding platform is an important part of EVG's efforts to not only ensure our customers have access to the most advanced technology available, but also to continue driving the commercialization of 3D ICs," stated Markus Wimplinger, corporate technology development and IP director for EVG. "A key advantage of our EZR and EZD modules is their ability to support a variety of adhesive materials, which in turn, provides our customers with increased flexibility during thin wafer processing."

ZoneBOND™ technology provides a breakthrough approach for temporary wafer bonding, thin wafer processing, and debonding applications-overcoming the last remaining limitations associated with thin wafer processing. Benefits of ZoneBOND™ technology include: the use of silicon, glass and other carriers; compatibility with existing, field-proven adhesive platforms; and the ability to debond at room temperature with virtually no vertical force being applied to the device wafer. To support grinding and backside processing at high temperatures and to allow for low-force carrier separation, ZoneBOND™ defines two distinctive zones on the carrier wafer surface with strong adhesion in the perimeter (edge zone) and minimal adhesion in the center zone. As a result, low separation force is only required for carrier separation once the polymeric edge adhesive has been removed by solvent dissolution or other means.

New non-executive chairman appointed by SPTS

Industry veteran Henry R. Nothhaft should strengthen the company's expansion and growth.

SPTS Technologies, a supplier of advanced wafer processing solutions for the global semiconductor industry and related markets, has appointed Henry R. "Hank" Nothhaft as non-executive chairman of the board.

In the role, Nothhaft will provide leadership to the Board of Directors, and assist senior management with business and corporate development strategies, plus provide end-market insights. The appointment became effective on November 1, 2011.

Nothhaft is widely recognised as an entrepreneur and industry trailblazer in high technology markets having grown several successful companies as CEO and chairman, including Danger (later acquired by Microsoft) and Concentric Network Corporation.

From 2004 to 2011, Nothhaft served as a board member and from 2008 as chairman, president and CEO of Tessera Technologies, a developer of semiconductor packaging technology. Nothhaft has served on a number of board of directors including DSC Communications, VMX Systems, Concentric Network Corporation, Ocular Networks, Vertical Networks and David Systems, and has recently been appointed to the board of directors of Openwave Systems. He also served on the telecommunications advisory board of Compaq Computer Corporation.

"We are very pleased that Hank is joining us as non-executive chairman, said William Johnson, president and CEO of SPTS. "Our company is on an exciting growth path following the June 2011 management acquisition, and Hank's record of growing technology companies demonstrates a unique ability to see beyond current market needs."

Bridgepoint partner and SPTS board member Kevin Reynolds echoed these sentiments, "We believe Hank's extensive business acumen in taking different businesses to market and making them successful further strengthens an already

impressive SPTS executive team."

The newly-appointed chairman Nothhaft said, "I am delighted to be joining the SPTS Technologies board and am excited by the opportunity to contribute to their expansion. I've observed their amazing growth over the past 2 years, and am looking forward to working with a motivated and talented management team.

An advocate for government policies that nurture innovation, small businesses and start-ups, Nothhaft has authored articles and opinion editorials, including a book titled "Great Again: Revitalizing America's Entrepreneurial Leadership," a call to revive America's entrepreneurial spirit. Nothhaft has an M.B.A. from the George Washington University in Information Systems Technology and a B.S. with distinction from the U.S. Naval Academy. He is a former officer in the U.S. Marine Corps and a Vietnam Veteran.

HTOT inaugurates sapphire manufacturing plant

The firm is now ramping up to volume production and when the plant is fully operational, it will be capable of producing 30,000,000 TIE of sapphire material annually.

Haotian Optoelectronics Technology (HTOT) celebrated the opening of its sapphire production facility with a gala event on October 26, at HTOT's new facility located in Guiyang City, Guizhou Province, China.

The city's Vice Mayor hosted the celebration, which included attendance of key provincial and local party officials as well as HTOT sapphire material customers.

Also present were GT Advanced Technologies' president and CEO Tom Gutierrez, Cheryl Diuguid, the company's vice president and general manager of its sapphire material and equipment business and Jeff Ford, GT's vice president and general manager of Asia.

GT announced the sale of its ASF sapphire crystal growth furnaces to HTOT in April, 2011.



GT Advanced Technologies president and CEO Tom Gutierrez celebrates the unveiling of the first sapphire boules produced in HTOT's new sapphire manufacturing facility located in Guiyang City, China. (Photo: Business Wire)

"We were delighted to be part of HTOT's celebration commemorating their official entrance into the sapphire material industry," said Tom Gutierrez. "Over the coming months we will work closely with the HTOT team to ensure a smooth ramp to volume production in their new state-of-the-art facility, which incorporates our ASF crystal growth equipment. In their initial production runs, HTOT has successfully grown four high quality boules, all of which were over 100 kilograms."

Gutierrez continued, "GT has a proven track record of partnering with companies to accelerate their entry into new markets by giving them the tools and support they need to become key industry players. Over the next few months we expect several of our other key sapphire customers in Asia to start producing sapphire and we look forward to working with these customers to ensure their smooth entrance into the sapphire growth industry."

Within six months, HTOT built a state-of-the-art production facility and is in the process of completing the installation of equipment and ramping to volume production. When the plant is fully operational it will be capable of producing 30,000,000 TIE of sapphire material annually.

Brisk 2010 GaAs epitaxial substrate revenue growth expected

Strategy Analytics' latest report says that 6-inch GaAs epitaxial substrates will be the most prevalent, accounting for slightly more than 80 percent of total device demand over the 2010 to 2015 period.

As mobile handsets and network infrastructure become more sophisticated, GaAs device usage in these applications is increasing.

This demand is also driving growth in the consumption of GaAs epitaxial wafers that form the basis for these devices. This is according to the recently released Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) Forecast and Outlook, "Markets for SI GaAs Epitaxial Substrates: 2010-2015."

The report says that demand from commercial and military applications resulted in semi-insulating (SI) GaAs epitaxial substrate demand of slightly more than 29600 ksi (kilo square inches) in 2010. The forecast estimates that growth in GaAs devices will increase the substrate demand to more than 40200 ksi and revenues of \$543 million in 2015.

This Strategy Analytics report forecasts that 6-inch GaAs epitaxial substrates will be the most prevalent, accounting for slightly more than 80 percent of total device demand over the forecast period. With cost sensitive, high volume markets dominating the demand for GaAs devices, the report forecasts a compounded average annual growth rate of 9 percent for 6-inch GaAs epitaxial substrate demand.

"Strong growth in the overall GaAs device market in 2010 propelled the GaAs epitaxial substrate market to solid gains in 2010," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service. "The GaAs substrate market is tied closely to wireless communications and Strategy Analytics anticipates continued growth in these areas."

Asif Anwar, Director in the Strategy Analytics Strategic Technologies Practice added, "We

continue to see similar growth rates for MOCVD and MBE epitaxial substrate material and the ability to supply both types of material is solidifying IQE's position as the largest supplier."

The Strategy Analytics forecast segments the Si GaAs epitaxial substrate market by diameter, geography, structure, application, device type and supplier. The report also addresses trends and recent developments in these segments.

II-VI quarterly revenues boosted by 15% to \$138.3 million

For the fiscal year ending June 30, 2012, the Company expects revenues to range from \$575 million to \$590 million. However, this does not take into account the impact of the floods in Thailand.

II-VI Incorporated has reported results for its first fiscal quarter ended September 30, 2011.

All per share data has been adjusted to account for the two-for-one split of the Company's common shares paid as a stock dividend to shareholders on June 24, 2011.

On July 1, 2011, the Company acquired Aegis Lightwave and on December 7, 2010, the Company acquired Max Levy Autograph (MLA). Results for the quarter ended September 30, 2011 include the operating results of both Aegis and MLA. Aegis is part of the Company's Near-Infrared Optics segment while MLA is part of the Company's Military & Materials segment.

Bookings for the quarter increased 16% to \$130,247,000 compared to \$112,050,000 in the first quarter of last fiscal year. Bookings are defined as customer orders received that are expected to be converted into revenues during the next 12 months.

Revenues for the quarter increased 15% to \$138,373,000 from \$120,134,000 in the first quarter of last fiscal year.

Net earnings attributed to II-VI Incorporated for the quarter were \$18,579,000 or \$0.29 per share-diluted compared with net earnings of \$18,367,000

or \$0.29 per share-diluted in the first quarter of last fiscal year.

Francis J. Kramer, president and chief executive officer said, "Our Infrared Optics segment continues to benefit from increased utilisation and deployment of CO2 laser systems worldwide. The Company's Near-Infrared Optics segment continued to experience softening in order intake as inventory adjustments impacted the telecommunication markets. The segment earnings of Near-Infrared Optics were impacted during the quarter by lower operating margins at Photop, mostly due to a change in product mix, lower military sales and gross margins at VLOC and costs incurred by Aegis related to acquisition write-ups of tangible and intangible assets."

"Our Pacific Rare Specialty Metals & Chemicals, Inc. business increased revenues by 28% over the first quarter of last fiscal year but profitability was impacted by commodity prices and a one-time charge resulting from a high-profile bankruptcy by one of our customers in the solar industry. Our Marlow business recorded double-digit increases in both bookings and revenues compared to the first quarter of last fiscal year."

Kramer continued, "During the quarter we completed the acquisition of Aegis Lightwave. We believe their partnership with Photop will provide significant enhancements to our telecommunications product line and anticipate customers' growing needs for network bandwidth and reliability."

Kramer concluded, "II-VI Incorporated is well positioned to take advantage of worldwide economic opportunities and to respond to changing global conditions. We continue to make strategic investments in capital equipment at our worldwide manufacturing locations to improve capacity, quality, productivity and yields. Our updated guidance for fiscal year 2012 has been adjusted to reflect general market conditions and the current cautious sentiment of our industrial and military customers."

Segment Information

The following segment information includes segment earnings (defined as earnings before income taxes, interest expense and other expense or income, net). Management believes segment

earnings are a useful performance measure because they reflect the results of segment performance over which management has direct control. Effective July 1, 2011, the Company renamed its former Compound Semiconductor Group operating segment the Advanced Products Group.

For the second fiscal quarter ending December 31, 2011, the Company currently forecasts revenues to range from \$133 million to \$138 million and earnings per share to range from \$0.26 to \$0.30. Comparable results for the quarter ended December 31, 2010 were revenues of \$120.9 million and earnings per share of \$0.30.

For the fiscal year ending June 30, 2012, the Company expects revenues to range from \$575 million to \$590 million and earnings per share to range from \$1.26 to \$1.33. Results for the year ended June 30, 2011 were revenues of \$502.8 million and earnings per share of \$1.30.

On October 24, 2011, Fabrinet, a company that manufactures products for the Company and manufactures products for certain of the Company's customers using II-VI products, announced that flood waters had infiltrated the manufacturing facilities at its Chokchai campus in Pathum Thani, Thailand. Fabrinet also announced that it has not yet been able to make a full assessment of the damage but believes it is unlikely that production would recommence at Chokchai for the remainder of the current quarter.

The Company does not know whether this event will have a material adverse impact on its results of operations. As a result, the foregoing outlook does not take into account the impact that this event will have on the Company for the quarter ending December 31, 2011 or for the fiscal year ending June 30, 2012.

II-VI Incorporated produces numerous crystalline compounds including zinc selenide for infrared laser optics, silicon carbide for high-power electronic and microwave applications, and bismuth telluride for thermoelectric coolers.

Kopin awarded in TSIA's "Recognised Innovator Awards"

The firm was acknowledged as a prominent leader in the compound semiconductor industry and for offering guidance and innovations that increase organisational efficiencies, returns, and accomplishments.

The Technology Services Industry Association (TSIA) has honoured Kopin with its Recognised Innovator Award for "Innovation in Products"

The firm was acknowledged at the Technology Services World conference in Las Vegas, Nevada last week. Conducted by John Ragsdale, TSIA vice president of technology research, the tour featured demos from all of the Recognised Innovator finalist companies.

Describing the Recognised Innovator Award winners, Ragsdale explained, "Business and technology innovation is the backbone of success for organisations across the globe, allowing them to achieve best-in-class results and drive customer loyalty. These solutions providers are prominent leaders in their respective industries, offering guidance and innovations that increase organisational efficiencies, returns, and accomplishments."

The Recognised Innovator Awards are an independently judged awards program that recognises innovation in technology services products and service offerings documented with customer case studies of measurable business value and results.

The Recognised Innovators in each category were selected by a panel of judges, including industry experts and TSIA members.

The next round of the Recognised Innovator awards program will be held in the spring of 2012, in conjunction with Technology Services World Silicon Valley.

Kopin Q3 results slide 6% to \$29.6 million

III-V revenues were affected by a shift in wireless handset sales as various OEMs are adjusting their product offering dates from a pattern which focused on the U.S. holiday season to more year-round introductions of handsets and tablets.

Kopin Corporation a supplier of advanced semiconductor products has announced financial results for the third quarter and nine months ended September 24, 2011.

Total revenues for the third quarter were down 6 percent to \$29.6 million compared with \$31.6 million for the same quarter of 2010. Through the nine months ended September 24, 2011, revenues increased to \$95.9 million from \$87.2 million for the comparable period of 2010.

“Despite the uncertain economic environment, our performance through the first nine months of 2011 has been quite strong,” said John C.C. Fan, Kopin’s President and Chief Executive Officer. “Revenues are 10 percent ahead of the same period in 2010, and we have generated \$10.6 million in cash from operating activities.”

“This has enabled us to maintain a strong balance sheet – \$103 million in cash and marketable securities and no debt – while at the same time aggressively investing to grow our business organically and through acquisitions. Income from operations has more than doubled to \$2.4 million for the first nine months of 2011, even as we have invested \$6.0 million more in research and development this year over last year,” he continued.

III-V revenues for the third quarter were \$15.5 million compared with \$16.6 million for the year-ago quarter. For the nine-month period of 2011, III-V revenues were \$49.1 million, up 4 percent from \$47.1 million through the same period of last year. Display revenues were \$14.1 million for the third quarter of 2011 versus \$15.0 million for the same period a year ago. Through the nine months ended September 24, 2011 display revenues increased 17 percent to \$46.8 million from \$40.1 million in the year-ago period.

“III-V third-quarter revenues were down

sequentially, but our current forecast indicates that the fourth-quarter revenues will be up over the third quarter,” Fan said. “We believe our III-V revenues were affected by a shift in wireless handset sales as various OEMs are adjusting their product offering dates from a pattern which focused on the U.S. holiday season to more year-round introductions of handsets and tablets.”

Gross margin for the third quarter of 2011 was \$9.5 million, or 33.2 percent of product revenues, compared with \$10.1 million, or 32.3 percent of product revenues, for the comparable period of 2010. Through the first nine months of 2011, gross margin was \$30.9 million, or 34.0 percent of product revenues compared with \$23.7 million, or 28.1 percent of product revenues, for the same period of 2010.

Research and development (R&D) expenses were \$6.4 million, or 22 percent of revenues, compared with \$4.8 million, or 15 percent of revenues, in the third quarter of 2010, reflecting Kopin’s investments in its Golden-i technology, III-V smartphone products and capacity expansion, military display products and the addition of Forth Dimension Displays (FDD), which the Company acquired in January 2011. R&D expenses totaled \$19.9 million through the first nine months of 2011 compared with \$13.9 million for the same period of 2010.

Selling, general and administrative (SG&A) expenses were \$4.4 million in the third quarter of 2011 compared with \$3.9 million for the same period of last year. SG&A expenses were \$13.5 million for the nine months ended September 24, 2011 compared with \$11.7 million for the same period in 2010. The increase in SG&A expenses for 2011 as compared to 2010 is a result of the inclusion of FDD.

Net income was \$0.8 million, or \$0.01 per diluted share, for the third quarter of 2011 compared with \$1.4 million, or \$0.02 per diluted share, for the third quarter of 2010. Results for the 2011 and 2010 three-month periods included a \$1.0 million gain and a \$0.6 million loss, respectively, related to foreign currency fluctuations.

Net income through the first nine months of 2011 was \$3.7 million, or \$0.06 per diluted share, compared with \$4.3 million, or \$0.06 per diluted share, in 2010. Results for the 2011 nine-month

period included a \$0.4 million gain on the sale of equity investments, while results for the 2010 period included a gain on the sale of equity investments of \$2.6 million.

Business Outlook

Based on current trends in its business, the Company expects 2011 revenues in the range of \$128 million to \$132 million. In the fourth quarter of 2011 Kopin believes that revenues will increase from the third quarter of the year as a result of increased demand for its III-V BiHEMT products and display sales driven by new design wins for digital still cameras and increased military product shipments.

“During periods of economic volatility as we are experiencing, we understand that there is one school of thought to scale back on investment and R&D and wait for the market to bounce back. Our philosophy is to use opportunities like this to invest in our business – including BiHEMT structures, the TWS program, night vision technology and Golden-i – to extend our leadership position while still maintaining our financial strength,” Fan said.

“Our BiHEMT activities are having the most immediate impact, as demand for this product is up six-fold from 2010 and we expect it to continue to ramp through 2012. During the summer our night vision products went through the first round of testing and the feedback was good.”

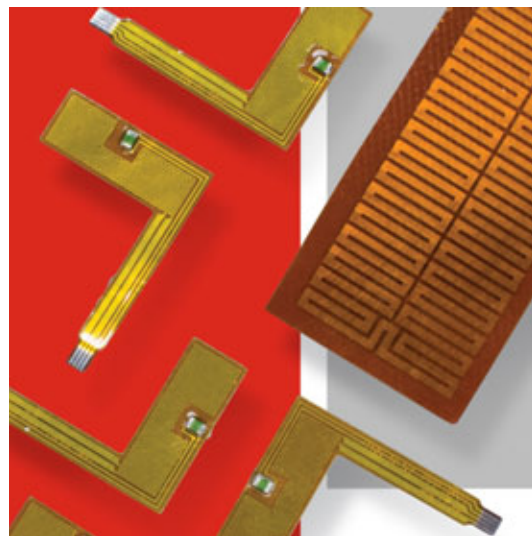
“During the third quarter we produced another round of qualification units that were shipped to the government in October. These will be tested through first quarter of 2012 after which it is anticipated the government will award production contracts. Furthermore, during the third quarter we had installed a wireless camera into the game-changing Golden-i system. While it will continue to undergo modifications and testing we are on schedule for its formal product introduction next year,” concluded Fan.

Kopin hosted a conference call discussing its third-quarter 2011 financial results. The call is available as an archived audio webcast on the “Investors” section of the Kopin website.

Watlow unveils enhanced developments for wafer processing

The firm’s new polyimide flexible heaters have low outgassing and are resistant to radiation, solvents and many other chemicals used in compound semiconductor wafer processing.

Polyimide is a thin, lightweight organic polymer film that provides excellent tensile strength, tear resistance and dimensional stability.



Polyimide heaters are best suited for semiconductor including compound semiconductor wafer processing applications. Polyimide has the additional attributes of low outgassing for and is resistant to radiation, solvents and many other chemicals.

Watlow’s enhanced precision registration cutting provides tight tolerance to fit customer’s application needs. New product features allows Watlow to custom design a heater to meet power supply needs.

Watlow can assist in development of polyimide heaters to meet the exact application requirements through precise temperature distribution. By properly bonding or attaching the heater to a customer’s, Watlow creates subassemblies that reduce installation costs for customers.

Capabilities include surface mount component integration, thermal subassemblies and fine etch

trace of 0.01 inches and surface flatness of 15µm. The polyimide heater operates to temperatures up to 250°C and watt densities to 40 W/in² in typical applications.

Keithley branches out with Indian website

In conjunction with the firm's new Web Forum, the website offers Indian scientists and compound semiconductor engineers instant access to technical test and measurement information around the clock.

Keithley Instruments has a new website created for its customers, prospective customers, and users of its products in India, www.keithley.in.

The English-language site provides scientists, researchers, and engineers based in India with a wealth of information on the company's offerings in advanced electrical test instruments and systems and how to use them effectively, providing in-depth product and applications information, as well as guidance on how to obtain additional assistance from local Keithley representatives.

Linda Rae, president of Keithley Instruments, noted, "We added the Indian website because India represents an important and growing market for Keithley. We've been building our reputation for technical innovation and customer support among Indian scientists and engineers since the 1970s, when we opened our first Indian office. Today, our instruments are widely used in India's educational institutions and scientific research labs, as well as in applied research settings and production testing of electronic components, ranging from mobile phones and power supplies to electrical sub-systems and semiconductors."

Ramesh Adahallikar, Keithley's country manager for India and the Middle East, added, "We're very excited to have a dedicated India website because it means we can serve our customers and users of Keithley products faster and more effectively. In conjunction with Keithley's new Web Forum, it offers Indian scientists and engineers instant access to technical test and measurement information around the clock."

India is just the latest addition to Keithley's list of international websites. Others include sites for the United States, Germany, France, the United Kingdom, Switzerland, Russia, Chile, Italy, the Netherlands, Singapore, Taiwan, Japan, China, and Korea.

Veeco Q3 net income slumps due to weak backlighting demand

The company's third quarter orders were impacted by weak near-term LED industry demand, low MOCVD equipment utilisation rates in Asia, and decreased business activity in China.

Veeco Instruments has announced its financial results for the third quarter ended September 30, 2011.

The firm reported results for Veeco's "Continuing Operations" which excludes the Metrology business sold to Bruker Corporation on October 7, 2010 and reflect the discontinuation of Veeco's CIGS Solar Systems business.

GAAP results for Q3 2011 were \$268 million compared to \$277.1 million for the same period last year. Net income took a severe hit and was \$52.6 million compared to \$93.7 million for Q3 2011, while diluted EPS dived from \$2.22 to \$1.31.

John R. Peeler, Veeco's Chief Executive Officer, commented, "Veeco reported a solid third quarter, with revenues of \$268 million, non-GAAP net income and earnings per share of \$53 million and \$1.33, respectively, all at the mid to high end of our guidance. LED & Solar revenues increased 7% sequentially to \$234 million, including \$220 million in MOCVD, while Data Storage revenues were \$34 million, down 25% sequentially."

"Veeco has continued to execute within the challenging overall business environment, particularly in China, where customer facility readiness and credit tightening remain significant issues. Veeco's new MaxBright MOCVD System represented nearly half of the quarter's MOCVD revenue, including broad-scale customer acceptance at tier one LED manufacturers."

“Veeco’s third quarter orders were impacted by weak near-term LED industry demand, low MOCVD equipment utilisation rates in Asia, and decreased business activity in China,” commented Peeler. “In addition, negative global macro-economic data points caused customers to slow or cut their capacity expansion plans.”

Veeco’s third quarter bookings were \$133 million, a decline of 57% sequentially. LED & Solar orders declined 59% sequentially to \$112 million, with MOCVD orders at \$103 million. Data Storage orders were \$21 million, down 44% sequentially. The Company’s Q3 2011 book-to-bill ratio was 0.50 to 1. Veeco recorded backlog adjustments of \$34 million during the quarter. The firm’s quarter-end backlog was \$389 million.

During the third quarter, under its Board authorised share buy-back program initiated in August 2010, Veeco purchased \$154 million in stock at an average price of \$38.63 per share.

Fourth Quarter 2011 Guidance & Outlook on a GAAP basis

Veeco’s fourth quarter 2011 revenue is currently forecasted to be between \$175 million and \$215 million. Earnings per share are currently forecasted to be between \$0.46 to \$0.78. For the full year, Veeco’s guidance is \$963 million to \$1.0 billion, with earnings per share forecasted to be between \$4.49 - \$4.79.

Peeler commented, “Despite the difficult overall environment, we are proud that the Company expects to deliver \$1 billion in 2011 revenue at the high end of guidance. This is a tremendous accomplishment and speaks to our technology leadership position, close connectivity to our global customers and ability to execute in a challenging environment.”

“Our current expectation is orders will remain depressed for a few quarters,” continued Peeler. “While there are many data points indicating that LED lighting is accelerating, weak backlighting demand continues to cause low factory utilisation rates. In Data Storage, planned industry consolidations combined with weak PC demand is causing our key customers to delay capex.”

“In addition, global macro-economic concerns will

likely have a dampening effect on our business heading into 2012. With our variable cost model, combined with plans to decrease spending levels to reflect the challenging business environment, we are confident we will remain profitable and expect to deliver double-digit EBITA performance next year.”

Peeler concluded, “While we do not know how long this slowdown will last, LED pricing declines will continue to stimulate demand for solid state lighting on a global basis. We expect wide-spread adoption of LED lighting led first by the commercial, municipal and industrial sectors, which make up 75% of the lighting market, followed by residential users as economic benefits of using LED-based products become more apparent.

Despite some level of cyclical, which is to be expected, there is an enormous multi-year growth opportunity for MOCVD, aligning with our overall expectation of 5,000+ reactors from 2011 to 2015. With the industry’s most productive MOCVD platforms, Veeco’s market position is the best it has ever been. We believe the Company can continue to gain share as LED lighting hits an inflection point in 2012 and 2013.”

Mouser to deliver National Products from TI

The firm will distribute TI analogue products which enable engineers to create new designs that solve tough challenges, such as making electronics more energy efficient.

Mouser Electronics, a design engineering resource and global distributor for semiconductors and electronic components, has announced that it is an authorised global distributor for the complete portfolio of National products from Texas Instruments (TI).

Building upon record sales and an ongoing commitment to global expansion, the addition of National products from TI increases Mouser’s offering of analogue products to its global customer base. These TI analogue products enable engineers to create new designs that solve tough challenges, such as making electronics more energy efficient – consuming less power, extending battery life and generating less heat.

Mike Scott, Mouser Vice President of Semiconductors, went on to express, "The addition of the National portfolio to our Texas Instruments line allows Mouser to offer our customers one of the industry's broadest in-stock selections. Designers have long-awaited the ability to procure National products from Mouser, and we are working diligently to ensure we have the components they need for their new designs."

CVD to expand materials business

The manufacturer of equipment used in the development, design and manufacture of advanced electronic components, materials and coatings for research and industrial applications will concentrate on a number of applications including nanowires.

CVD Equipment Corporation has announced the expansion of the materials portion of its business. These materials will be marketed through its wholly owned subsidiary, CVD Materials Corporation, ("CVD Materials").

Leonard Rosenbaum, President of CVD Equipment Corporation, states, "We believe that now is the right time to build on the processing capability, material manufacturing, marketing and business growth success of our Application Laboratory which continues to open new business opportunities in both traditional and non traditional chemical vapour deposition related markets."

"We will further develop our in-house next generation material manufacturing capabilities and capacities and expand our marketing and sales efforts directly to researchers and innovators at Universities, Government and Industrial R&D facilities that are working on application development for tomorrow's next generation products in Semiconductors, Solar, Batteries, Capacitors, Water Filtration, Catalysts Composites, and other traditional and non-traditional chemical vapour deposition applications through CVD Materials."

"These applications will primarily utilise graphene, carbon nanotubes, nanowires, and other 1D, 2D and 3D surface and surface area enhanced materials. CVD Materials Corporation will primarily

focus on 1) Contract CVD related process development, 2) Research material manufacturing, 3) CVD and other nano enabled material manufacturing licensed from third parties and 4) on CVD Equipment Corporation's proprietary materials and material processing platforms," he concludes.

Karlheinz Strobl, Vice President of Business Development, further states, "We expect that this business model extension will help to accelerate the commercialization of tomorrow's technologies and will bring future Equipment, Material Manufacturing and Joint Venture business opportunities to CVD Equipment Corporation. This expansion of the Application Laboratory will further accelerate the commercialisation of tomorrow's technology and our "Sustainable Growth with Low Risk" business strategy."

Dry pump which delivers significant reduction in cost-of-ownership

The new iXH500H dry pump series is optimised for solar, FPD and compound semiconductor processes requiring high gas flows and flexible pump temperature profiles.

Edwards Limited, has expanded its iXH family of harsh process dry pumps with the introduction of the iXH500H series.

This new series of 500m³/h pumps has been optimised for flat panel, solar and advanced semiconductor processes requiring high gas flows and flexible pump temperature profiles. These pumps offer significant cost of ownership benefits due to lower energy consumption and enhanced mean time between servicing (MTBS), while delivering the small footprint and hydrogen pumping capabilities of the iXH450 series.

"This new series in the iXH family is designed to address the varying pumping challenges encountered in flat panel, solar and advanced semiconductor processes that can significantly reduce a pump's MTBS," said Allister Watson, drypump product manager- FPD & Solar Sectors, Edwards. "Until now, the industry lacked a single harsh process dry pump with the flexibility to

address these different challenges. The iXH500H series, with its increased pump temperature flexibility, addresses this need, while also reducing pump energy consumption by up to 15 percent. As a result, the iXH500H may yield a 30 percent lower cost of ownership as compared to previous-generation iXH dry pumps.”

Vacuum pumps used by flat panel, solar and semiconductor manufacturers must accommodate a wide range of operating conditions and materials. The iXH500H series temperature flexibility makes it ideal for such harsh processes. Running at low pump temperatures, the iXH500H series is beneficial for processes that use high flows of corrosive gases (e.g. FPD PECVD, thin film solar PECVD, semiconductor MOCVD), or for processes that use thermally sensitive pre-cursors (e.g. atomic layer deposition) that could ‘plate out’ by-products within the pump. High operating temperatures can be used where the risk is condensation of by-products within the pump (e.g. high-k dielectric deposition).

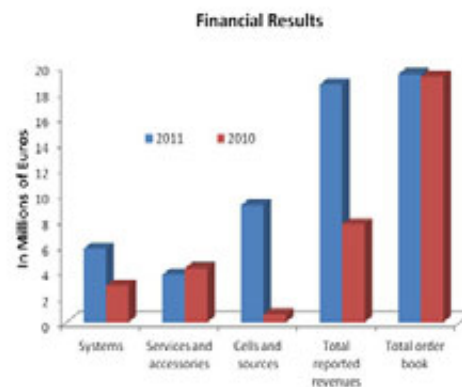
Edwards’ iXH500H series pumps are now available. Service upgrades are also now available to convert existing iXH450 series pumps to the new iXH500H series.

Riber sees strong growth in revenues

With an order book of €19.3 million, Riber is forecasting around €29 million in full-year revenues.

Riber, a manufacturer of MBE reactors, has posted €18.5 million in revenues at the end of September 2011, up 142% in relation to the same period the previous year.

Revenues for the third quarter of 2011 came to €5.5 million, compared with €3.2 million for the third quarter of 2010. With an order book of €19.3 million, Riber is forecasting around €29 million in full-year revenues.

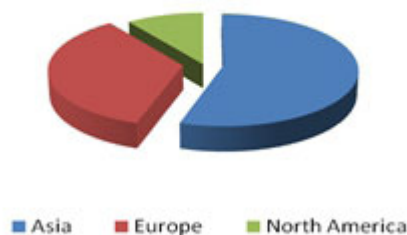


Growth in business is being driven primarily by the increase in sales of evaporation sources, multiplied by 14 over one year. This performance reflects the delivery of major orders for investments on the OLED markets.

During the first three quarters, 5 MBE systems were delivered, compared with four research systems at September 30th, 2010, with a marked improvement in their unit value. However, the service business has contracted by 12% as a result of the slowdown in demand, particularly in the US.

At September 30th, 2011, the breakdown of Riber’s sales was as follows: Asia (55%), Europe (35%) and North America (10%).

Riber proportion of sales by region



The order book represented €19.3 million at the end of September 2011 (€19.1 million one year earlier), with three production systems and seven research systems, to be delivered between 2011 and 2013.

In view of the delivery schedule for the end of the year, Riber is targeting around €29 million in annual revenues, combined with an operating margin rate of over 15%.

5N Plus and Rio Tinto unite to recover gallium

In light of anticipated strong growth in the demand for gallium, the new source will enable the companies to strengthen their supply chains.

5N Plus, a producer of metal and chemical products used in compound semiconductor manufacturing, has signed a memorandum of understanding (MOU) with Rio Tinto Alcan, a provider of aluminium.

This MOU will allow 5N Plus and Rio Tinto to pursue discussions regarding a project to recover gallium from an alumina production stream at Rio Tinto Alcan's Vaudreuil alumina facility, Quebec.

Jacques L'Écuyer, President and Chief Executive Officer of 5N Plus said, "We are very pleased with the scope of our discussions with Rio Tinto, and have good reason to believe that we will shortly be in a position to develop a new primary source of gallium. In light of anticipated strong growth in the demand for gallium, this new source will enable us to both strengthen our supply chain and forge a strategic partnership with Rio Tinto."

5N Plus deploys a range of proprietary technologies to produce products which are used in a number of advanced pharmaceutical, electronic and industrial applications. Typical products include purified metals such as bismuth, gallium, germanium, indium, selenium and tellurium, inorganic chemicals based on such metals and compound semiconductor wafers. Many of these are critical precursors and key enablers in markets such as solar, LEDs and eco friendly materials.

Portable Raman instrument for material verification in cGMP

The compact spectrometer can support a broad range of applications in multiple industries including compound semiconductors.

B&W Tek, an advanced instrumentation company producing optical spectroscopy and laser systems, is introducing the NanoRam, a new class of small,

handheld instruments for materials identification and verification within cGMP compliant facilities.

The NanoRam is a state-of-the-art compact Raman spectrometer and integrated computing system, based on an open systems architecture design that can support a broad range of applications in multiple industries. Designed for use by non-specialists, the NanoRam is easy to use and operates single-handedly.

The NanoRam allows rapid development of standardised and validated methods to facilitate 100% inspection for purity and quality.

The advantages of portable Raman spectroscopy are ease of sampling, on the spot analysis with no need for quarantine areas, highly selective peaks for both qualitative and quantitative analysis, and the ability to analyse both organic and inorganic compounds over a wide spectral range.

B&W Tek says the NanoRam reduces production costs and escalates productivity, all at the same time and that new spectra can be easily generated and added to existing libraries. Raman spectral libraries that have been created on other instruments can be transferred to the NanoRam platform using a library conversion utility.

The NanoRam is equipped with B&W Tek's patented CleanLaze technology for exceptional laser stabilisation and narrow linewidth. Other features include a spectral resolution below 10 cm⁻¹, wide Raman shift coverage up to 3200cm⁻¹, and a TE cooled 2048 pixel CCD array.

Weighing less than 1.1 kg, the instrument's small, compact package, large OLED display, and low power consumption provides high quality Raman measurements and ease of use anywhere. The unit comes with a range of sampling accessories for gels, liquids, powders and solids.

"The NanoRam represents a new generation of small handheld tools for material identification and verification," says Mike Kayat, VP of Sales & Marketing for B&W Tek. "Rapid validation and deployment within cGMP facilities is made possible by the combination of near-laboratory grade Raman spectral analysis with a high performance PC-based environment that can communicate with ERP systems, together with validated methods and

libraries within an open systems architecture.”

NanoRam customers will be able to take advantage of extended warranty plans, annual recertification services, assistance with method and/or new library development and other services such as assistance with IQ/OQ/PQ validation.

Sparton to produce germanium exclusively from Voltaix GeO₂

Sparton says it has the capacity to be the 7th largest primary producer of

Voltaix has executed a Memorandum of Understanding (the “MOU”) with Canadian based Sparton Energy for the purchase of all germanium production from the Huajun Mine in Yunnan Province, China.

The MOU contemplates an investment by Voltaix of approximately \$US4.2 million dollars in a series of advances related to milestones in the development of the Huajun operations.

“We are pleased to have reached this important strategic relationship with Sparton,” said Mark Wilkinson, Executive Vice President of Voltaix. “As the world’s leading germane producer, securing our germanium supply is critical. This relationship allows us to continue to provide our customers with the highest levels of supply chain security by giving Voltaix an exclusive source of significant germanium reserves. This also represents a win for the local workers at Huajun, who will be re-employed once the mining license is granted.”

Sparton President, Lee Barker, stated, “Sparton is delighted to establish this unique long term relationship with Voltaix and become a supplier of one of the primary components necessary for its leading edge technology products. Local germanium concentrate prices at Lincang have almost doubled within the past year, and we look forward to resuming production of this specialty metal.”

The MOU contemplates deliveries of germanium dioxide (GeO₂) by Huajun to Voltaix over the life of

the Strategic Supply Agreement (the “SSA”). The advances are to be recouped through deliveries of GeO₂ pursuant to the SSA. The price for this product is based on a blended formula related to actual processing and refining costs and local market pricing for GeO₂. The advances are to be used for several purposes, including additional safety upgrades and efficiency improvements that will increase production rates.

The Huajun Mine is in the final stages of having a new mining licence issued. At full capacity, the mine employs approximately 400 people. The mine has completed all necessary safety and security upgrades to meet new Chinese regulatory requirements and reactivation of the operations will begin immediately after the new mining licence is received. The mine has a 7 year history of no major lost time accidents.

Voltaix materials enable logic chips to compute more quickly and solar cells to absorb a broader portion of the solar spectrum, and they improve manufacturability by minimising defect formation and increasing machine throughput.

Voltaix manufactures specialty materials that enhance the performance and manufacturability of semiconductors and photovoltaics. Utilising its expertise in silicon, germanium and boron chemistry, its products are custom designed for the most demanding applications, including SiGe transistors for wireless communications chips.

Voltaix manufactures of a number of electronics products, including germane, diborane, trisilane, and trimethyl boron. The firm uses proprietary synthesis, purification, and packaging technology developed in-house. It also designs and builds its own equipment for use in its manufacturing operations.

Voltaix reaches out to Chinese market

The provider of materials, including those used in silicon germanium chip production, that enhance the performance of compound semiconductor chips and solar cells is expanding.

Voltaix has established a sales and technical/

customer support office in Shanghai, China.

Yun Liu, Asian Business Manager and Voltaix's first employee in China, will be responsible for executing the regional sales and marketing initiatives. Yun has an MBA from the University of Ottawa as well as Bachelor Degree in Mechanical Engineering from Shanghai University. Over the past five years he has held various positions with a large industrial gas company driving growth in solar, semiconductor and TFT applications. The office will allow for an expanded sales and marketing staff in the future.

"Sustainable growth of Voltaix chemistries in China for solar and semiconductor applications is expected to continue well into the future. We felt the need to bring resources closer to our distribution partners and end users to provide timely technical and customer support. Voltaix's decision to expand into China illustrates our commitment to better understanding the market in China and improve the overall customer experience. We are pleased to have someone with Yun's experience join the Voltaix team," said Greg Muhr, Director, Global Sales & Marketing of Voltaix.

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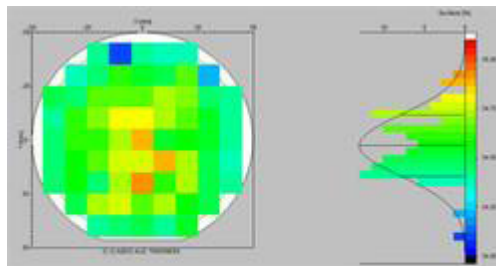
Sentech reveals PEALD tool for precise thickness control

The plasma enhanced atomic layer deposition system can be used in a variety of applications including compound semiconductor growth.

Atomic layer deposition (ALD) is a layer-by-layer deposition process of very thin films with conformal

coating on 3D structures.

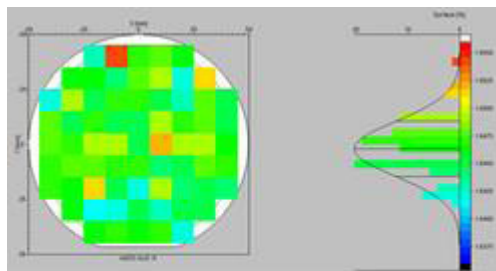
Precise control of thickness and film properties is facilitated by adding precursors in separate steps into the vacuum chamber during process cycle. Plasma enhanced atomic layer deposition (PEALD) is an advanced method of extending the capabilities of ALD by applying radical gas species rather than water as oxidiser during the deposition process.



34.6 nm PEALD-Al₂O₃ with very good homogeneity of +/- 1% on 4" wafer at 200°C substrate temperature

Based on many years of experience in developing and manufacturing PECVD and ICPECVD equipment, including the proprietary planar triple spiral antenna ICP source, Sentech has launched its first PEALD system. The new ALD system enables both thermal and plasma assisted operation and deposition monitoring using Sentech ellipsometers.

Sentech offers leading edge ultra-fast in-situ ellipsometers for monitoring layer-by-layer film growth applying laser ellipsometry as well as wide range spectroscopic ellipsometry.



Variation of refractive index of PEALD-Al₂O₃ on 4" wafer at 200°C substrate temperature (1.646 +/- 0.3% at 632.8 nm)

The first PEALD system was already set in operation at the TU Braunschweig for the deposition of extremely uniform and dense thin oxide films like Al₂O₃ and ZnO. For the deposition of Al₂O₃, TMA (C₃H₉Al) and plasma generated atomic oxygen 'O' were utilised at substrate temperatures from 80°C to 200°C.

Sentech says the PEALD films exhibit excellent thickness uniformity and very small variation of the refractive index measured with Sentech spectroscopic ellipsometers.

Jordan Valley among the 50 fastest growing companies in Israel

Deloitte Technology Israel Fast 50 has acknowledged the company which manufactures X-ray equipment used to characterise gallium arsenide, gallium nitride and indium phosphide wafers.

Jordan Valley Semiconductors (JVS), a provider of X-ray metrology solutions for the global semiconductors industry has been named one of the 2011 Deloitte Israel Technology Fast 50, the ranking of the 50 fastest growing technology companies in Israel. Rankings are based on percentage of fiscal year revenue growth over five years.

«Since the Deloitte Brightman Almagor Zohar Fast 50 award measures sustained revenue growth over five years, being one of the 50 fastest growing technology companies in Israel is an impressive achievement», said Tal Chen, partner in charge of the Deloitte Brightman Almagor Zohar Israel Technology Fast 50 Program. «Jordan Valley deserves a lot of credit for its remarkable growth.»

«Jordan Valley is extremely proud to be named to the Fast 50 list, for the 4th time in the last 6 years» says Isaac Mazor, Jordan Valley founder and CEO. «Our growth is a testament to our entire organization's commitment to technological superiority and to the wide adaptation of our x-ray metrology into the advanced semiconductor manufacturing processes as well as other emerging markets such as the LED and compound semiconductors.»

The JVX6200i advanced X-ray metrology system is a high throughput, high uptime and low Cost of ownership production tool. It is a multi-channel metrology tool for advanced semiconductors FEOL and BEOL processes as well as wafer-level packaging (WLP) applications. The popular

configuration combines X-ray fluorescence (XRF) and X-ray reflectance (XRR). Typical applications are: FEOL (High-k/metal gate, SiON and ACL hard masks), BEOL (Cu seed/barrier, Cu electroplating & CMP) and WLP (UBM stack, Sn/Ag micro bumps and Cu pillars).

The JVX7200 advanced X-ray metrology system is the first in-line production control tool for epitaxial SiGe & Si:C applications. This tool combines Fast HRXRD and Fast XRR channels, capable of measuring SiGe composition, thickness, density, strain and relaxation of single and multi-layer stacks on product wafers with high throughput, accuracy and repeatability. Unlike optical or spectroscopic tools HRXRD and XRR are first principle techniques that deliver accurate and precise results without calibration.

The QC3 / QC-Velox are High Resolution X-Ray Diffractometers (HRXRD) especially designed for production in-line quality control for the compound Semi markets such as LED, Photovoltaic, CPV, Power Transistors, RF and others.

The tools are designed for epitaxial thin-film materials analysis, measuring thickness, composition and relaxation of epilayers such as GaN, GaAs, InP, MQW, silicon, germanium & others. QC-Velox demonstrates the best cost-performance ratio with outstanding throughput, competitive price and low cost of ownership.

Novel Devices

GaN nanowires have a bright future

Gallium nitride nanowires grown by PML scientists may only be a few tenths of a micron in diameter, but they promise a very wide range of applications, from new LEDs and diode lasers to ultra-small resonators, chemical sensors, and highly sensitive atomic probe tips.

In the two decades since GaN was first employed in a commercially viable LED, ushering in a dazzling future for low-power lighting and high-

power transistors, the III-V semiconductor has been produced and investigated numerous ways, in both thin-film and nanowire form.

At PML's Quantum Electronics and Photonics Division in Boulder, Colorado, much of the recent effort has been devoted to growing and characterising extremely high-quality GaN nanowires – “some of the best, if not the best, in the world,” says Norman Sanford, co-leader of the Semiconductor Metrology for Energy Conversion project.

GaN emits light when holes and electrons recombine at a junction created by doping the crystal to create p-type and n-type regions. These layers are formed by a variety of deposition methods, typically on a sapphire or SiC substrate. Conventional methods produce crystals with relatively high defect densities. Unfortunately, defects in the lattice limit light emission, introduce signal noise, and lead to early device failure.

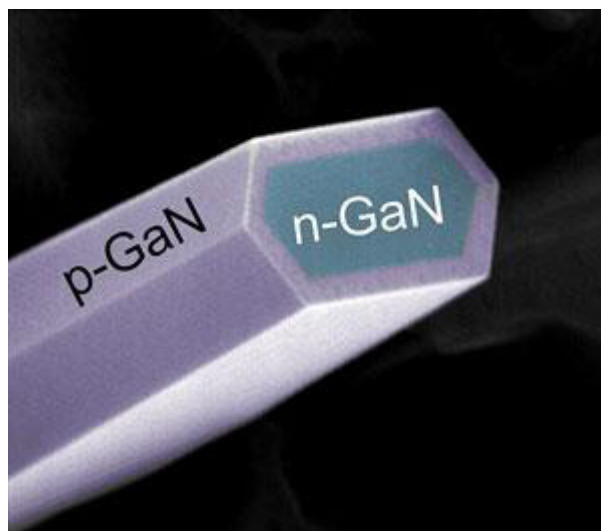
The Boulder team, by contrast, grows virtually defect-free hexagonal GaN nanowires very slowly from a silicon base. Their MBE deposition method allows the nanowires to form spontaneously without the use of catalyst particles. Although catalyst particles are widely used for nanowire growth, they leave behind trace impurities that can degrade GaN. It takes two to three days for the structures to reach a length around 10 microns (about one-tenth the thickness of a human hair), but the wait pays off because the crystal structure is very nearly perfect.



Optically pumped GaN nanowire laser shown glowing orange. The actual laser output is UV (≈ 370 nm) and invisible to the unaided eye. The length of the lasing nanowire is roughly 10

microns and the diameter is roughly 200 nm. The metal probe tip at the top of the image is used to examine proximity effects on the lasing properties of the nanowire. Other (non-lasing) nanowires are also seen in the image.

Among other advantages, flawless crystals produce more light. «Now, for the first time, the electroluminescence from a single GaN nanowire LED is sufficiently bright that we can measure its spectrum and track the spectrum with drive current to see evidence of heating,» says project co-leader Kris Bertness. «There are no other examples of electroluminescence spectra from a single MBE-grown GaN nanowire in the literature.»

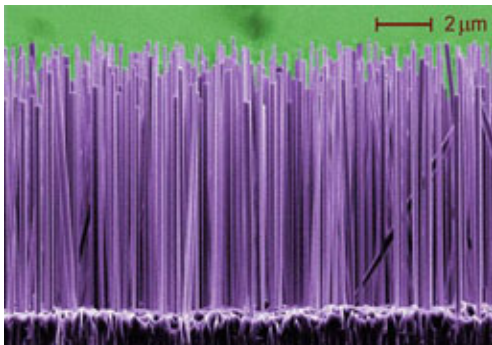


Structure of an n-type GaN nanowire grown by MBE and coated in a thin-shell of p-type GaN grown by halide vapor phase epitaxy. (Credit: Aric Sanders and Albert Davydov/MML)

GaN and its related alloy system (including semiconductors containing indium and aluminium) form the basis of the rapidly expanding solid state lighting industry. It could move faster, experts believe, if industry could develop an economical method to grow low-defect-density material.

“Conventional GaN-based LEDs grown on cost-effective but non-lattice-matched substrates (such as sapphire) suffer from unavoidable strain and defects which compromise efficiency,” Sanford says. “Additionally, light extraction from conventional planar (flat) LED structures is impeded by total internal reflection resulting in wasted photons which are trapped in the device rather than radiating outward as useful light.”

GaN nanowire LED technology offers significant improvements since the wires grow essentially free of strain and defects and should thus enable fundamentally more efficient devices. What's more, the morphology provided by a "forest" of densely arrayed nanowire LEDs offers improvements in the light-extraction efficiency of these structures compared with their planar counterparts.



A "forest" of nanowires

Testing and measuring those and other properties, however, poses significant challenges. "P-type GaN is difficult to grow by any common growth method," Bertness says. "And what turns out to be very hard is making good electrical contacts to the nanowire, because it is not flat, and its thickness is larger than most of the metal films used to contact planar films.

"This 3D geometry encourages void formation and trapping of chemical impurities near the contacts, both of which degrade the contact, sometimes to the point of being unusable. This is an area we are actively investigating."

The team is looking at ways to grow nanowires in regular arrays, with careful control of the spacing and dimensions of each individual wire. Recently they found that by creating a grid-like pattern of openings on the order of 200 nanometres wide in a SiN "mask layer" placed over the substrate, they could achieve selective growth of highly regular wires. The ability to produce ordered patterns of uniform GaN devices, Bertness says, "is essential for reliable manufacturing."

GaN is not only a light source. It also has multiple uses in different fields. "Another nice thing about GaN is that it's insensitive to high temperatures," says Robert Hickernell, leader of the Optoelectronic Manufacturing Group, which includes the Semiconductor Metrology project. "That's an advantage for high electrical power applications."

The Group is also studying nanowire field effect transistors (FETs) to accurately measure carrier transport properties. "And we've got GaN nanowire FETs that are some of the best research devices in the world."

In addition, GaN nanowires are mechanically robust. Very robust: Four years ago, a PML-University of Colorado collaboration made headlines by producing nanowires with extraordinarily high quality factors that make them potentially excellent oscillators. "In the distant future," Hickernell says, "they might be used in cell phone applications as micro-resonators."

The combination of high mechanical quality factor and tiny mass also makes them capable of detecting masses in the sub-attogram range. PML collaborators at the University of Colorado are confident that they can extrapolate the present experiments to roughly 0.01 attograms, or 10 zeptograms sensitivity. (For comparison, the mass of a virus is on the order of 1 attogram, or 10

Earlier this year, Bertness, Sanford and CU collaborators used GaN's native piezoresistance to measure frequency response in nanowires stretched across a 10 micron gap. The results showed that the devices had "immediate utility in high-resolution mass and force sensing applications," the researchers wrote in their published report.

The team thinks it is possible to make "a new class of electrically-addressable multifunction scanning-probe tools," Bertness explains. "For example, conventional NSOM relies on a scanning optical tip with an aperture diameter in range of 10 to 100 nanometres which is formed at the tapered end of a passive optical fibre. Those tips are mechanically and chemically fragile and have a very short service life – hours to days. On the other hand, GaN nanowire based NSOM tools can potentially offer electrically-addressable multifunction operation that combines optical emission, optical detection, AFM and RF-AFM functionality."

Finally, GaN nanowires are also well suited for use in chemical, biological, and gas sensing. Ongoing collaborative work between the team and NIST's Material Measurement Laboratory is producing interesting results with GaN nanowires used in tandem with nanoclusters of TiO

Philip Smallwood to present at CS Europe Conference 2012

The Lighting Market Analyst at IMS Research will give a presentation on “The Market for LEDs in Lighting”.

Following the success of CS Europe 2011, next year’s conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Register at www.cseurope.net & book your delegate place now as numbers will be limited. The conference takes place on 12th/13th March 2012 at Hilton Hotel, Frankfurt, Germany.

A networking dinner will also be held the night of the 12th March.

Conference Chair

Dr Andrew W Nelson, President & CEO, IQE

Markets and III-V CMOS - Morning 12th March

A mix of insightful market research presentations & cutting-edge research destined to shape tomorrow’s compound semiconductor industry.

Presentations will include:

Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director – Strategic Technologies Practice, Strategy Analytics

The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research

Wide Bandgap device market update - Dr. Philippe ROUSSEL, Senior Project Manager, Yole Développement

European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, Imec

An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense

Advanced Research Projects Agency/Microsystems Technology Office

The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow

III-Vs on 200 mm Si for VLSI – Dr Richard Hill, Project Manager, Sematech

III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

LEDs, lasers, PV and electronics - Afternoon of 12th March & full day of 13th March

KEYNOTE SPEAKER: III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow, Intel

Talks will include:

SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer Power & RF, Cree

Ammono’s ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.

Tomorrow’s RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD

Building a Successful III-V Pure Play Foundry - Dr. John Atherton, Associate Vice President, WIN Semiconductors

Scalable “on-silicon” solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.

III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - Dr James W. Raring, VP Laser Engineering, Sora Inc.

Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.

Perspective of an LED Manufacturer - Professor Iain Black, VP WW Manufacturing Engineering,

Technology & Innovation, Philips Lumileds Lighting Company

The CPV Market following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU, Senior Director

Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier

GaN the enabler for true SDR - Professor Rik Jos, RF Technology Fellow & Innovation Manager, NXP Semiconductors

Holistic Approach to MOCVD vacuum & Abatement - Dr Mike Czerniak, Product Marketing Manager, EdwardsVacuum Ltd

Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Global market manager, Power Electronics, Dow Corning

Large diameter GaN-on-Si epiwafers for power electronics - Dr Mariane Germain, Co-Founder & CEO, EpiGaN

Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced Technology Director, TriQuint Semiconductor

Damage - free Deposition on LED devices - Dr Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Asif Anwar, Director, Strategy Analytics to present at CS Europe Conference

His presentation is entitled, "Compound Semiconductor Markets: Current Status and Future Prospects".

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Conference schedule:

12th March 2012 am : "CS Europe 2012: Markets and III-V CMOS Conference"

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**12th March 2012 pm & 13th March - full day
: “CS Europe 2012: LEDs, lasers, PV and
electronics Conference”**

***This day and a half will concentrate on
presentations involving industry mainly from
the chipmaker sector.***

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow
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-

Sanjay Raman, DARPA Program Manager, to present at CS Europe 2012

The talk, taking place at the CS Europe conference in March 2012, Frankfurt, will be “An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program.”

Defining the next steps for the Compound Semiconductor Industry

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•Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

InGaAs nanowires on silicon a hot solar cell development

The geometry of the indium gallium arsenide nanowires provides the additional benefit of enhancing solar cell performance through greater light absorption and carrier collection efficiency.

Tiny wires could help engineers realise high-performance solar cells and other electronics, according to University of Illinois researchers.

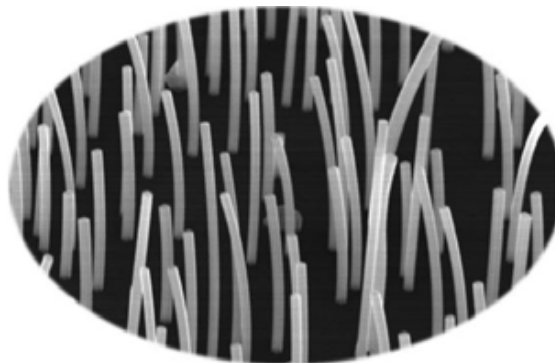
The research group, led by electrical and computer engineering professor Xiuling Li, have developed a technique to integrate compound semiconductor nanowires on silicon wafers, overcoming key challenges in device production.

Semiconductors in the III-V group are promising for devices that change light to electricity and vice-versa, such as high-end solar cells or lasers. However, they don't integrate with silicon seamlessly, which is a problem since silicon is the most ubiquitous device platform. Each material has a specific distance between the atoms in the crystal, known as the lattice constant.

"The biggest challenge has been that III-V semiconductors and silicon do not have the same lattice constants," Li said. "They cannot be stacked on top of each other in a straightforward way without generating dislocations, which can be thought of as atomic scale cracks."

When the crystal lattices don't line up, there is a mismatch between the materials. Researchers usually deposit III-V materials on top of silicon wafers in a thin film that covers the wafer, but the mismatch causes strain and introduces defects, degrading the device performance.

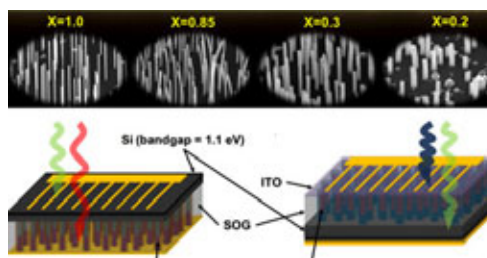
Instead of a thin film, the Illinois team grew a densely packed array of nanowires, tiny strands of III-V semiconductor that grow up vertically from the silicon wafer.



Professor Xiuling Li's group developed a method for growing semiconductor nanowires on silicon wafers that holds promise for advanced device applications, including solar cells. (Graphic by Xiuling Li)

"The nanowire geometry offers a lot more freedom from lattice-matching restrictions by dissipating the mismatch strain energy laterally through the sidewalls," Li said.

The researchers found conditions for growing nanowires of various compositions of the III-V semiconductor indium gallium arsenide. Their methodology has the advantages of using a common growth technique without the need for any special treatments or patterning on the silicon wafer or the metal catalysts that are often needed for such reactions.



InGaAs: Solar cells (bottom) made with arrays of nanowires. Engineers can tune the performance by using nanowires of differing composition and thickness (top). (Graphic by Xiuling Li)

The nanowire geometry provides the additional benefit of enhancing solar cell performance through greater light absorption and carrier collection efficiency. The nanowire approach also uses less material than thin films, reducing the cost.

"This work represents the first report on ternary semiconductor nanowire arrays grown on silicon

substrates, that are truly epitaxial, controllable in size and doping, high aspect ratio, non-tapered, and broadly tuneable in energy for practical device integration,” said Li, who is affiliated with the Micro and Nanotechnology Laboratory, the Frederick Seitz Materials Research Laboratory and the Beckman Institute for Advanced Science and Technology at the U. of I.

Li believes the nanowire approach could be applied broadly to other semiconductors, enabling other applications that have been deterred by mismatch concerns. Next, Li and her group hope soon to demonstrate nanowire-based multi-junction tandem solar cells with high quality and efficiency.

The Department of Energy and the National Science Foundation supported this work.

More details of this work have been published in the paper, “InxGa1-xAs Nanowires on Silicon: One-Dimensional Heterogeneous Epitaxy, Bandgap Engineering, and Photovoltaics,” by Jae Cheol Shin *et al*, *Nano Letters*, Articles ASAP (As Soon As Publishable), Publication Date (Web): October 3, 2011 (Letter). DOI: 10.1021/nl202676b

Intel Senior Fellow to be Keynote Speaker at CS Europe Conference

Robert S. Chau, Intel Senior Fellow, Technology and Manufacturing Group Director, Transistor Research and Nanotechnology, Intel Corporation will act as Key Note Speaker at the CS Europe Conference, March 2012, Frankfurt.

Following the success of CS Europe 2011, next year’s conference is expanding to 2 days and offers a fantastic mix/quality of speakers making it the must attend industry event for 2012.

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

The conference will take place on 12th and 13th March 2012 at the Hilton Hotel, Frankfurt, Germany.

It will feature a mix of insightful market research

presentations and cutting-edge research destined to shape tomorrow’s compound semiconductor industry.

Conference schedule:

12th March 2012 am : “CS Europe 2012: Markets and III-V CMOS Conference”

Talks will include:

- Compound Semiconductor Markets: Current Status and Future Prospects - Asif Anwar, Director - Strategic Technologies Practice, Strategy Analytics
- The Market for LEDs in Lighting - Mr. Philip Smallwood, Lighting Market Analyst, IMS Research
- Wide Bandgap device market update - Dr. Philippe Roussel, Senior Project Manager, Yole Développement
- European efforts to develop III-Vs on 200 and 300 mm silicon - Dr. Matty Caymax, Chief Scientist, imec
- An Overview of the DARPA Diverse Accessible Heterogeneous Integration (DAHI) Program - Sanjay Raman, Program Manager, Defense Advanced Research Projects Agency/Microsystems Technology Office
- The Integration of silicon CMOS with III-Vs - Professor Iain Thayne, University of Glasgow
- III-V on 200 mm Si for VLSI - Richard Hill, Sematech
- III-V 3D Transistors - Peide Ye, Professor of Electrical and Computer Engineering, Purdue University

12th March 2012 pm & 13th March - full day : “CS Europe 2012: LEDs, lasers, PV and electronics Conference”

This day and a half will concentrate on presentations involving industry mainly from the chipmaker sector.

- Key Note - III-V on Silicon: Challenges and Opportunities - Robert S. Chau, Intel Senior Fellow

- SiC and GaN Electronics - Dr. John Palmour, Cree co-founder and chief technology officer, Power & RF
- Ammono's ammonothermal method to make GaN substrates – Dr. Robert Dwiliński, President, CEO, Ammonno S.A.
- Tomorrow's RF chips for mobile devices - Todd Gillenwater, VP of Technology and Advanced Development, RFMD
- Building a Successful III-V Pure Play Foundry - Dr. John Atherton, WIN Semiconductors
- Scalable «on-silicon» solutions (GaN-on-Si and Ge-on-Si) using rare oxide buffer layers – Dr. Michael Leppy, General Manager & Chief Technology Officer, Translucent Inc.
- III-Nitride Lasers Based on Nonpolar/Semipolar Substrates - James W. Raring, VP of Laser Engineering, Sora Inc.
- Markets and Applications for SiC Transistors - Dieter Liesabeths, Vice President Sales & Marketing, SemiSouth Laboratories, Inc.
- Perspective of an LED Manufacturer - Iain Black, Philips Lumileds Lighting Company
- The CPV Market, following the acquisition of Quantasol technology - Jan-Gustav Werthen, JDSU
- Commercialisation of GaN on Si based Power Devices at International Rectifier - Dr. Michael A. Briere, International Rectifier
- GaN the enabler for true SDR- Professor Rik Jos, NXP
- Holistic Approach to MOCVD vacuum & Abatement –Dr. Mike Czerniak, EdwardsVacuum Ltd
- Advances in Wide Bandgap Semiconductors for Power Electronics - Dr. Markus Behet, Dow Corning
- Large diameter GaN-on-Si epiwafers for power electronics – Dr. Mariane Germain, EpiGaN
- Gallium nitride from both a product perspective and foundry - Dr Otto Berger, Corporate Advanced

Technology Director, TriQuint Semiconductor

•Damage - free Deposition on LED devices –Dr. Silvia Schwyn Thöny, Senior Process Engineer, Evatec Ltd

•Temporary Bonding: An enabling technology for RF and power compound semiconductor devices - Dr Thomas Uhrmann, Business Development Manager, EV Group (EVG)

Please register at www.cseurope.net and remember to book your delegate place now as numbers will be limited.

Defects in SiC could revolutionise computing

Electrons that become trapped by certain imperfections in silicon carbide meet the requirements for use as a quantum bit.

A discovery by physicists at UC Santa Barbara may earn SiC, a role at the centre of a new generation of information technologies designed to exploit quantum physics for tasks such as ultrafast computing and nanoscale sensing. The research team discovered that SiC contains crystal imperfections that can be controlled at a quantum mechanical level. The research group of David Awschalom made the finding. Awschalom is director of UCSB's Centre for Spintronics & Quantum Computation, professor of physics, electrical and computer engineering, and the Peter J. Clarke Director of the California NanoSystems Institute.



David Awschalom (Credit: Rod Rolle)

In conventional semiconductor-based electronic devices, crystal defects are often deemed undesirable because of their tendency to immobilise electrons by “trapping” them at a particular crystal location. However, the UCSB team discovered that electrons that become trapped by certain imperfections in SiC do so in a way that allows their quantum states to be initialised, precisely manipulated, and measured using a combination of light and microwave radiation. This means that each of these defects meets the requirements for use as a quantum bit, or “qubit,” which is often described as the quantum mechanical analogue of a transistor, since it is the basic unit of a quantum computer.

“We are looking for the beauty and utility in imperfection, rather than struggling to bring about perfect order,” said Awschalom, “and to use these defects as the basis for a future quantum technology.”

Most crystal imperfections do not possess these properties, which are intimately tied to the atomic structure of a defect and the electronic characteristics of its semiconductor host, explained Awschalom. In fact, before this research, the only system known to possess these same characteristics was a flaw in diamond known as the nitrogen-vacancy centre.

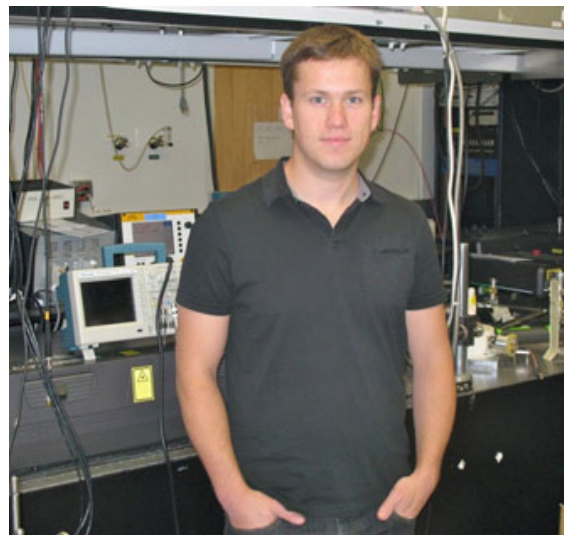
The diamond nitrogen-vacancy centre is renowned for its ability to function as a qubit at room temperature, while many other quantum states of matter require an extremely cold temperature, near absolute zero. However, this centre exists in a material that is difficult to grow and challenging to manufacture into integrated circuits.

In contrast, high-quality crystals of SiC, multiple inches in diameter, are commonly produced for commercial purposes. They can be readily fashioned into a multitude of intricate electronic, optoelectronic, and electromechanical devices. In addition, the defects studied by Awschalom and his group are addressed using infrared light that is close in energy to the light used widely throughout modern telecommunications networks. And while several distinct defect types were studied at a range of temperatures, two of them were capable of room temperature operation, just like the diamond

nitrogen-vacancy centre.

The combination of these features makes SiC, with its defects, an attractive candidate for future work seeking to integrate quantum mechanical objects with sophisticated electronic and optical circuitry, according to the scientists. This research fits within a wider effort at UCSB to engineer quantum devices by fostering collaboration between the fields of materials science and quantum physics.

While defects in SiC may offer many technologically attractive qualities, an immense number of defects in other semiconductors are still left to be explored.



William Koehl, Credit: George Foulsham, Office of Public Affairs, UCSB

“Our dream is to make quantum mechanics fully engineerable,” said William Koehl, a graduate student in the Awschalom lab. “Much like a civil engineer is able to design a bridge based on factors such as load capacity and length span, we’d like to see a day when there are quantum engineers who can design a quantum electronic device based on specifications such as degree of quantum entanglement and quality of interaction with the surrounding environment.”

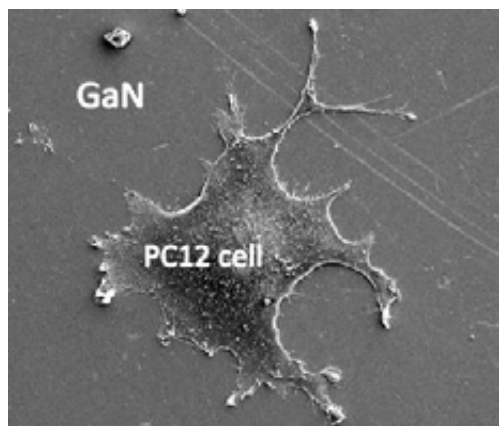
Further details of this work can be seen in the paper “Room temperature coherent control of defect spin qubits in silicon carbide” by Koehl et al in *Nature*, **479**, p 84–87, DOI: doi:10.1038/nature10562

Gallium nitride is non-toxic and biocompatible

Recent findings have shown that GaN could be used to construct electrodes used in neurostimulation therapies for Alzheimer's to transistors used to monitor blood chemistry.

Researchers from North Carolina State University and Purdue University have shown that the GaN is non-toxic and is compatible with human cells – opening the door to the material's use in a variety of biomedical implant technologies.

GaN is currently used in a host of technologies, from LED lighting to optic sensors, but it is not in widespread use in biomedical implants. However, the new findings mean that GaN holds promise for an array of implantable technologies – from electrodes used in neurostimulation therapies for Alzheimer's to transistors used to monitor blood chemistry.



Scanning electron microscope image of cell growth on GaN that has been coated with peptides

“The first finding is that GaN, unlike other semiconductor materials that have been considered for biomedical implants, is not toxic. That minimises risk to both the environment and to patients,” says Albena Ivanisevic, an associate professor of materials science and engineering at NC State and associate professor of the joint biomedical engineering program at NC State and the University of North Carolina at Chapel Hill.

Researchers used a mass spectrometry technique to see how much gallium is released from

GaN when the material is exposed to various environments that mimic conditions in the human body. This is important because gallium oxides are toxic. But the researchers found that GaN is very stable in these environments – releasing such a tiny amount of gallium that it is non-toxic.

The researchers also wanted to determine GaN's potential biocompatibility. To do this they bonded peptides – the building blocks that make up proteins – to the GaN material. The scientists then placed peptide-coated GaN and uncoated GaN into cell cultures to see how the material and the cells interacted.

They found that the peptide-coated GaN bonded more effectively with the cells. Specifically, more cells bonded to the material and those cells spread over a larger area.

“This matters because we want materials that give us some control over cell behaviour,” Ivanisevic says. “For example, being able to make cells adhere to a material or to avoid it.

“One problem facing many biomedical implants, such as sensors, is that they can become coated with biological material in the body. We've shown that we can coat GaN with peptides that attract and bond with cells. That suggests that we may also be able to coat GaN with peptides that would help prevent cell growth – and keep the implant 'clean.' Our next step will be to explore the use of such 'anti-fouling' peptides with GaN.”

Further details of this work are described in the paper, “Gallium Nitride is Biocompatible and Non-Toxic Before and After Functionalization with Peptides,” by Jewett *et al*, which will be published in a forthcoming edition of *Acta Biomaterialia*.

The research was funded by the National Science Foundation.