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Keeping the community together

I've just returned from the ninth International Conference on Nitride Semiconductors, which was, without doubt, a very good meeting.

You know that a strong programme has been put together when you want to be in two places at once. And that's how I felt on several occasions, including the time I went to an excellent talk from Toyota on a pair of devices that it is developing for delivering electrical conversion in hybrid electric vehicles. While I was there, I had to miss what was certain to be an interesting presentation from Samsung on their development of GaN LEDs on 8-inch silicon.

This Korean outfit gave several talks, including a fascinating account of how to produce LEDs spanning a vast colour range on pyramid-shaped nanostructures. Vertical variants producing promising results were reported by Osram Opto Semiconductors, and this company also revealed its progress in green lasers.

However, these companies were not joined by other big names in the opto-field, such as Lumileds, Cree and Nichia, who didn't speak at the meeting. In my opinion, it was their absence that prevented the conference from being a truly great one, like it was in Las Vegas in 2007, when on one memorable afternoon several of the big LED chipmakers went head-to-head as they detailed their latest lab results.

Input from companies was also lacking on the laser diode front, with the likes of Nichia, Rohm and Sumitomo not giving talks at the conference. And unfortunately GaN RF manufacturers were even thinner on the ground.

Given that the vast majority of academic research presented at the conference targets improvements to device performance, I feel that the lack of talks by the leading chipmakers is not healthy. That is because presentations by the big firms detailing state-of-the-art performance and potential roadblocks for further success will motivate many academics and show them areas where tomorrow's research can have commercial impact.

The absence of the GaN RF makers is not a really big concern for me, because these firms do get together at other conferences, such as CS Europe and CS Mantech. But what about the LED chipmakers that will together drive a revolution in general illumination?

As far as I'm aware, these firms don't have a conference that focuses at the chip level on LED manufacturing. And judging by the evolution of the silicon industry, really high volume production requires such gatherings, which can play a role in agreeing standards and helping to improve manufacturing processes.

It will be interesting to see what happens. And while I wait, I'll look forward to hearing many great talks at the next ICNS, which will be held in Washington DC in 2013.

Richard Stevenson PhD
Consultant Editor



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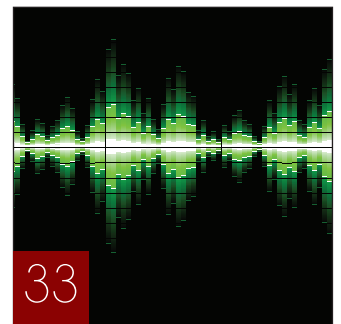
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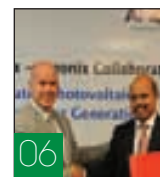
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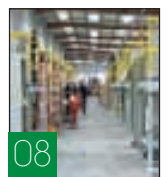
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India is set to benefit from CPV

THERMAX LIMITED and Amonix, Inc. have announced an agreement that will bring proven, concentrated photovoltaic (CPV) technology for clean power generation to India. In this exclusive partnership, Amonix will offer high-performance solar power generation systems and Thermax will be the Engineering, Procurement and Construction (EPC) partner to provide turnkey solutions to customers in India.

Amonix CPV solar power systems incorporate highly efficient solar cells originally developed for aerospace applications. The dual-axis tracking systems utilise durable state-of-the-art optics to focus sunlight onto multijunction solar cells. As this technology requires no water for power production and uses land more efficiently, compared to conventional solar technologies, CPV systems delivers more energy output from a given area at low energy production costs.

“Concentrated PV will be a game changer in solar power generation technologies because of the substantially high efficiency it offers. India, with its above average solar incidence, is an ideal location for CPV



technology and we expect our national solar mission to act as a catalyst for its growth. We are happy to partner with Amonix, a global leader of this technology,” says M. S. Unnikrishnan, Managing Director and Chief Executive Officer of Thermax.

Amonix systems can be deployed quickly, at the rate of half a megawatt post-pedestal installation per day. They offer 31 percent module efficiency and 29 percent system efficiency.

“As an organization committed to designing and manufacturing high performance cost-effective CPV solar power systems, Amonix is pleased to enter into a partnership with Thermax, a leader

in energy and environment management. Together, we will access the Indian market by enabling developers of solar projects to build projects, supported by world-class technology from Amonix and the strong delivery track record, supply chain and construction experience of Thermax.

This provides us the opportunity and access to the Indian market that is greatly suited for CPV solar power systems,” commented Brian Robertson, CEO and a board director at Amonix.

Concentrated photovoltaic technology will pave the way to meet the goals of the Indian Government’s Solar Mission that promotes sustainable growth while addressing India’s energy security. It is an integral part of the initiative to respond to the global challenge of climate change.

The first phase of the Mission aims to commission 1000MW of grid-connected solar power projects by 2013. In addition to helping meet these targets in the most efficient manner, concentrated photovoltaic solar power will introduce a new solar technology to India.

First Solar heads to Copper Mountain

PACIFIC GAS AND ELECTRIC and Sempra Generation have entered into a 25-year contract for 150 MW of renewable power from an expansion of Sempra Generation’s Copper Mountain Solar complex in Boulder City, Nevada.

First Solar, a producer of CdTe photovoltaic (PV) solar modules, will provide the ground mounted thin film panels and serve as the engineering, procurement and construction (EPC) contractor for the solar project.

The first 92 MW of solar panels at Copper Mountain Solar 2 are expected to be installed by January 2013, with the remaining 58 MW slated for completion by 2015. Under the terms of the contract, PG&E has the option to accelerate the commercial operation date of the second phase.

“Copper Mountain Solar 2 is a great opportunity for PG&E to continue down the path toward a clean energy future - a

vision we share with our customers,” said Fong Wan, senior vice president for procurement for PG&E. “We are delighted to be part of this partnership that will allow us to deliver more green power to meet our customers’ long-term electricity needs.”

“Copper Mountain Solar 2 is another exciting step forward on our plan to construct 1,000 megawatts of additional renewable capacity by 2015,” said Jeffrey W. Martin, president and chief executive officer of Sempra Generation. “We couldn’t be more pleased to move forward with PG&E and First Solar on our third and largest solar project in Nevada, which will deliver a new supply of clean power to California consumers.”

Construction on the 1,100-acre solar plant is expected to begin in early 2012. Copper Mountain Solar 2 will produce enough zero-emission electricity to power about 45,000 homes when fully developed.

“The combination of First Solar’s advanced thin film PV modules with our industry leading EPC capabilities enables us to rapidly deploy utility-scale solutions like Copper Mountain Solar 2, bringing down the cost of renewable energy,” said Jim Lamon, First Solar senior vice president of EPC, Operations and Maintenance. “We’re pleased to be working with Sempra and PG&E again.”

Sempra Generation and First Solar have previously teamed-up on the construction of two other large-scale solar projects in Nevada, including Copper Mountain Solar 1. The 48-MW installation was completed in late 2010 and is currently the largest photovoltaic solar power plant in the U.S. PG&E is currently delivering the power produced at the plant to its customers.

The power supply contract between Sempra Generation and PG&E is subject to approval by the California Public Utilities Commission.

China aims for LED global domination by 2015

ASIAN governments are investing in LED technologies and concentrating on reducing costs; China intends for its LED lighting products to be 40 percent below the market price by 2015.



already has a 60-watt equivalent LED light bulb priced at less than \$20.

In Japan, sales volume LED light bulbs have already reached an adoption rate of more

than 40percent and are expected to exceed 50 percent in the second half of 2011.

According to the report "Niche Markets and Strategies for Small/Mid-size Semiconductor Equipment Companies," which was recently published by The Information Network, there is currently as see steady and positive proliferation of LED lighting products. This analyst argues that key price points could trigger real commercial demand, and Korea, Japan, and China appear to have the solutions.

"The rapid increase in the market for LEDs used in various applications such as notebook backlights and automobile headlights is spurring heavy capital investments by LED makers", noted Robert Castellano, president of The Information Network. "LEDs are creating a niche market for conventional suppliers of semiconductor processing tools and a lucrative market for MOCVD suppliers."

High brightness LEDs will reach nearly 135 billion units shipped in 2011 from less than 100 billion in 2010. Backlight LEDs will reach 30 billion units shipped, up from 20 billion in 2010.

The South Korean government launched a new LED lighting adoption program last month as part of its national energy-saving program. The program aims at achieving 100 percent adoption rate for LED lighting in the Korean public sector and 60 percent penetration of all lighting applications nationwide by 2020. The government will fund \$185 million in 2012 and 2013 to support energy-efficiency rebates.

South Korea's Samsung and LG have a broad range of LED lighting products for the domestic market and highly competitive pricing strategies; Samsung

In China, the Central Government's objective is to end up with five to six major Chinese players, who can compete globally, including 3 to 5 flagship companies. The report says that not only will China become a powerhouse in low-cost manufacturing by 2015, it will also be the largest consumer of LEDs. Currently there are 50 large indoor and outdoor lighting projects already in place.

The Information Network says that the Chinese domestic SSL value will reach US\$ 74bn by 2015 and that a business-to-government deal with central and local governments is imminent. Continued investments in the Chinese LED value chain between 2010 and 2015 will see 75 percent going into the supply chain and 25percent into vertically integrated players.

By 2015, China intends for its manufacturing standards to be globally viable for the volume production market and its LED lighting products to be 40percent below the market price.

Since mid 2009, the Chinese central government has had in place a substantial investment program, as have many local government authorities in China. Both are focused on accelerating the development of a sustainable LED industry.

Apart from their global commercial aspirations, they are also greatly motivated by the high potential internal benefits that will arise from having access to energy efficient lighting and consequently, LEDs are a very prominent target technology in China's latest five-year plan.

Sales of sapphire manufacturing equipment yield \$96.9 million for ARC Energy

ADVANCED RENEWABLE ENERGY COMPANY, LLC (ARC Energy), has signed \$96.9 million in additional new contracts with two leading Asian manufacturers.

Under the terms of the agreements, ARC Energy will provide each customer with LED sapphire manufacturing equipment and technology, including highly automated, leading edge, c-axis Controlled Heat Extraction System (CHES) Furnaces, and additional turnkey solutions and services.

ARC Energy is also expanding its manufacturing facility by 30,000 square feet. The expansion, which is scheduled for completion in the 4th quarter of 2011, will triple ARC Energy's manufacturing capacity, enabling the company to become one of the largest LED sapphire furnace suppliers in the world.

"Many manufacturers are now installing and operating ARC Energy's technology for mass production of large diameter sapphire," said Hap Hewes, ARC Energy's senior vice president. "These new contracts and our planned capacity expansion highlight the advantages of our unique c-axis sapphire platform and ARC Energy's associated turnkey solutions. We are pleased by our progress and our continued success in the marketplace."

ARC Energy says its proprietary c-axis technology is superior to other sapphire growth technologies and that c-axis wafers are the optimum orientation for LED applications. The company says that when compared with conventional a-axis technologies, c-axis growth leads to higher material utilisation and lower overall costs.

Mobile shipments see massive growth

THE WORLDWIDE mobile phone market grew 11.3 percent year over year in the second quarter of 2011 (2Q11), despite a weaker feature phone market, which declined for the first time since 3Q09.

According to the IDC Worldwide Mobile Phone Tracker, vendors shipped a total of 365.4 million units in 2Q11 compared to 328.4 million units in the second quarter of 2010. The 11.3 percent growth was lower than IDC's forecast of 13.3 percent for the quarter and was below the 16.8 percent growth in 1Q11.

The feature phone market shrank 4% in 2Q11 when compared to 2Q10. The decline in shipments was most prominent in economically mature regions, such as the US, Japan, and Western Europe, as users transition to smartphones. This was the first decline since Q3 2009 and reflected a combination of conservative spending and shift to smartphones.

"The shrinking market is having an impact on some of the world's largest suppliers of mobile phones," said Kevin Restivo, senior research analyst with IDC. "Stalwarts such

as Nokia are losing share in the feature phone category to low-cost suppliers such as Micromax, TCL-Alcatel, and Huawei."

"For the overall market to grow by double digits year over year is testament to the strength of the global smartphone market," noted Ramon Llamas, senior research analyst with IDC's Mobile Phone Technology and Trends team. "While this is not a new trend it does mark something of a transition point, as demonstrated by the number and variety of smartphones featured in the vendors' portfolios."

Model K1 sapphire expands its Californian facilities

Thermal Technology has recently tripled its manufacturing capacity with a production facility in California. The new location is dedicated to Model K1 sapphire crystal grower production as well as neighbours Thermal Technology's sales and manufacturing site.

"Market response to the K1 grower has been very strong. Customers see our machines in full production elsewhere and are convinced of our technology," says Matt Mede, Thermal Technology president and CEO. "Utilising the modified Kyropoulos method, our growers remain the most productive tool in the market with large crystal size and a short growth cycle. We also have the most growers in

production, compared to competitors."

Thermal Technology says it is shipping multiple sapphire growers weekly. The new high-volume production facility enables the company to meet its customers' rising demand for the Model K1.

"The new facility increases our production capacity and improves the flow of our production processes. The expansion was fuelled by continued growth in our Model K1 sales," says Jim Coffey, Thermal Technology's production manager.

Thermal Technology designs and manufactures crystal growing systems and high temperature vacuum and



Interior of Thermal Technology production facility at the new "Model K1" facility in Santa Rosa, California.

controlled atmosphere furnaces for the advanced processing of metals, ceramics, glass and quartz. Thermal Technology has 60 years of experience with more than 3000 installations in 40 countries.

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Kyma adds n+ bulk GaN substrates to its portfolio



KYMA'S new n+ GaN substrate product line will boast a bulk resistivity specification of $< 0.02 \Omega\text{-cm}$, which is two orders of magnitude lower in resistivity than Kyma's offered n-type GaN.

What's more, Kyma has successfully produced n+ bulk GaN wafers with measured carrier concentrations of up to $6 \times 10^{18}\text{cm}^{-3}$ and corresponding bulk resistivities of $< 0.005 \Omega\text{-cm}$. The firm's n-type GaN product is still being offered and, for distinction, is being relabelled as n- GaN ("nminus" GaN).

Kyma says that although its n- GaN remains an excellent starting material for a variety of materials and device studies, its

n+ GaN offers benefits for vertical devices as well as reduced contact resistance for all devices. Key advantages for vertical power devices include ultra-low on-resistance as well as decreased parasitic resistance. Key advantages for LEDs include low vertical resistance and the mitigation of current crowding effects.

"We are pleased to respond to our customers' requests for more conductive substrates," said Jacob Leach, Kyma Characterisation and Device Engineer. "The high electron concentrations in this new product line directly support higher performance and reliability for a number of device applications of great commercial interest."

Tamara Stephenson, Kyma's Technical Sales Engineer, added, "We are happy to offer these new substrates in form factors of 10 mm x 10mm squares and 18 mm x 18 mm squares. Additionally, the development of commercially available 2" diameter and larger n+ bulk GaN substrates is underway."

Kyma is a supplier of crystalline GaN and AlN materials for a broad range of high performance nitride semiconductor device applications. The market for nitride semiconductor devices is expected to surpass \$90B over the long term, including over \$60B in visible lighting applications and over \$30B in power electronics applications.

Ascent Solar climbs higher with strategic alliance in China

Ascent Solar Technologies and TFG Radiant Group have signed a \$275 million plus royalties strategic partnership that includes investments by TFG Radiant into Ascent. They have also signed a joint development agreement to establish manufacturing facilities in East Asia. Under the agreement, TFG Radiant has committed \$165 million for the initial East Asia FAB, bringing the total deal value to about \$450 million plus royalties.

Ascent has agreed to exclusively license its technology for fabrication and distribution of flexible, lightweight CIGS photovoltaic modules to TFG Radiant for East Asia. The East Asia territory includes China, Taiwan, Hong Kong, Malaysia, Indonesia, Thailand, Korea, and Singapore. Ascent retains all rights for the U.S. and rest of the world.

Pursuant to the strategic alliance, in addition to continuing to ramp its existing FABs and improve its technology, Ascent will develop a next-generation PV production line in Colorado. Based on

Ascent's technology, TFG Radiant will build its first fabrication facility in China, with a projected direct investment of over \$165 million. This FAB is expected to have an annual production capacity of 100 MW.

TFG Radiant will cover consulting costs for Ascent personnel in helping to install and bring online the FAB in China. Ascent will receive partial ownership of the China FAB and royalties on all sales from that FAB. TFG Radiant also has the right to build, at its cost, multiple additional FABs for the East Asian markets and Ascent will receive partial ownership, royalties and consulting fees for all such FABs. Ascent will receive license fees and non-recurring engineering fees from TFG Radiant. In addition, Ascent will receive milestone payments tied to the achievement of certain production and cost goals. The total of such milestone payments could exceed \$250 million over multiple years.

"This partnership is transformative in nature. It is based on the complementary expertise of TFG Radiant, in metal roofing

and construction in one of the world's largest markets, and Ascent, in market leading flexible CIGS technology," said Amit Kumar, Chairman of Ascent.

"We are excited to be working with TFG Radiant," said Ron Eller, President and CEO of Ascent. "They bring expertise in innovative roof design and materials, balance of system design, volume manufacturing, and broad access to the East Asian markets. While we continue to ramp our current Colorado FABs, this arrangement enables us to work with a key partner to build the first non-U.S. and largest CIGS FAB based on Ascent's unique, flexible, monolithically integrated technology. TFG Radiant has the market leadership, distribution channels, installation capability and infrastructure, and established and highly motivated customer base that will accelerate the market for Ascent's CIGS products in East Asia. TFG Radiant's major financial and strategic commitments to this alliance are a strong endorsement of Ascent's flexible CIGS technology."

Agilent teams up with Davis to speed terahertz technology

AGILENT TECHNOLOGIES and the University of California, Davis, are setting up the "Davis Millimetre Wave Research Centre".

The DMRC will focus on advancing technology in millimetre wave and THz systems for radar, imaging systems, sensors, communications and integrated passive devices found in electromagnetic metamaterials and antennae.

The DMRC is vertically integrated, with research involving devices, integrated circuits, packaging, metamaterials and defected ground integrated passives, imaging systems, THz vacuum electronics, THz micro-machined devices, nonlinear modelling, nanomaterials and wireless implantable devices.

These devices and systems are found in commercial products such as medical imaging systems, security scanners, gigabit wireless communications devices and sensors, as well as defence usages such as radar and active denial systems. The first aim of the new centre is to

establish a core test facility with measurement capabilities that include Agilent nonlinear vector network and spectrum analysis test equipment up to 325 GHz. These facilities will support gigabit wireless communications at 60 GHz and 80 GHz, as well as the imaging, radar and active denial systems to 325 GHz.

"In launching the DMRC, our goal is to become a premier millimetre-wave research centre nationally and internationally," said Linda P.B. Katehi, chancellor of UC Davis. "With this new facility, UC Davis will be able to expand the research, and recruit outstanding graduate students and faculty."

"Agilent is delighted to support UC Davis' research into millimetre wave technology," said Gregg Peters, vice president of Agilent's Component Test Division. "Millimetre wave implementation has broad industry impact, and our many first-to-market test solutions are ideal tools for revealing the information critical to their work."

Cree's record revenue of \$988 million is thanks to LED lighting

CREE has announced revenue of \$243.0 million for its fourth quarter of fiscal 2011, ended June 26, 2011. This represents an 8% decrease compared to revenue of \$264.6 million reported for the fourth fiscal quarter last year and an 11% increase compared to the third quarter of fiscal 2011.

For fiscal year 2011, Cree reported revenue of \$987.6 million, which represents a 14% increase compared to revenue of \$867.3 million for fiscal 2010.

"Q4 results were in-line with our targets, and we are encouraged by the 11% sequential growth in quarterly revenue," stated Chuck Swoboda, Cree chairman and CEO. "Over the last fiscal year, we

continued to have success leading the LED lighting revolution and growing our LED lighting business, while at the same time managing through a challenging business cycle for our LED component and LED chip product lines."

For its first quarter of fiscal 2012 Cree targets revenue in a range of \$245 million to \$255 million with GAAP and non-GAAP gross margin targeted to be in a similar range as Q4 at 38-39%. GAAP operating expenses are to increase by \$2.0 million to \$75 million. The tax rate is targeted at 20% for fiscal Q1. GAAP net income is targeted at \$16 million to \$19 million, or \$0.14 to \$0.17 per diluted share. The GAAP net targets are based on an estimated 110.2 million diluted weighted average shares.

Emcore's GaAs cells launched in final space shuttle mission

A pair of Emcore Inverted Metamorphic Module Quadruple-Junction (IMM4J) solar cells were carried on a platform from the Space Shuttle Atlantis' cargo bay on July 20, 2011 after Atlantis undocked from the International Space Station during its historic final mission. Emcore says its IMM4J large-area solar cells, with solar-to-electric conversion efficiencies in excess of 33percent, are amongst the highest efficiency solar cells ever launched into space. The IMM4J solar cell technology, which is currently under development, has also demonstrated a laboratory world record conversion efficiency of greater than 36percent, measured under simulated space solar illumination conditions at Emcore.



"The on-orbit data from these cells provides an invaluable opportunity for Emcore to assess the performance of our latest solar cell technologies under space flight conditions," said Christopher Larocca, Chief Operating Officer of Emcore. "We are also very proud to make a contribution to the final mission of the Space Shuttle program."

Emcore is one of the world's largest manufacturers of highly efficient radiation-hard solar cells for space power applications. With a beginning-of-life conversion efficiency in the order of 30 percent and the option for a patented, onboard monolithic bypass diode, Emcore's multi-junction solar cells can provide extremely high powers to interplanetary spacecrafts and earth orbiting satellites.

New LED entrants in China to boost 2012 outlook

IMS Research has lowered its 2011 gallium nitride MOCVD forecast by 24% to 833 reactors, which still represents 4% growth over 2011. In 2012, China is expected to continue to dominate the market for GaN MOCVD tools, market, but shrink to 61% in Q4'12 as Taiwan and Korea rebound.

IMS RESEARCH has released the MOCVD chapters of its 300-page "Quarterly LED Supply and Demand Report" which reveals significant shifts in MOCVD adoption for LED manufacturing.

In June, the previous quarter's report lowered the annual GaN LED revenue growth forecast to just 4% to \$8.7B on rapid 1H'11 ASP reductions from a rising surplus, slower LCD and LED panel growth and the lighting market not yet cost competitive.

With growth slowing, margins shrinking, the oversupply worsening and credit in China tighter than expected, LED manufacturers have pushed out a significant number of installations in 2011 resulting in a surprisingly large MOCVD shipment downgrade.

IMS Research has lowered its 2011 GaN MOCVD forecast by 24% to 833 reactors, which still represents 4% growth over 2011 as shown below. Smaller capacity growth should slow down the LED oversupply and stabilise pricing which will benefit near term LED manufacturer profitability and eventually lead to more tool sales resulting in an upgrade to the 2012 outlook.

Looking to 2012, the 2011 delays along with 13 new entrants in China taking tools should result in a healthy 2012 GaN MOCVD market of 569 tools, down 36% vs. 2011, but higher than previously expected. Tool shipments are forecasted quarterly and identified by customer and wafer size.

These new entrants are a key reason for the growth with these companies accounting for 110 tools in 2012. Slower price reductions from a smaller surplus should boost the 2012 GaN LED market to \$10B, up 15% with packaged LEDs for lighting up 35% to \$2.3B.

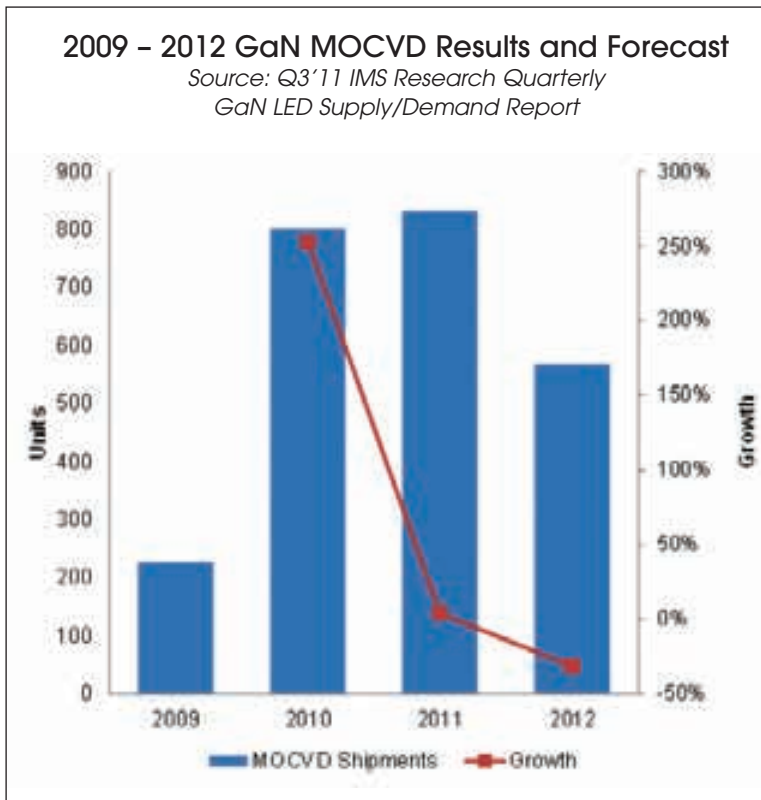
China is expected to continue to dominate the market for GaN MOCVD tools, market, but shrink to 61% in Q4'12 as Taiwan and Korea rebound. Epistar is expected to be the #1 MOCVD customer in 2012 followed by San'an, GCL Opto, SemiLEDs and Genesis Photonics. The report also identifies two Chinese MOCVD

manufacturers which are expected to win business from 2H'11.

The most recent report also quantifies Q2'11 GaN MOCVD shipment results. Shipments were down Y/Y for the first time since at least 2008, falling 14% if Veeco's MaxBright reactors were excluded as Veeco has not yet recognised revenues for this new tool in according with GAAP.

Including MaxBright reactor shipments, installations were still down 2%. Excluding MaxBright shipments, China continued to dominate the market, accounting for 70% of installations with Korea and Taiwan at 11% each.

Lextar was the top customer in Q2'10 and 9 of the top 10 customers had operations in China. Aixtron remained #1 in GaN MOCVD shipments, gaining 4 points of market share to 57% excluding MaxBright with Veeco losing 3 points to 41%.



MaxBright, Veeco led in China, USA and Europe while Aixtron led in Korea and Taiwan. Veeco's K465i remained the industry's most popular tool, but Aixtron's CRIUS II and G5 each gained share and rose to the #2 and #3 positions.

The 4" shipment share rose more than 50% while the 6" share more than doubled as companies move to larger wafer sizes to boost their output and lower their costs.

IMS Research's latest Quarterly GaN LED Supply and Demand Report also forecasts LED demand by application through 2016, panel and LED panel shipments by supplier, number of

LEDs/panel by supplier by size, LED and MOCVD supply/demand through 2016, sapphire supply and demand and sapphire pricing.

Including MaxBright reactors, Aixtron's advantage slips to 49% vs. 48% for Veeco, the closest it has ever been between the two competitors. By region excluding

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Droop draws the crowds at **ICNS-9**

Causes of LED droop and the progress of green lasers were two of the big topics at this year's nitride conference. **Richard Stevenson reports.**

Aside from the weather, the delegates that went to Glasgow for the ninth International Conference on Nitride Semiconductors received an incredibly warm welcome. Maybe this is not that surprising – after all, Scotland’s most populous conurbation has worked hard to get itself known as ‘The friendly city’. However, this is not always the case, and at times the city’s reputation can be tarnished by the fans of the two big football clubs – Celtic and Rangers – who will never ever see eye to eye. As expected, the delegates were on far better terms than these rival supporters, but that didn’t mean that there wasn’t a whiff of confrontation in the air at some of the sessions.

One topic that continues to court controversy and encourage researchers to vigorously defend their own position is that of the origin of droop, the mysterious phenomena that accounts for the decline in nitride LED efficiency when the current in this device is cranked up. Talks on this topic were very well attended, and while there seems to be a growing consensus of opinion that droop involves some form of Auger recombination (a non-radiative process involving either two electrons and one hole, or two holes and one electron), the debate is far from over.

In contrast to the last two ICNS meetings in Korea and the US, none of the leading LED manufacturers spoke about droop during the conference. This may be because these leading chipmakers feel that they now have a good enough understanding of the causes of droop and they cannot justify the funding of further research into its intricacies. However, that is probably only part of the reason – in the past few years the efficiencies of state-of-the-art white-emitting LEDs have shot passed those of compact fluorescent bulbs, and chipmakers are now focusing on improving the manufacturing process of these nitride-based devices, so that they can drive a revolution in general lighting. In their absence, academics made the running in the droop debate, sometimes aided by commercial modelling software.

Droop: the case for Auger

Some of the most compelling evidence for Auger recombination as the primary cause of droop was given in a talk by Wolfgang Scheibenzuber from Fraunhofer IAF. He and his co-workers, including members of Nicolas Grandjean’s group from EPFL, Switzerland, have determined the extent of Auger recombination in nitride laser diodes, the cousins of nitride LEDs.

Scheibenzuber began his talk by describing a pair of equations that he and his colleagues have used to



ICNS-9 was held on 10-15 July at the Scottish Exhibition and Conference Centre, Glasgow.

model carrier and photon populations in the laser diodes. He then went on to explain that this work employs the well-known ABC model for determining the evolution of charge carriers – in this widely used model, which is defined in terms of the carrier density n , the carrier recombination rate is described as the sum of three terms: the Shockley-Reed-Hall non-radiative recombination rate, An ; the radiative recombination rate, Bn^2 ; and the Auger non-radiative recombination rate, Cn^3 .

According to Scheibenzuber, one advantage of working with lasers, rather than LEDs, is that it is possible to determine the injection efficiency of the device using optical gain spectroscopy. After extracting this value – in this case it was 68 percent – it is possible to separate carrier leakage from the recombination rate.

The European collaboration's next step was to characterise their laser under very low driving currents and obtain a value for the A coefficient of $4.2 \times 10^7 \text{ s}^{-1}$. They then studied the dynamics of the laser, such as relaxation oscillations and turn-on delays, and were finally able to extract values for the B and C coefficients of $3 \times 10^{-12} \text{ cm}^6 \text{ s}^{-1}$ and $4.5 \times 10^{-31} \text{ cm}^6 \text{ s}^{-1}$.

Scheibenzuber concluded his talk by pointing out that the value obtained for the C coefficient agrees with the value calculated by Chis van de Walle and co-workers from the University of California, Santa Barbara (UCSB). These West-coast theorists believe that the forms of Auger recombination that dominate LED droop involve phonons and alloy disorder.

Further support for Auger recombination as the primary cause of LED droop came from a presentation by Ted

Thrush from the University of Cambridge. He presented electroluminescence intensity plots for a commercial LED driven at current densities from 0.0001 A cm^{-2} to 100 A cm^{-2} at temperatures ranging from 77K to 385K.

Thrush and his colleagues have characterized this LED with a transmission electron microscope: Its threading dislocation density is $1.4 \times 10^9 \text{ cm}^{-2}$ and its active region features five wells with thicknesses of 3.2 nm, sandwiched between 4.8 nm-thick barriers.

The ABC model has been used to provide a good fit to the electroluminescence intensity plots, using the same B and C coefficients at all temperatures. Thrush said that consistency of the C coefficient over this temperature range indicated that the droop mechanism was not due to traps, leakage or a direct Auger process. He argued, however, that it was consistent with an impurity- or phonon-mediated Auger process, as suggested by the theoretical work of the UCSB group.

Auger recombination was also blamed as the major culprit behind LED droop in a paper given by Dmitry Zakheim from Ioffe Physico-Technical Institute, Russia, who has been working with researchers from Epi-center and STR-Group. Through a combination of theory and experiment, this partnership from St Petersburg has shown that LED efficiency can be increased by switching from a conventional active region to one based on a short-period superlattice.

Zakheim and his co-workers have used the STR Software SiLENSe 5.0 to model electron and hole distributions in a conventional LED featuring five, 3 nm-thick quantum wells sandwiched between 10 nm-thick barriers. This model – which includes drift and diffusion effects and can account for carrier delocalisation in the active region – revealed that the holes are not uniformly distributed through the active region, but predominantly located in the well nearest the p-type region (see Figure 1). According to Zakheim, this high degree of carrier localisation leads to high Auger recombination losses, and ultimately LEDs that suffer from significant droop.

Modelling indicates that a far more uniform hole distribution is possible with a superlattice active region comprising 2.5 nm-thick wells and barriers. Such a structure is far better at combating droop: A standard flip-chip LED with a p-type contact formed from ITO and silver had an efficiency at 1 A that was 52 percent of its peak value; in comparison, a similar device with a superlattice active region delivered 76 percent of its peak output at 1 A.

It is also possible to suppress droop by improving the capability of the electron-blocking layer. According to

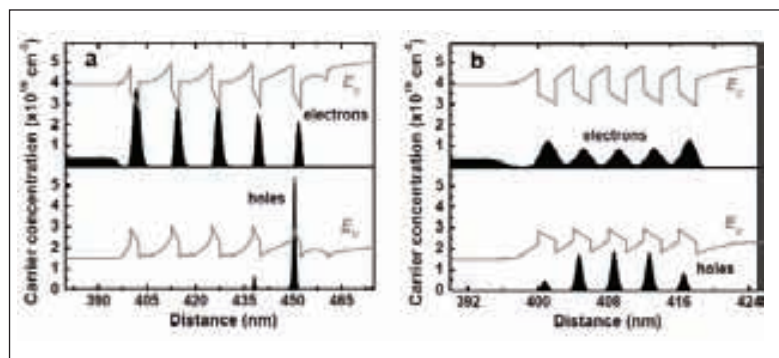


Figure 1. A partnership between Ioffe Physico-Technical Institute, Epi-Center and STR-Group has modelled electron and hole distributions in two types of LED: (a) a device with a conventional active region, containing five, 3 nm-thick quantum wells sandwiched between 10 nm-thick barriers (b) a device with a short-period superlattice active region comprising 2.5 nm-thick wells and barriers.

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Russell Dupuis from Georgia Institute of Technology, who has been working with Fernando Ponce's group at Arizona State University, one way to do this is to replace the conventional p-type InGaN layer with p-type InAlN.

This US partnership fabricated a series of LEDs with $\text{In}_{0.18}\text{Ga}_{0.82}\text{N}$ electron-blocking layers of differing thicknesses, and found that device performance peaked for a 15 nm-thick blocking layer. The team have simulated device performance with a modified version of the ABC model that includes a term for electron spill-over. In their work, they found a good fit to their experimental data using values for A, B and C of $1 \times 10^7 \text{ s}^{-1}$, $2 \times 10^{-10} \text{ cm}^3 \text{ s}^{-1}$ and $4.5 \times 10^{-29} \text{ cm}^6 \text{ s}^{-1}$.

One of the great strengths of the widely used ABC model is its simplicity. However, it has its weaknesses too, according to Mary Crawford from Sandia National Laboratories, Albuquerque, NM. She explained that the radiative recombination in real devices is not actually proportional to Bn^2 at high carrier densities, and claimed that more realistic modelling is possible by using momentum-resolved carrier distributions, which allow direct implementation of bandstructure properties into the rate equations. This provides a more accurate description of carrier-carrier and carrier-phonon interactions, includes a treatment of carrier leakage and capture, and derives radiative recombination via bandstructure and carrier distributions. One tremendous benefit of this approach is that it can be used to consider contributions not present in the ABC model, such as recombination at defects with a microscopically determined, carrier-density-dependent A coefficient.

Droop: The case for carrier overflow

Going against the grain, Akio Kaneta from Kyoto University, Japan, did not attribute any of the droop he observed in his light-emitting nitride samples to Auger recombination. Instead, he pointed the finger at carrier overflow for the droop in blue LEDs, and blamed carrier diffusion from radiative recombination domains to non-radiative ones for the decline in green LED efficiency at higher drive currents.

Kaneta and his colleagues came to these conclusions after scrutinizing the photoluminescence produced by blue and green single-quantum-well structures with a scanning near-field optical microscope, a form of scanning probe microscope that can realise incredibly high spatial resolution in the optical domain by illuminating a sample through a sub-wavelength aperture formed at the apex of an optical fibre.

The researchers illuminated both samples through the aperture at two excitation powers, differing by a factor of 100, and recorded the local emission intensity. The two samples featured domains of strong photoluminescence that were several hundred nanometers across,

Toyota gears up HEMTs for HEVs

Toyota is developing vertical HEMTs for incredibly efficient, high-power switching in hybrid electric vehicles (HEVs), and lateral equivalents for lower power applications in cars. The motivation behind these efforts, according to Tetsu Kachi from Toyota Central R&D Labs, Japan, is that the silicon electronics used today to convert DC power from the battery to an AC form to power the motor throws away 5-10 percent of the energy, which is wasted as heat. Managing this requires a water-cooling system, and the amount of energy lost could increase because the trend is towards higher and higher powers in HEVs. The first generation Prius used a 30 kW motor, but second and third generations have increased this figure to 50 kW and 70 kW. Even higher figures are being used by Lexus, which has a motor with a power of more than 150 kW in its model LS600h.

Losses in the DC-to-AC conversion process results from imperfect switching. The ideal: No current would be drawn in the off-state; in the on-state there would be no resistance; and switching speeds would be instantaneous. Switching losses promise to fall by a factor of about six by replacing silicon switches with those made from GaN. But that's not the only benefit – switch to GaN and the electronics no longer needs its own dedicated water-cooling system, explained Kachi. Instead, it can tap into the one used for the engine, which one day might just require air cooling.

Smaller power modules operating at a few kilowatts are also needed in HEVs for air-conditioning, and emergency and outdoor applications.

Toyota is developing two types of GaN HEMT for the HEV: vertical devices for high-powers, which have the merits of high current density, high breakdown voltage and a high on-resistance; and lateral transistors for lower powers, which combine high frequencies with a low resistance, and high breakdown voltage and low cost. The vertical devices feature a novel U-shaped trench that is formed by dry etching with an inductively coupled plasma, followed by wet etching for 60 minutes at 85 °C. The sidewall forms a metal-oxide-semiconductor channel that works well up to 300 °C. Normally-off operation is realised with this device, which has a breakdown of 180 V. The goal is to increase this to 600 V. Efforts on the lateral devices have created transistors that are normally off above 3 V, and have issues related to current collapse and reliability of the gate insulator. Engineers at Toyota will work to improve this device and its vertical cousin.



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With the blue-emitting sample, the researchers found that the emission from the brighter areas saturated when they collected the photoluminescence through the aperture of their probe. This was not the case when a lens, which collects photoluminescence over a greater sample area, captured the emission. The conclusion of Kaneta and his co-workers: Photo-excited carriers overflow from localisation centres and are not captured by non-radiative recombination centres, thanks to the potential barrier surrounding them. This explanation is consistent with blue LED droop caused by a decline in carrier injection efficiency. In contrast, photoluminescence mapping of the green-emitting sample showed

saturation everywhere, indicating that carriers move from radiative domains to areas that are non-radiative, probably due to threading dislocations.

Lasers for displays

Another highlight of ICNS-9 was the talks from representatives of Osram Opto Semiconductors and the UCSB spin-off, Soraa, which provided updates on their company's performance of their laser chips for display applications, including picoprojectors. According to James Raring from Soraa, lamps and LEDs are alternatives for the light source, but they deliver an inferior optical throughput, typically by a factor of three.

Raring explained that the vast majority of commercial green lasers on the market today and capable of serving picoprojectors employ some form of frequency doubling of an infrared source. Replacing such devices with single, green-emitting chips will lead to improvements in efficiency, compactness, ruggedness and speckle. However, according to Uwe Strauss from Osram OS, in order to produce an image with sufficient brightness, these green laser chips must have: An emission wavelength of at least 515 nm; output power of 50 mW or more; a minimum wall plug efficiency of 5 percent; and, in both the lateral and vertical directions, a single mode output. If a shorter wavelength source is used – for example, a 505 nm laser – the power output requirements are higher.

Osram can exceed these requirements. Its lasers, which it has developed on the conventional c-plane, produce 70 mW at 522 nm with a wall plug efficiency of 5-6 percent, and have a spectral width of 1.8 nm. What's more, reliability – defined as the time taken for the operating current to increase by 30 percent – is more than 1000 hours. In comparison, the continuous-wave output of Soraa's 516 nm green lasers that are grown on unconventional planes of GaN now exceed 100 mW. Other characteristics of these packaged diodes included threshold currents and voltages of 125 mA and 5.9 V, a slope efficiency of 0.4 W/A and a wall-plug efficiency that peaks at 4.1 percent.

In Raring's talk, he explained that one of the benefits of using semi-polar and non-polar planes is an increase in the radiative recombination rate, which stems from increased overlap of the electrons and holes in the quantum wells. These orientations also aid hole injection, thanks to a reduction in the effective mass of this carrier. However, he claimed that the most exciting aspect of these novel planes is the far greater design freedom that they enable.

Soraa's efforts have not been limited to increasing output power – the West-coast start-up has also focused on improving the beam-quality of its single-mode green lasers. Divergence along the fast axis is 14-22 degrees,

Toshiba addresses the green gap in LEDs

One of the biggest problems facing the nitride community is the 'green gap' – the rapidly declining efficiency of green light emitters at longer and longer wavelengths. But this issue can be combated, according to Toshiba's Tamonari Shioda, by inserting thin AlGaIn layers in the active region of a conventional device. This approach can increase the output power of green LEDs by a factor of almost ten.

Shioda explained that there are several issues associated with propelling LEDs to longer wavelengths: Deterioration of the crystal structure and increased phase separation, which can be addressed by improving the growth process; and an increase in electron-hole separation via the quantum-confined Stark effect, which can be mitigated by switching the growth platform to a semi-polar or non-polar orientation.

Toshiba wants to improve its green devices on c-plane sapphire, and to do this its engineers have worked to improve the band structure of the device. The primary goal of this effort has been to increase radiative recombination efficiency through greater electron-hole overlap.

Initial efforts in this direction involved the growth of multiple quantum well structures featuring 1.5 nm-thick AlGaIn layers with a range of aluminium compositions up to 30 percent. Cross-sectional transmission electron microscopy analysis on this set of samples revealed no degradation in any of the structures. And probing these structures via photoluminescence showed that the greater the aluminium composition in the layer, the greater the suppression of the decline in efficiency at longer wavelengths.

Shioda and his co-workers have produced 600 µm by 600 µm LEDs with an active region featuring AlGaIn layers, which were grown at the same temperature as the InGaIn quantum wells. The output power of these LEDs increases with the proportion of aluminium in the interlayer. Driven at 20 mW, a 532 nm LED incorporating an Al_{0.3}Ga_{0.7}N layer produced an output of 12 mW at an external quantum efficiency of 25.9 percent. One downside of this structure is its higher operating voltage – insertion of this aluminium layer increases the forward voltage from 3.5 V to 4.6 V.

and in the slow axis it is 10-14 degrees. Similar improvements have been made to the divergence of the company's single-mode blue lasers, which in packaged form have a slope efficiency of more than 1.6 W/A, and a threshold current and voltage of 30 mA and 3.9 V.

When emitting 500 mW, these diodes deliver a wall plug efficiency of more than 20 percent and hit 22 percent at 200 mW. Soraia has also made more powerful, multi-mode variants that can produce 1.4 W and have a wall-plug efficiency of more than 23 percent.

Making affordable, semi-polar LEDs

Another company turning to novel nitride planes to develop new products is the Korean outfit LG Electronics. High-power, semi-polar green LEDs is the goal, which will be built on *r*-plane sapphire due to the high cost of GaN substrates and their incompatibility with mass production systems.

Yoon-ho Choi from LG explained that there are two options for forming *a*-plane GaN on *r*-plane sapphire: A planar approach involving interlayers; or selective growth, which tends to involve lateral overgrowth. "We tried to optimise and combine these strategies," explained Chio.

The result is a process that begins by forming GaN seeds on the sapphire surface. Three-dimensional growth follows to form large islands, before an interlayer is added that creates a continuous GaN film across the surface. After optimising this approach, the dislocation density in the epilayer is $2-3 \times 10^9 \text{ cm}^{-2}$, and the stacking fault density is $1-2 \times 10^5 \text{ cm}^{-1}$.

According to Choi, these values are not good enough for making LEDs, so the engineers then apply a lateral overgrowth step to these wafers with a hexagonal pattern. Engineers from LG have made some very basic LEDs on this platform, using an architecture that Choi claims to be around 20 years off the pace – for example, it has no electron-blocking layer. Compared to an equivalent LED on sapphire, the *a*-plane variant is 40 percent brighter. However, Choi says that this improvement is partly caused by the air gaps in the underlying structure that increase light extraction.

The development by LG of green LEDs, as well as the improvements to green and blue lasers by Soraia, indicates that it may not be long before semi-polar and non-polar devices start making a significant commercial impact. So it will be interesting to see how much progress has been made when ICNS-10 comes around in Washington DC in 2014. And by then, maybe, just maybe, the community will be closer to agreeing on the cause of droop. But don't bet on this just yet.

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Switching faces improves high-speed HEMTs

Researcher Umesh Mishra from the University of California, Santa Barbara, opened the ICNS meeting by highlighting the performance of GaN HEMTs and detailing approaches to take these transistors to a new level.

He kicked off his talk by saying that LEDs had made great progress in recent times, and now it was the turn of the electronics sector to make significant commercial headway.

Mishra then provided a brief overview of where the RF performance of HEMTs stand today: 13.7 W/mm at 30 GHz, 10.5 W/mm at 40 GHz, and 2.4 W/mm at 60 GHz. He also reminded the audience of the records for the fastest devices – a cut-off frequency of 220 GHz and a maximum oscillation frequency of 400 GHz.

"I'm convinced that you will see 500 GHz in the next five years. It will happen," added Mishra, who explained that only a few years ago such frequencies were unthinkable.

However, he pointed out that these devices have a major weakness – the gain falls fast as frequency rises. This stems from parasitic capacitances and resistances that

are too high. According to Mishra, the best way to address these issues is to switch from a conventional HEMT, which is produced using the gallium face, to a variant based on the nitrogen face. Making contacts to this novel device is easier, and drastically reduces the contact resistance.

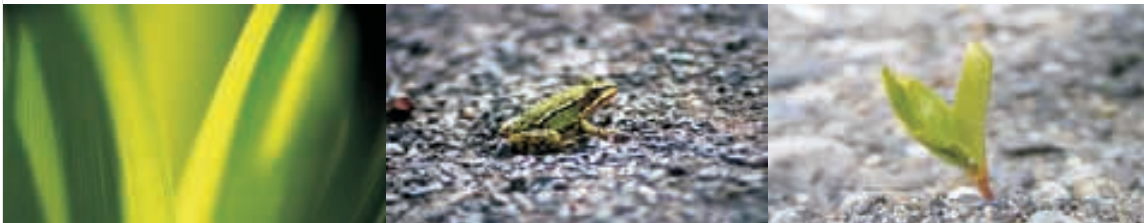
One downside of HEMTs with a nitrogen face is that they have traps at the interface between AlGaN and GaN. However, by doping this region it is possible to lift these trap levels out of harms way. Mishra's team have built MBE-grown, nitrogen-face devices with optically defined gates that produce 5.7 W/mm at 10 GHz. And MOCVD-grown variants fabricated on off-cut SiC, deliver 20.7 W/mm at 4 GHz, and 16.7 W/mm at 10 GHz.

The team has started to move to higher speeds, which is where the benefits of the nitrogen-face really come into play. Initial results include a cut-off frequency of 163 GHz.

The West-coast academic also spoke about the promise of GaN transistors for digital applications – his team has produced a 60 nm gate length HEMT with an InAlN back barrier that produces 2.77 mA/mm.

Activities at Transphorm, the company that Mishra co-founded in 2007, were briefly covered towards the end of the presentation. Normally-off HEMTs produced by this start-up are converted into a normally-on mode with an additional circuit, and can be used to make products for power switching. This includes three-phase inverters for photovoltaics that can operate at efficiencies of more than 98 percent.





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NXP goes with GaN

Following several years of development with UMS and Fraunhofer Freiburg Institute, NXP is starting to launch a family of high-performance GaN-on-SiC power transistors that will complement its hugely successful silicon LDMOS products, says the company's **Director of Marketing for RF Power, Mark Murphy**.

At NXP we have recently unveiled our activities in bringing RF power GaN products to the market, which are a significant strand in our portfolio development for the coming years. We believe this demonstrates to the electronics industry something of a breakthrough in the maturity of the technology, as it progresses from being a boutique-only affair to part of a broad range of products from a leading high performance RF supplier like ourselves.

NXP GaN - the story so far

Our firm is not a latecomer to GaN – we are firm believers in the many benefits this wide bandgap semiconductor brings and our involvement stems back through many years of research and development. We are investing in GaN for different market segments, which will inevitably result in more than one GaN process to meet the different product-application requirements.

Significantly, for the RF power activity, we have had a great partnership with United Monolithic Semiconductors (UMS) and the Fraunhofer Freiburg Institute that has helped the technology mature by leaps and bounds to the point today, where we can prepare for the first product releases. In-house testing has gone well these past months and we have been boosted by some glowing endorsements from selected customer sampling. As of today, we are well underway with a full release of the wafer process and the first phase of product designs.

The products that we will release will compete in the market for RF power transistors, which will break the \$1 billion mark in 2011, according to independent market research. Products built from GaN will play an increasing role in this sector, and are tipped to take as much as 30 percent of this market by 2014. If true, this would lead to a GaN RF power transistors market of at least \$300 million.

For such numbers to come to fruition, GaN technology needs to be supported by mainstream vendors. In the world of RF power, we are the first to offer such an

extensive portfolio that covers both silicon LDMOS and GaN products – combined these two technologies will account for nearly 90 percent of the RF power market.

This leads to the obvious question: what makes GaN a winner for RF power applications? Simply put, this material makes a step increase in efficiency and power density performance over silicon LDMOS in most applications. The suitability of semiconductors for RF power transistors is captured in the Johnson's Figure of Merit (FoM) – a combination of material constants that starts with 1 for silicon as a reference and ends with 324 for GaN. To put this into some context, GaAs, another commonly used compound material in RF, has a FoM of 1.44. Suffice to say, GaN truly represents a breakthrough technology.

To make the most of the benefits of GaN we will use devices fabricated on SiC substrates and package them using the latest low-thermal-resistance materials. The excellent thermal properties of SiC mean that we can exploit the higher operating temperature capabilities of GaN versus LDMOS by keeping the transient thermal impedance down to a minimum – an important requirement for an RF power transistor.



The first product in NXP's GaN power product portfolio is the CLF1G0530-50, a broadband amplifier spanning the 500-3000 MHz range that has a nominal P1dB of 50W

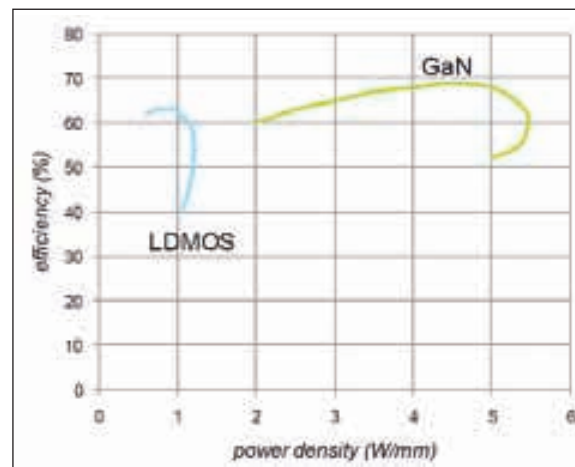


Fig. 1 GaN clearly outperforms silicon LDMOS at 2.1 GHz

	Silicon	SiC
wafer diameter	8 inch	3-4 inches
resistivity	v.low Ohmic	v.low Ohmic
thermal conductivity	1.5 W/cm.K	4.9W/cm.K
breakdown field	25V/ μm	220V/ μm
Johnson's FoM	1	310

Table 1:
Comparison of silicon & SiC substrate material

The products that we will release are HEMTs, a class of transistor that exploits one of the intrinsic benefits of GaN: the high electron drift velocity. These transistors will be depletion-mode devices, that is, devices that are normally on, without the need for applying a gate bias. A negative gate bias will be needed to switch the transistors off. This biasing is not straightforward, but we like to offer solutions rather than just components, so we already have a tried-and-tested bias circuit available and will provide application support through the life of the product.

In a few applications we will see GaN replace silicon LDMOS. However, ideally this should be the exception rather than the rule, because GaN should be seen as extending the scope for RF power coverage.

A tale of two compounds

From a compound semiconductor perspective it is important to realise that the products discussed here exploit the advantages of two compound materials: SiC and GaN. SiC is used as the substrate owing to its excellent thermal conductivity and the junctions are formed by GaN epilayers to improve the efficiency and power density and also extend the frequency range compared to silicon LDMOS devices.

Table 2:
Comparison of Si LDMOS & GaN HEMT material

	Silicon LDMOS	GaN HEMT
epi	homogeneous silicon	heterogeneous, GaN
bandgap	1.1 eV	3.4 eV
electron velocity:	-	-
saturated	1×10^5 m/s	1.5×10^5 m/s
peak	1×10^5 m/s	2.7×10^5 m/s
breakdown field	25V/ μm	300V/ μm
typ BVds	75 V	175 V
processing	standard CMOS	bespoke fab
mask count	22	13
max frequency	3.8 GHz	>12 GHz
max temperature	225 °C	250 °C
Johnson's FoM	1	324

Although the channel is structured laterally in RF power devices the current also flows through the substrate as the principal source contact. For this reason we need low Ohmic substrates for LDMOS devices. Silicon, of course, is available from multiple suppliers and for RF power we use 8-inch (200mm) wafers. In contrast SiC has much a smaller supply base and is in the process of moving from 3-inch to 4-inch substrates. This makes the real-estate on SiC more expensive, but that cost adder is more than compensated for by the incredible performance improvements: a five-fold hike in thermal conductivity and a factor of nine gain in electrical breakdown.

For GaN devices a rather complex heterostructure ends with GaN epi in which the active junctions are formed. But the benefits are to be found in the electron drift velocity and the electrical field breakdown. The peak electron drift velocity (another way of expressing the electron mobility) for GaN is nearly three times that of silicon, leading to devices with lower specific $R_{\text{ds(on)}}$ and smaller gate length, in turn yielding devices that can work at much higher power densities.

GaN's suitability as a general purpose power switch exploits the better electron mobility plus a factor of 12 improvement in breakdown field: this opens up the market for a complete new level of very low Ohmic, high-voltage devices. For RF power we will see devices with a typical breakdown voltage more than twice that of silicon LDMOS, enabling higher V_{ds} bias voltages to be used. A further advantage of GaN is that it is a very hard material capable of withstanding very high temperatures. Our GaN transistors will be specified to a maximum temperature of 250 °C, compared to 225 °C for silicon LDMOS.

The potential for GaN as a material for RF Power devices can be stated, without exaggeration, as outstanding. As an illustration of what this means in terms of real device performance, see the efficiency-power density comparison for LDMOS and GaN in figure 1.

From an industrialisation aspect, we have managed to incorporate silicon LDMOS processing into a standard CMOS fab environment, with just a few minor process variants. This has been essential for a market that consumes thousands of wafers and millions of products per year. With this comes great economy-of-scale advantages for silicon LDMOS. For now, GaN is processed in dedicated fabs, the mask count is lower but the economies of scale are some years away.

Initially we will focus on bringing a range of broadband devices to market. This will give customers the chance to evaluate a GaN device in as many applications as possible. But these devices are far more than evaluation vehicles: we will bring them to full release this year and offer all the product and application support required for customers to use them in volume production.

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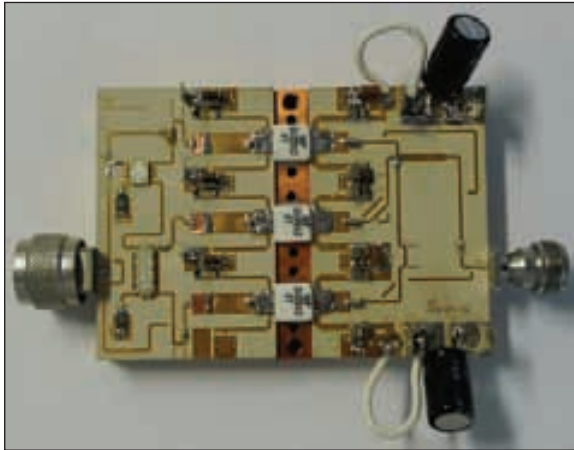
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NXP has built a 2.7 GHz Doherty demo using three small, unmatched GaN devices that is claimed to achieve a decent power density and efficiency performance when compared to silicon LDMOS



The first released type will be the CLF1G0530-50, hardly a catchy name but one with meaning: the 'C' is our code for GaN technology; 'F' denotes a ceramic package type; '1G' stands for first-generation technology; 0530 describes the optimal frequency range of 500-3000 MHz; and '50' is short-form for a nominal P1dB of 50 W. This is the naming convention we will apply to our portfolio: 100W and 150W, unmatched broadband versions will follow before we start on a few frequency-specific matched types.

The biggest market segment for RF power transistors is telecom base-station infrastructure equipment. Typical operating frequencies range from less than 1000 MHz for various GSM, WCDMA and LTE standards to 2700 MHz for other LTE use and to 3800 MHz for WiMAX. In recent times the power amplifier (PA) architecture of choice has changed from the classic class AB to the more exotic Doherty configuration. A Doherty is a hybrid amplifier, with one portion for the main signal and one for the peak power. The Doherty concept sacrifices linearity in favour of efficiency. Combined with system improvements in the signal handling – digital pre-distortion (DPD) – base-station designs can be made with much higher efficiencies whilst retaining linearity.

As a small step in the right direction, we have produced a neat 2.7 GHz Doherty demo using three small, unmatched GaN devices that achieve a decent power density and efficiency performance when compared to silicon LDMOS – this drew much interest at the recent International Microwave Symposium (IMS/MTTS) show in Baltimore, June 2011. Commercial devices for base-station applications will require the next process version and improved matching designs; these will start to become available during the first half of 2012.

From analogue to digital

As well as being a complement to LDMOS in existing linear topologies, GaN offers a much more exciting prospect – it is an enabling technology for digital

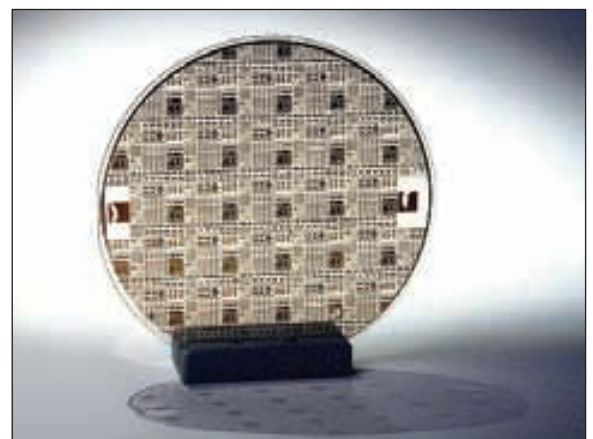
transmission. This is another key research and development project for us, which illustrates how our focus in the high-performance RF domain allows us to demonstrate our abilities as an innovator of improved systems. The digital transmitter rationalises the digital signal chain and culminates in a switched mode PA (SMPA) – a concept impossible without GaN. The thinking behind the SMPA is to make a break from the current family of linear designs of PA, with their inherent current and voltage losses, to a true switching design, with near-zero switching losses. The SMPA will follow the class E/F topology, taking the efficiency up to the 70-80 percent mark. The whole concept is aimed at producing far smaller, cheaper, cooler, and hence greener base-stations.

Our application insight for system concepts like the digital transmitter is complemented by a deep appreciation of knowing how to get perfect device partitioning. In this respect, we are not constrained by a single material and adopt the right technology for the required functionality.

Here it is important to mention SiGe, another compound semiconductor receiving much of our attention. The benefits of SiGe are distinct but quite different to GaN. Whereas the benefits of GaN are as the optimum RF power transistor material, SiGe's benefits are as a very cost-effective technology for mixed signal RF solutions compared to GaAs.

We will continue to adopt an agnostic approach to materials throughout this year and beyond. 2011 could well go down as a year in the evolution of GaN with great strides in becoming a material that is available, workable and reproducible in significant volumes.

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NXP has developed its power transistors on 3-inch SiC substrates in partnership with United Monolithic Semiconductors (UMS) and the Fraunhofer Freiburg Institute



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Displays will reignite the red laser market

The red laser is a great friend of the film buff. It has been the key ingredient for extracting the data from billions and billions of DVDs, and thanks to increases in output power, it promises to now enable the manufacture of brighter, more colourful displays, including three-dimensional ones employed in cinemas, says **Modulight's Marketing Manager Anca Guina.**

For more than a decade the red laser diode's only high-volume application has been optical storage – the playback and recording of DVDs, which can store films and other forms of digital data. According to the US market research firm Strategies Unlimited, shipments of 300 million laser chips serving this application, which emit milliWatt outputs at 650 nm in pulsed mode, accounted for 98 percent of the \$1.41 billion visible red laser market in 2008.

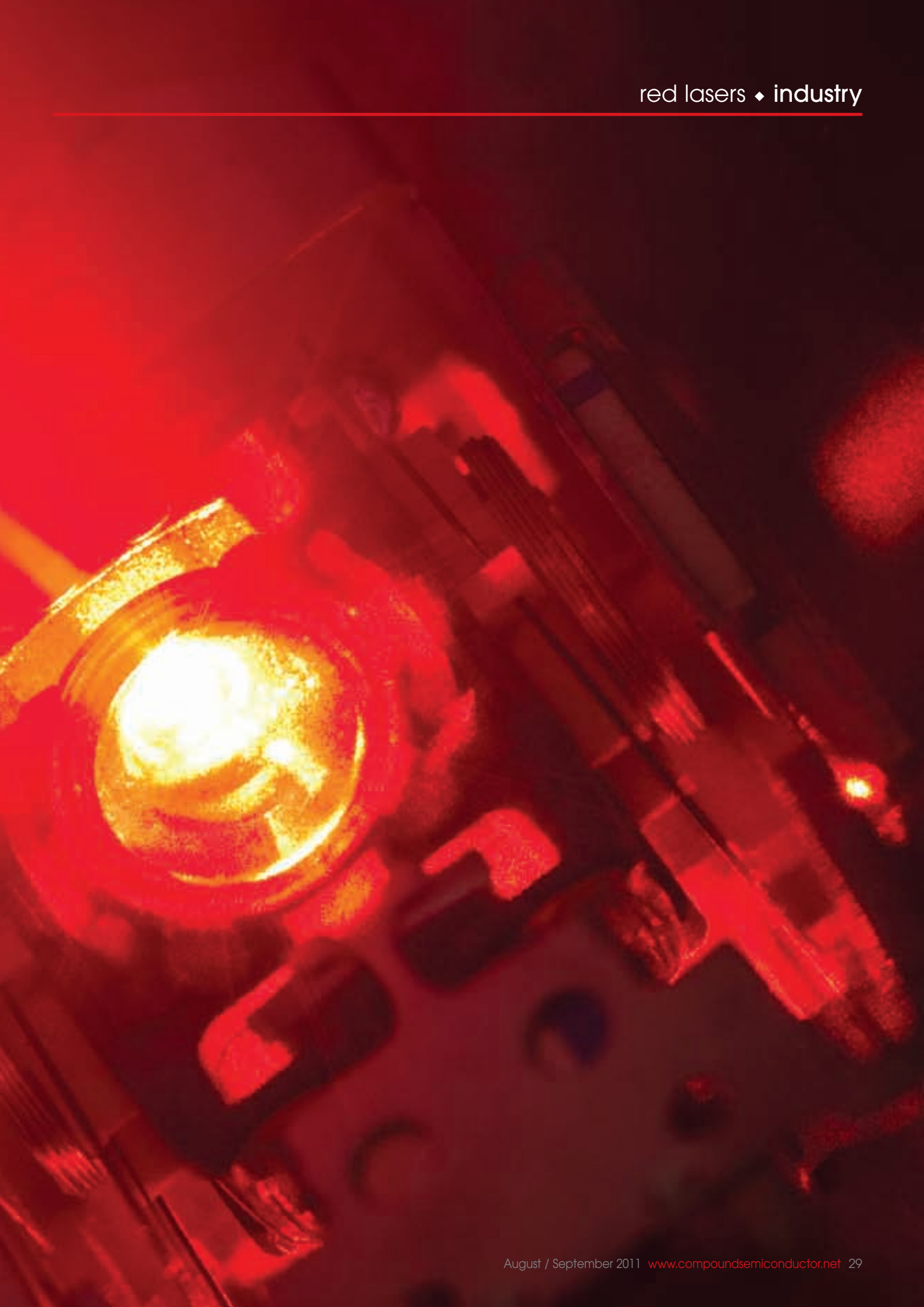
However, while this market will continue to be a very valuable one for red laser manufacturers for many years to come, any chipmaker looking to grow their revenues will need to start serving new applications too, because sales of 650 nm diodes for optical storage have saturated. What's more, these laser makers will also have to look beyond the other well-established, but far smaller markets for low-power red lasers, including those for bar code scanners and industrial applications that employ these diodes for pointing and measurement.

At Modulight – a well-established Finnish in-house manufacturer of red diode lasers that has a technology that originates from Tampere University of Technology – we have been identifying alternative markets for red lasers. They require sources with higher output powers, typically 1W or more.

Our company, along with other makers of red lasers, expects these sources to play a growing role in the medical laser market, which had a value last year of \$432 million, equating to just less than 7 percent of the entire laser market, according to Strategies Unlimited. In this sector, high power lasers can be used for therapy and illumination applications. However, producing lasers with higher output powers that can operate reliably for the length of time demanded by this application is challenging, and the lack of 'killer applications' in this sector discourages chipmakers from running expensive development programmes.

A more promising application for red lasers is the entertainment and display market. Although it was only valued at \$32 million in 2010, it is forecasted to grow at an annual rate of 20 percent over coming years. The main attraction of turning to visible lasers, or LEDs for that matter, is that they promise to deliver a far wider colour space than that which is attainable with conventional lamp-based technology. By mixing the output of red, green and blue lasers, it is possible to produce significantly deeper colours while setting a new benchmark for brightness.

Products that could soon sport small versions of these projectors – known as a picoprojectors – are top-of-the-





The Chilllase standard product offering at Modulight ranges from 500 mW chips to 12 W fiber coupled laser modules and systems

range mobile phones and digital cameras. This add-on will allow the user to project images, typically the size of this magazine, onto flat, light-coloured surfaces. The output power demands for this particular application are not that challenging, typically requiring between 200 and 400 mW, which is comparable to the power used to burn information onto a DVD.

Many companies with existing red laser technology for optical storage will be looking to enter the market for pico projector lasers, which require low-power, single-mode sources. We, however, are more excited by the larger scale projection applications that require watt level multimode lasers, sources that only a handful of laser companies are capable of producing.

Increasing the output power of red, green and blue lasers from hundred of milliwatts to tens of watts enables colour projection systems to increase the image of the display

Getting lasers into TV...

A major breakthrough in this market has been the launch the first laser-TV by Mitsubishi in early 2008. Widespread adoption of this class of TV has been hampered by its high price tag – although it has fallen since the launch of this product, a whopping 75-inch display based on this technology still retails for \$3500.

Consumers are also enjoying the benefits of severe price erosion in the high-quality end of the large size LCD TV market, and now take it for granted that they can have a screen thickness of just a few centimetres.

This may deter some home cinema lovers from investing in bulky, laser projection TVs that have a thickness of up to 30 cm.

One possible scenario is that laser diodes will find greater deployment in TVs, although not in the way pioneered by Mitsubishi. Instead, they could be used as backlighting for LCD displays, replacing the LED backlit technology that is starting to dominate this market now. Switching to laser-backlit LCD-TV could improve the colour gamut of these displays, and also usher in the ultimate power-lean, 'green' LCD-TV technology.

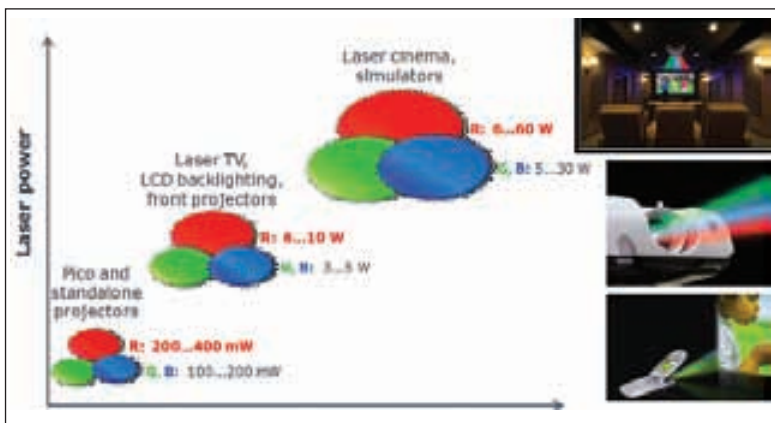
Another market where lasers are starting to be adopted is that of business projectors. Companies such as Casio have released products on this market that combine the emission of a blue laser with a red LED and a green source involving a diode-pumped phosphor. This market, which requires sources with outputs of several Watts, is dominated by consumer-related products. If laser makers are to enjoy commercial success in this arena, they have to produce low-cost lasers with a very high level of performance.

... and onto the big screen

Some of the most impressive projection systems are found in movie theatres, which number more than 115,000 around the globe. These theatres are moving towards new projection technologies that are digital, and in some cases capable of generating three-dimensional images. It will not be long before cinemas also start turning to laser-based projection displays that deliver incredibly bright images with wonderfully realistic hues and tones.

The inferiority of the incumbent lighting technology in cinema projectors, the Xenon lamp, is not restricted to colour temperature. It also has a very low efficiency, making it incredibly power hungry, and it is has to be replaced every 400-500 hours.

These weaknesses have encouraged projector manufacturers to investigate different lighting technologies using prototype laser sources. In



September 2010 Kodak demonstrated a laser-based cinema projector. The Film Distributor's Association has approved this for use in the US. Kodak has decided that it will not manufacture this product in-house, and is planning to license its technology to interested parties. Meanwhile, the Chinese firm Beijing Phoebus Vision has announced that it has developed laser-based cinema projection systems for domestic use. This company showcased a laser projector demonstrator during the opening ceremony of the Beijing Olympics.

Depending on the size of the screen, lasers used for cinema projection must produce between 50 W and 200 W of total power for each colour. Such a high output power is challenging to deliver from a reliable source. That's because it is much more difficult to manufacture visible lasers than their infrared cousins that have a far higher wall plug efficiency and are used in industrial applications.

However, the good news is that in cinemas, lasers are deployed in a controlled environment and do not require a wide operating temperature range and a demanding consumer product design. Instead, these systems can be built in an industrial manner. Currently, key players in cinema projection are planning strategies for this market and designing prototypes.

Tapping into the emerging markets

We believe that we are well placed to make inroads into the emerging market for laser-based displays, and we have already gained traction in the more established market for medical lasers. Our product portfolio spans laser die to turnkey systems, which are all part of the Sparklight product platform. We have also had success with our ChiliLase red laser diode family, a range that goes from 500 mW single-emitter chips to 12 W fiber-coupled laser modules and systems. These products that were launched in 2007 have already won adoption in medical and industrial applications, including 'design-ins' to major OEMs such as PerkinElmer.

In the last few years, our ChiliLase products have attracted the attention of the display market, which places a very high value on reliable, high-power visible lasers. In late 2009 we started supplying 500 mW, 635 nm lasers to Asia for deployment in displays, and last year we shipped more than 5000 Watts of ChiliLase products for this application.

The rapid adoption of these lasers has spurred us to further invest in the development of red lasers for displays. We are particularly keen to target multiWatt (>50 W per color) visible lasers for digital cinema projectors. Such laser systems at visible wavelengths are not commercially available, and we aim to change this, eventually bringing complete laser engines to this market that are based on our Sparklight laser system platform.

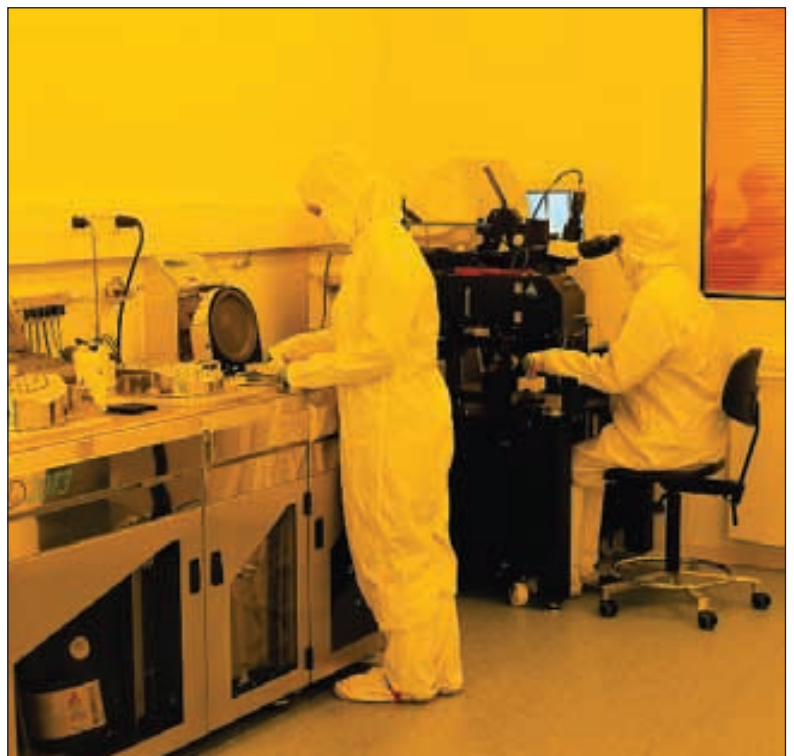


We anticipate that the business opportunity for red laser diode manufacture in cinema projectors will be at least \$50-100 million over the next five-to-seven years. Additional sales for red lasers emitting 1 W or more will come from laser-TV and business-scale projectors and laser shows. Thanks to our in-house chip technology and system integration capability, we believe that we are in an excellent position to capitalize on this opportunity in the coming years. In fact, it would be fair to say that we see our future shining bright in the red dawn of the era of new display applications.

Modulight produces its red lasers in-house

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Modulight's fab in Tampere, Finland





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500 GHz transistors based on GaN ... when and how?

To take nitride transistor speeds to a completely new level, researchers must work with novel designs employing either a new pairing of materials or the unconventional nitrogen-face, argue Dong Seup Lee and Tomas Palacios from Massachusetts Institute of Technology.

GaN transistors are uniquely suited for RF power amplifiers and mixed signal applications, thanks to their unique combination of a large breakdown voltage and a high electron velocity. Researchers have discovered how to exploit these attributes over the last two decades and have managed to build devices with better and better performance figures. The fruits of this labour include class-AB amplifiers operating at 10 GHz with efficiency in excess of 70 percent, and power amplifiers operating in the K_a band (40 GHz) delivering an output power density higher than 10 W/mm.

Although the GaN transistor has come a long way, it still has the potential to operate at far, far higher frequencies, thanks to the very high electron mobility associated with GaN – it is at least three times higher than that for silicon. The great speed that electrons can

zip about in this wide bandgap semiconductor indicates that it should be possible to fabricate devices operating at several hundred gigahertz or more, which would have many practical benefits.

Such devices could, for example, enable wireless communications with unprecedented speed. They could also revolutionize terahertz imaging by unlocking the door to a new generation of body scanners that reduce the threat of terrorism on aircraft, and they could also lead to advanced chemical and biological sensors to ensure the safety of our food and environment. GaN-enabled anti-collision car radar systems could prevent cars from crashing, and efficient point-to-point mm- and sub-mm wave communications would help to eliminate the extensive, complex array of cables and wires that currently connect our computer's peripherals and media centres.

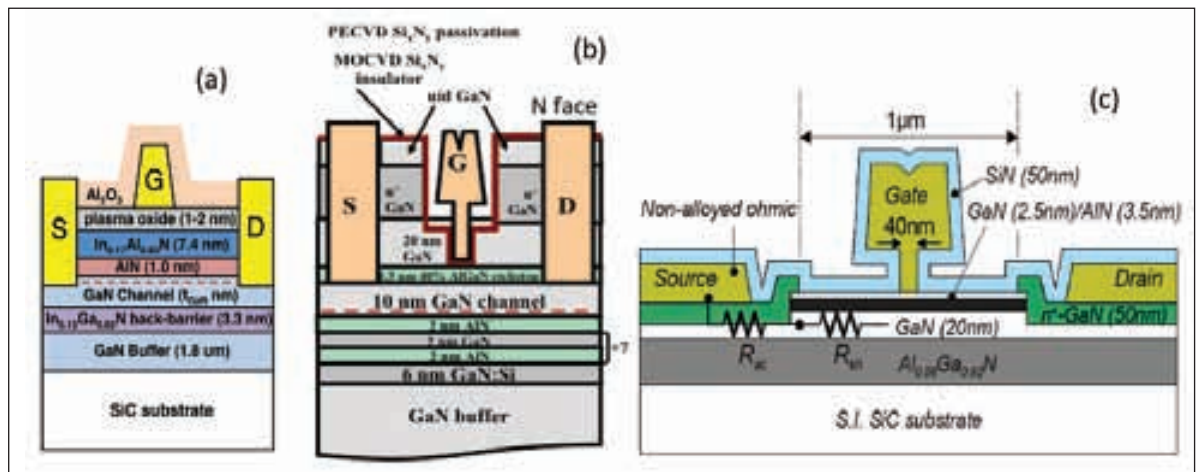


Figure 1. Three different device structures designed for high speeds and fabricated under the sponsorship of the DARPA NEXT program: a state-of-the-art InAlN/GaN transistor fabricated by Tomas Palacios and co-workers at MIT (a); an N-face transistor fabricated at UCSB (b) an AlN/GaN high-speed transistor from HRL (c)

Radical requirements

One of the biggest obstacles facing engineers wanting to fabricate devices operating at unprecedented speeds, such as of 500 GHz or more, is that they cannot work with conventional nitride transistors that employ the pairing of GaN and AlGaIn. Conventional transistor structures require AlGaIn barriers with a thickness in excess of 20 nm to induce a high enough carrier density in the channel. This thickness has a major downside for high speeds: It leads to a relatively large distance between the gate metal and the channel, and ultimately reduces the ability of the gate electrode to efficiently modulate the channel electrons. Gate recesses have been proposed to mitigate this problem, but the damage introduced by the gate recess introduces new challenges.

The good news is that there are three alternative architectures that promise to yield transistors operating at ultra-high frequencies: InAlN/GaN heterostructures, which are being investigated by several research teams, including our group at Massachusetts Institute of Technology; nitrogen-face GaN/AlGaIn devices; and AlN/GaN structures. In all three cases, researchers are reaching higher and higher speeds through aggressive scaling of the dimensions of the transistor in both lateral and vertical directions.

Such efforts are aided by DARPA, which is funding the Nitride Electronic NeXT Generation Technology (NEXT) programme. US agencies have a good track record in helping to advance GaN technology, and through The Office of Naval Research it previously funded the Millimeter-wave Initiative in Nitride Electronics, Multi-University Research Initiative (MINE MURI). Of these three nascent technologies, arguably the most established is the InAlN/GaN heterostructure, which was first proposed by Jan Kuzmik from the Slovak Academy

of Science in 2001.

Transistors made with InAlN and GaN can realize extremely high charge densities, due to the large polarization discontinuity between the InAlN barrier and the GaN channel. However, the benefits of polarization discontinuity are not limited to a reduction in the access resistance of these devices – this architecture also suppresses short-channel effects in deep-submicron transistors. It is also worth noting that this suppression does not require the use of a gate recess process that can introduce plasma damage during the dry etching step.

By taking advantage of these strengths, several groups have been able to attain outstanding results for short-channel InAlN/GaN transistors. Last year a Swiss partnership between ETH-Zurich and EPFL reported a 100-nm gate length InAlN/GaN transistor with a cut-off frequency (f_T) of 144 GHz, and a maximum oscillation frequency (f_{MAX}) of 137 GHz. It did not take long for them to trump that effort and hit an f_T / f_{MAX} of 205 / 191 GHz with a 55-nm gate-length device. More recently, we have set a new benchmark for InAlN/GaN transistors, working in close collaboration with the University of Notre Dame and the companies TriQuint and IQE. Our 30 nm gate length device produces an f_T of 300 GHz, the highest cut-off frequency ever reported for GaN transistors (see Figure 1).

Fabrication of this record-breaking device stemmed from a combination of gate-length scaling and the introduction of novel technologies that were able to squeeze a few more gigahertz from this transistor. These technologies included vertical scaling of the device, which holds the key to reduced short channel effects, and also led to an increase in the modulation efficiency of the gate electrode and higher frequency performance.

Another feature of our transistor is its barrier thickness of only 9 nm, which leads to a significant improvement in the modulation efficiency of the electrons in the GaN channel by the gate electrode. Our device also contains a 3.3 nm InGaN back-barrier structure underneath the GaN channel that helps to mitigate short-channel effects top barrier scaling. And last but by no means least, we have introduced an oxygen plasma treatment step prior to gate metal deposition that increases the frequency of the transistor by at least 30 percent, due to elimination of transconductance dispersion at high frequencies.

Another device that is showing great promise for sub-mm wave applications is the GaN/AlGaIn transistor that has a nitrogen-face GaN structure. This device has several advantages over its conventional equivalent with a gallium-face. One of the biggest benefits results from the formation of the two-dimensional electron gas on top of the AlGaIn layer, which occurs because the polarization in this transistor is inverted compared to the standard Ga-face AlGaIn/GaN/AlGaIn one.

Thanks to this switch in the direction of polarization, a top nitride barrier is not needed – an omission that paves the way to obtaining a very low contact resistance. What's more, the bottom AlGaIn layer that induces the two-dimensional electron gas also leads to excellent channel confinement, a characteristic that enables a high output resistance even in deep-submicron devices. Unlocking the benefits of these nitrogen-face devices has traditionally been very tough, because it is tricky to grow high-quality GaN with a nitrogen-face. But continued efforts in this direction have recently led to substantial improvements in material quality, and researchers at the University of California, Santa Barbara, have reported some excellent results.

That team has produced N-face devices with a 0.7 μm gate with a power-added efficiency of 74 percent at 4 GHz and f_T/f_{MAX} of 15 / 42 GHz. Devices with a 100 nm gate length have shown a maximum f_T of 163 GHz, while the optimization of the gate structure allows an f_{MAX} as high as 310 GHz in transistors with a gate length of 70 nm. These transistors also feature an unalloyed ohmic contact with a contact resistance of just 0.027 ohm-mm, which was formed via InGaIn re-growth. This technology has also been used to produce self-aligned devices.

The third class of novel device – a heterostructure transistor formed from the pairing of AlN and GaN – has also been piquing the interest of the wide bandgap microelectronics community, due to its potential for forming highly scaled transistors. Thanks to a very large polarization discontinuity between the two nitrides, such structures can yield a charge density well in excess of $2 \times 10^{13} \text{ cm}^{-2}$, which in turn leads to a room-temperature sheet resistance of 150-180 ohm/ \square . In addition to this strength, the ultra-thin AlN barriers that are typically used in these devices can significantly mitigate degradation caused by short-channel effects. Devices

More recently, we have set a new benchmark for InAlN/GaN transistors, working in close collaboration with the University of Notre Dame and the companies TriQuint and IQE. Our 30 nm gate length device produces an f_T of 300 GHz, the highest cut-off frequency ever reported for GaN transistors

made from this material system are delivering promising results. Transistors made by a team at the National Institute of Information and Communication Technology in Japan with gate lengths of 250 nm and 60 nm have delivered f_T and f_{MAX} combinations of 52 GHz and 60 GHz, and 107 GHz and 133 GHz, respectively. However, even more impressive results are possible by applying a combination of a re-growth contact and back-barrier structure. Engineers at HRL have pioneered this approach, and produced a 45-nm gate length device with an f_T of 260 GHz and a f_{MAX} of 394 GHz. The latter value is a record for GaN transistors.

The results outlined above showcase the tremendous improvements in all three classes of novel nitride transistor over the last few years. And the race is certainly on to break the 500 GHz barrier, a target that would have seemed far-fetched in the not-to-distant-past. Once that record has been claimed, many will rejoice at the fabrication of transistors that combine speed with great efficiencies and output power levels at mm- and sub-mm wave frequencies that are orders of magnitude higher than what exists today. Hopefully the wait will be a short one.

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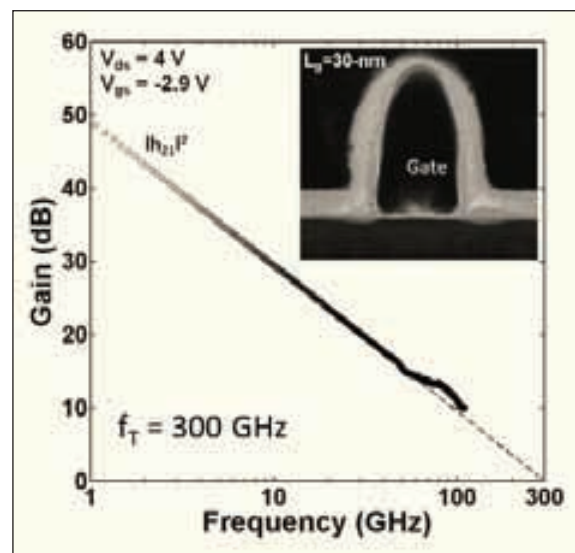


Figure 2: Small signal, high frequency performance of the InAlN/GaN HEMT produced by MIT. The gate length of this transistor is just 30 nm

CPV market starts to gain momentum

Talk of a concentrating photovoltaic (CPV) market that is about to take off will court derision from some quarters, with sceptics arguing that they've heard it all before. But this industry has undoubtedly matured in recent times, and there is very good reason to believe that CPV deployments will rise and rise, offering a great opportunity for makers of triple-junction cells that can fulfil the wishes of their customers. **Richard Stevenson investigates.**

In 2008 it looked like the CPV market was about to head into overdrive. Although projects in this industry, which uses mirrors and lenses to focus light onto triple-junction III-V cells, were typically for deployments of just a few hundred kilowatts, plans were in place to build far, far bigger plants. This included a staggering 154 MW installation in Mildura, Australia.

But a few months later many of these plans were in tatters, including the flagship project in Mildura. By then the credit crunch was wreaking havoc and many chastened investors were unwilling to take the risk of

putting their cash behind a relatively new technology. The fledgling CPV industry was left treading water.

Since then the installed capacity of CPV across the globe has grown modestly – according to the CPV consortium, which represents more than 90 percent of the industry, in 2010 about 8 MW of CPV was installed and generating electricity. This year should be a fair bit better, and even more encouragingly, there is good reason to believe that the rocketing growth predicted at the back end of the last decade can now take place over the next few years.



Evidence for this surge in CPV deployment can be found in the press releases of the leading system manufacturers. “The amount of announcements has been huge, and the traction for CPV is not like it’s ever been before,” says Nancy Hartsoch, Chairman of the CPV Consortium and VP of Marketing at the Californian-based CPV system maker SolFocus. “Before it was push, push, push – now there is pull.”

The raft of recent announcements for CPV deployment includes a 30 MW contract for SolFocus to install 30 MW in San Diego County. Work will start in the last quarter of this year and will be completed by the end of 2012. “What we are excited about [with this project] is that this is being funded by an independent. It’s not someone investing in us – it’s someone investing in the project,” enthuses Hartsoch. “It truly says that CPV at scale is financeable by conventional financing. That’s a big step for CPV.”

The European CPV system manufacturer Soitec has an even bigger project in the pipeline. It has signed power-purchase agreements to supply a total of 305 MW to the San Diego Electricity and Gas company. To deliver, Soitec will build a factory in the US, before installing the CPV Systems between 2013 and 2015. The finance for this venture is in place, because the company recently raised €150 million for its CPV and LED business.

Why now?

The tremendous growth that is expected within the CPV industry comes at a time of weak, precarious financial recovery in the US and Europe. So the success in

winning these power-purchase agreements has not been easy, and is a triumph for CPV system manufacturers, who are now able to make a far stronger case for deployment of this technology than ever before.

One of the biggest reasons why the CPV industry is in far better shape than it was two or three year’s ago is that it now can now provide evidence that this technology can succeed. “If you can show an investor, a bank and an independent engineer that you are able to do a megawatt with a customer, a power-purchase agreement and real market pressure – and set up the plant in time, in-cost, and the plant performs in-spec – that makes the change,” explains Concentrix founder Hansjörg Lerchenmüller, who is now the Senior VP of the Customer Group of the Solar Energy Business Unit at Soitec.

Hartsoch agrees with Lerchenmüller, pointing out that some of the leading CPV system makers now have installations that have been running for up to three years: “Our oldest site is a test site that was put in the ground in late 2007.” At this location the company’s first-generation product, plus subsequent generations, has been put ‘on sun’ and data gathered for four years. In addition to testing under normal operating conditions, engineers subject the cells to very high temperatures to confirm that they can withstand the most extreme conditions and still remain within the operating temperature range of the cells.

Another factor behind today’s positive outlook for CPV is an improvement in product quality. For example, several players have certified their products, and some





SolFocus announced its SF-1136SX CPV system, which has been refined to meet the growing needs of the CPV market. This 15.6 kW system is claimed to output more power per tracker, and it features a streamlined design utilising multi-panel assemblies to cut installation times and costs

have introduced of new generations of modules that have led to a gain of a few percent in efficiency at the system level. CPV's competitiveness has also increased through improvements in the efficiency of triple-junction cells, which are getting cheaper and cheaper. Today they only account for a low-double-digit percentage of the system cost – in the past it was up to 20 percent. According to Hartsoch, the lower costs stem from increased competition: "The market was dominated by one or two guys for a long time. Now there is a lot of pressure." Cell shipments have also gone up, which leads to lower production costs through economies of scale, and there is the promise of far larger orders.

Shifting landscapes

How CPV is installed is also changing. Up until now, quite a few of the CPV projects have been focused on generating electricity for very local consumption. For example, Sol Focus recently completed a 1 MW installation for a pistachio farmer in California's central valley that provides 70 percent of the power for his processing facilities. But from now on, deployments for utilities will account for a higher and higher proportion of CPV system shipments.



These deployments initially targeted the sunny parts of Europe, such as Greece and Spain, where developers could exploit very attractive feed-in tariffs. But those great incentives have now been withdrawn, and the South-West US is the new hotbed for CPV. "If we look at 2011 and 2012, probably about half our market will be the US; maybe a quarter Europe, the Middle-East and Africa; and a quarter the rest of the world," says Hartsoch.

Lerchenmüller offers several reasons why California, in particular, is a very attractive place for deploying CPV systems: a strong demand for summer, daytime electricity due to widespread use of air-conditioning; incredibly sunny sites that are 100 miles or so from areas with a very high population density; and a day-time premium on electricity. Although there are no feed-in tariffs in operation, CPV installations are able to apply for investment tax credits (ITC).

Hartsoch believes that CPV deployments in California have the potential to generate electricity at a cost of 11 or 12 cents per kWhr, even without incentives. And Lerchenmüller agrees, saying that he expects Soitec's near-term projects to produce electricity at a cost of 12-15 cents per kWhr, a figure that should fall to 10-12 cents per kWhr without the ITC in three-to-four-years' time. "That, for me, is really grid parity on a power plant level," says Lerchenmüller. "Below 10 cents is clearly another hurdle." The case for CPV is so strong in the sunny climes of California that it has helped SolFocus to win two or three contracts against two of the biggest names in the PV sector: The trailblazer of CdTe-on-glass panels, First Solar; and SunPower, a massive player in the silicon sector with annual sales of a more than a billion dollars. SolFocus won the contracts, says Hartsoch, because although it had slightly higher capital costs, its system would generate 20 to 30 percent more energy.

She believes that within a few years, CPV systems will be able to start making a stronger impact in 'rest-of-the-world' areas where there are no incentives. In many of these regions, energy prices are currently unpredictable, and a switch to CPV could quash these fluctuations. In addition, this form of power generation could bring electricity to regions that are currently without this valuable resource. "CPV can be a big asset there when you partner with somebody who has the storage equation," says Hartsoch.

Opportunities for cell makers

The big contracts being signed by CPV makers will be greatly welcomed by developers and manufacturers of triple-junction solar cells. Both Hartsoch and Lerchenmüller offer some insights into what these chipmakers must do if they are to be successful, such as excelling in several areas of device performance. "The cells we get today are reliable and proven in space applications. Cell reliability is not a problem today, and

for new entrants in the cell market, reliability is your ticket to entry," says Hartsoch. Decisions by SolFocus on the selection of cell suppliers are heavily influenced by the cost of the device and its performance. "You can have really low cost and lower efficiency, and that's OK, or you can have really high efficiency and high cost, and that's OK. The real issue is how the cost of the cells and the related performance affects the overall cost of energy from the system," says Hartsoch.

Lerchenmüller hold similar views. However, he believes that efficiency is the key metric, arguing that one of the benefits of higher efficiency at the system level is a reduction in the number of cells and modules needed to deliver a given output power. He also thinks that it doesn't necessarily follow that a cell must be more expensive, if it is more efficient.

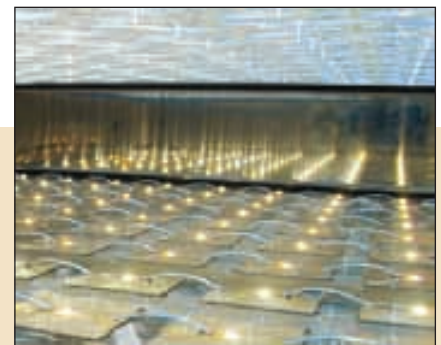
Any company that is trying to win orders with CPV system manufacturers may have to begin with a qualification period, which can take several months. SolFocus and Soitec both have IEC-certified product. So if they are to adopt different cells, they have to build modules with these cells and then send them out to test labs to pass IEC certification. "It can take six months," says Lerchenmüller. CPV system makers will only go with a start-up if it can scale its manufacturing capacity. "This industry is going to grow rapidly," says Hartsoch,

"so you want to partner with the guys that have a technology that can go to volume manufacturing and increase quickly, and investors that are willing to take the companies there." She points out that the capital costs for CPV system makers to build a 100 MW factory can be as low as just 12 cents per Watt, and depend on the CPV system design. "For the cell guys, to increase their capacity, it's a lot of capital investment."

If a start-up increases its capacity, it will then be competing with the incumbents that are unlikely to need any in-house investment to cater for the predicted hike in orders over the next few years. "We have at least four cell manufacturers that are readily available to increase product at the right quality and the right cost," says Lerchenmüller. He explains that these suppliers have a "huge buffer zone" in their manufacturing capacity, which is needed to accommodate the volatility of orders for cells for space applications. It is imperative to hit the deadlines for these aerospace contracts, as the knock-on effects of a delay would be disastrous. "Just converting this overcapacity [into production of cells for CPV] will serve the business for the next two to three years."

Crunch time

The ease at which global triple-junction cell capacity can



that result from a more complex production process.

Modules made by Soitec use just one Fresnel lens made from silicone to focus the sun's rays onto triple-junction cells.

Soitec and SolFocus: Adopting different approaches

The CPV system manufacturers Soitec and SolFocus have adopted different approaches to focusing sunlight onto triple-junction cells: the former uses a single lens, while the latter employs reflecting mirrors.

Soitec prides itself on the simplicity and robustness of its module. Its top part consists of a glass sheet, which underneath it has a 70 μm -thick silicone film that is embossed and includes the Fresnel lens. The bottom section also features a sheet of glass, which is the foundation for mounting metal heat distributors and the III-V cell.

Engineers at the European outfit have extensively tested silicone for its stability under UV radiation. "We started with just normal UV bulbs, and we didn't see anything," says Hansjörg Lerchenmüller, Senior VP of the Customer Group of the

Solar Energy Business Unit at Soitec. So they added more lamps, but were still unable to detect any changes to the silicone. "So we then went down the brute force method and found a guy with a UV laser, and saw the first signs of degradation at UV doses equivalent to something like 3000 years."

The modules that Soitec makes operate at concentrations of 500 suns. This factor could be increased to 800 or even 1000, but higher concentration requires the addition of a secondary focusing element.

According to Lerchenmüller, it is not clear whether savings resulting from using less semiconductor material outweigh the combination of the additional cost of a secondary optical element; reductions in overall efficiency that stem from additional reflections; increased risk to reliability; and lower manufacturing yields

With SolFocus' reflector-based systems, which currently operate at 650 suns, the case for going to higher concentrations is much stronger. Regardless of the focusing technology, increases in concentration pay the penalty of a reduction in the acceptance angle of the incoming light.

However, according to SolFocus, the acceptance angle for its reflective system – which is over 1° for today's modules – is two to four times higher than that for most Fresnel-based equivalents.



CPV is providing power to the City Coachella Water Treatment Facility in Coachella, CA. This allows the city to purchase less power, particularly during the high-value post noon hours, including into the early evening peak period

increase over the next few years will restrict the success of start-ups. "Of those 15-20 start-ups, there will be two or three winners," says Hartsoch, who believes that those that succeed will be those that can win investment, scale up capacity and partner with CPV firms to secure initial business.

"It's an exciting part of the business, with no other technology can you be so flexible at adopting an

advancement as you can with CPV systems."

Lerchenmüller believes that cell producers can gain the edge over their rivals by adopting the mindset of companies operating in the silicon industry. "You have to provide a better product next year at a lower cost – full stop." If companies of any size can take on this attitude and execute of this front, they will stand a far better chance of qualifying product with Soitec.

Meanwhile, SolFocus' bugbear with cell suppliers has been a lack of commercial processes such as outgoing test, but these chipmakers are making progress in this direction. "Historically, because they were cells used in space, 100 percent incoming inspection was standard," explains Hartsoch. One way that some cell start-ups are trying to stand out from the crowd is by developing triple-junction devices with novel architectures that offer spectral tuning.

Lerchenmüller believes that this is an important feature, but does not see a big advantage at site-specific tuning at present, because there is a high degree of similarity in the spectral profile of sunlight at many of the sites where CPV will be deployed over the next few years: "A typical site for large installations is California, in areas that are elevated, but not too highly elevated." He adds that most sites with a high value of direct normal irradiance have a similar spectrum, and says that a choice of cells is only needed once the market has grown substantially to several GWs or more. "We believe that the CPV market, by 2015, can be as high as 1.8 GW." If he's right, the ramp in CPV deployments during the next few years is going to be breathtakingly fast.

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The synergy of Soitec and Concentrix

The French firm Soitec is renowned for its Smart Cut technology that enables the separation of incredibly thin, single-crystal layers from a substrate, which can be used over and over again. This technology promises to deliver major benefits to triple-junction solar cell production, which is the reason behind Soitec's acquisition of Concentrix in late 2009.

One advantage of the Smart Cut approach is that it increases the freedom of choice for the materials in the cell, because these layers do not have to be lattice-matched to one another. The upshot is that compositions can be optimised for spectral absorption and current output, enabling a higher efficiency for the device. It is also possible to use materials with greater purity, which have been formed in ingots rather than epi-chambers.

Soitec is developing its novel technology for triple-junction cells in collaboration with: CEA-Leti, Grenoble, which is focusing on Smart Cut technology; and the Fraunhofer Institute for Solar Energy Systems in Freiburg, Germany, which is concentrating on epitaxy and cell manufacturing. Cell production is scheduled to begin in 2014 or 2015. The cells will only be used internally, and Soitec is yet to decide whether these devices will be produced in-house or with an external partner.

Atom probe unveils electron-induced indium clustering

Indium clustering in InGaN quantum wells stems from electron beam exposure, according to atom probe measurements

THERE is an on-going debate within the nitride community as to whether indium clustering in InGaN quantum wells occurs naturally or is induced by electron beams used to scrutinize the make up of these trenches, which are just a few nanometers thick. Additional, compelling evidence for the latter cause has now emerged from a UK partnership between the University of Cambridge and the University of Oxford.

Researchers at these two institutions have employed a local electrode atom probe to determine the precise locations of indium atoms in two samples featuring multiple InGaN quantum wells. The only difference between these two samples is that, prior to loading them in the atom probe, one has been exposed to electron beam irradiation in a transmission electron microscope for 64 minutes at a current density of 1.1 A cm^{-2} .

Atom probe measurements on these blue-emitting 2.4 nm-thick wells with an indium

fraction of 18 percent reveal that the indium composition in the unexposed sample has a random distribution. In contrast, the sample exposed to the electron beam has compositional inhomogeneities in its indium content.

One of the consequences of previous, flawed observations of indium clustering in quantum wells by electron microscopy has been that it has been used to provide an explanation for the high internal quantum efficiency in blue LEDs, which are riddled with defects.

The conjecture proposed was this: Indium-rich clusters are of high crystalline quality, and thanks to their lower energy, they capture all the electrons injected into the wells, before enabling these carriers to recombine efficiently with holes.

For several years Colin Humphreys, head of the Cambridge effort, has been arguing that indium clustering in quantum wells is a measurement artefact. More recently, his

group has proposed an alternative theory for the high internal quantum efficiency in blue LEDs.

“We’ve been collaborating with colleagues in Manchester to try and model the possible localisation sites based on the atom probe tomography data,” explains corresponding author Rachel Oliver from Cambridge University.

According to her, the results of that modelling suggest that holes are likely to be localised in randomly occurring regions of higher indium content. “In a random alloy, which is what atom probe tomography suggests InGaN to be, the composition varies a lot at the nanoscale.”

The Cambridge-Manchester modelling effort indicates that electrons may be weakly localised at the same sites as the holes, or they may be more strongly localised due to changes in quantum well thickness, which occur due to the roughness of the upper quantum well surface. “Alternatively, the localisation of the holes and the coulomb interaction between electrons and holes may help to localise the electrons,” adds Oliver.

If diffusion of electrons and holes through InGaN quantum wells is limited, it will prevent carriers from reaching the defect sites and ultimately explain why defect-ridden LEDs can operate at high efficiencies.

S. Bennett et al. Appl. Phys. Lett. 99 021906 (2011)

Warsaw propels lasers on ammonothermal substrates to 2.5W

A Polish team’s violet InGaN laser is a good candidate for ultra-high optical power systems like laser projectors, thanks to its combination of high-power operation, good spectral characteristics and differential efficiency.

INGAN laser diode mini-arrays with unprecedented power levels have been grown by the two Polish companies TopGaN and Ammono, working in conjunction with researchers from the Polish academy, Institute of High Pressure Physics Unipress.

The researchers, who are all based in Warsaw, believe that their devices are good candidates for ultra-high power systems like laser projectors, because in addition to high-power operation, these sources have good spectral characteristics and a high differential efficiency.

The team fabricated mini-arrays consisting of three or five emitters processed on a single chip. The optimal performance was achieved for the three emitter array, which attained 2.5 W of optical power at 408-412 nm.

Lasers were grown on low-dislocation density GaN substrates that were made by Ammono’s ammonothermal growth method.

Mini-arrays were employed to avoid the problem of catastrophic optical damage, which appears under high optical power density (around 50 MW/cm^2). Indeed, the

optical power density per facet was limited to only about 25 MW/cm^2 at the maximum output power of 2.5 W.

Threshold current density was 5 kA/cm^2 for all the mini-arrays. The slope efficiency for the devices varied between 0.76 A/W for the three-stripe device, and 0.47 W/A for the five-stripe device.

The emission line-width for the single emitter device was just 0.25 nm.

P. Perlin et al Appl. Phys. Express 4 062103 (2011)

Tiny cylinder-shaped lasers show promise for PICs

Microlasers deliver continuous-wave single-mode-operation at room temperature

CHINESE researchers have connected InAlGaAs/InP cylinder microlasers with a radius of 15 μm using two 2 μm wide output waveguides fabricated by a novel planar technology process. Continuous-wave (CW) electrically injected single-mode-operation is realised at room temperature with side-mode suppression of 32 dB.

Electrically injected directional emission microlasers are potential light sources for photonic integrated circuits. Circular microlasers are most commonly used as whispering-gallery mode (WGM) microlasers. However, the total internal reflection of WGM in circular resonators limits the directional emission from the microlasers. Directional emission circular microlasers have previously been investigated by evanescent-wave coupling or directly connecting with an output waveguide.

Optical memory has also been achieved using InP-based microdisk lasers vertically integrated with a silicon-on-insulator (SOI) waveguide, where two sides of the SOI waveguide work as input and output ports. More recently, researchers fabricated a two-port InGaAsP/InP square resonator microlaser; this emitted light from one cleaved port, and a circular microresonator was predicted to realise multiple-port directional emission based on the coupled modes.

Now scientists based at the Chinese



Figure 1. Microscope image of a cylinder microlaser with two output waveguides cleaved for testing

Academy of Sciences in Beijing are reporting the fabrication of AlGaInAs/InP cylinder microlasers with radius of 15 μm connected with two 2- μm -wide output waveguides. The microlasers have achieved continuous-wave (CW) electrically injecting single-mode-operation at room temperature.

A common edge-emitting AlGaInAs/InP laser wafer, which consists of six compressively strained quantum wells sandwiched between 100 nm AlGaInAs cladding layers, is used to fabricate the cylinder microlasers. The thicknesses of the quantum wells and barrier layers are 6 nm and 9 nm, respectively.

The 15- μm -radius AlGaInAs/InP cylinder microlasers with two 2- μm -wide output waveguides are fabricated by firstly, depositing an 800-nm SiO_2 layer using plasma-enhanced CVD on the laser wafer as a hard mask for dry etching. Then, the circular resonator patterns with the waveguides are transferred onto the SiO_2 layer using standard photolithography and inductively coupled-plasma (ICP) etching techniques, and the laser wafer is etched by about 5.5 μm using ICP technique again with the patterned SiO_2 as hard masks. Ti-Au and Au-Ge-Ni are used as p-contact and n-contact metals, respectively, and the etched sidewalls of the microcylinder are surrounded by insulating SiO_2 layer and p-contact metals.

Figure 1 shows the microscope image of a cylinder microlaser, where the waveguides of the port-a and port-b are normal and with a crossing angle of 45° to the cleaved facet, respectively, and the lengths of the waveguides are 25 μm and 38 μm . Output powers coupled into a multimode fiber are measured and plotted as functions of CW injecting current in Figure 2 at room temperature of 20 °C, where the current kinks at 24 mA and 30 mA for port-a and port-b indicate the domination of the stimulated emission in the corresponding waveguide. The extending lines as shown by dashed lines in Figure 2 have the cross points of 14 mA and 16 mA at the current axis for the output power from port-a and port-b, respectively.

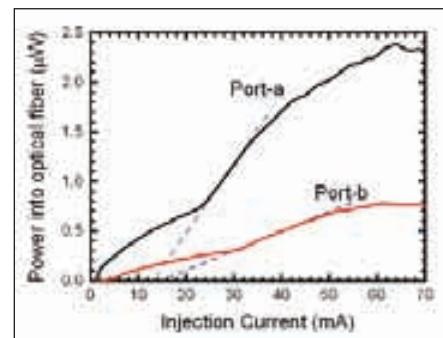


Figure 2. Output power coupled into optical fibre versus the injection current for the cylinder microlaser measured from port-a and port-b

Considering the cross points are corresponding to the threshold current, there are near values of the threshold currents for the two ports. The output power coupled into an optical fiber is 2.0 and 0.67 μW at the injecting current of 50 mA from port-a and port-b, the total internal reflection on the cleaved facet limits the light emission from the port-b. Furthermore, the output power directly measured by butt-coupling a 5 mm-diameter photodetector is larger than 20 μW . So the minor peaks are almost invisible in the laser spectrum of the port-b.

The laser output spectra measured from port-a and port-b are plotted in Figure 3(a) at the injection current of 45 mA. Single mode operation is realised with the lasing wavelength of 1577 nm, and the side mode suppression ratio of 32 dB is obtained from the lasing spectrum of the port-b. The mode wavelength intervals of 7.2~7.6 nm are corresponding to the longitudinal mode intervals of the circular microresonator.

Detailed laser spectra are measured by an optical spectrum analyser with the resolution of 0.067 nm at 25 mA and 25 °C and plotted in the inset of Figure 3(b). The full width at half maximum of 0.087 nm is measured for the resonance peak at 1562.85 nm by fitting a Lorentzian function, and the corresponding mode Q factor of 1.8×10^4 is obtained as the ratio of the peak wavelength to the full width.

Dots bolster their telecom credentials

Quantum dots enable long-wavelength telecom lasers to combine sufficient output with incredibly low noise figures

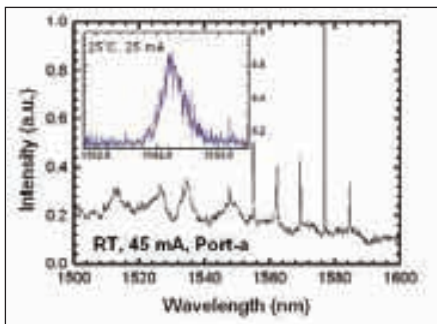
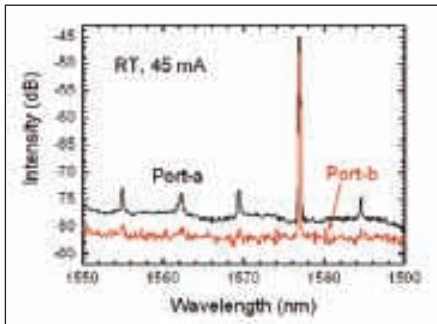


Figure 3 Lasing spectra of the cylinder microlaser at the injection current of 45 mA measured from (a) port-a and port-b, and (b) port-a at room temperature. The inset in (b) is measured at 25 mA and 25 °C.

Compared to the cylinder microlaser with one output waveguide and degenerate lasing modes, the researchers found that the cylinder microlasers with two output waveguides are better in realising single transverse mode operation.

Some of the high Q confined modes in the microcylinder resonator with one waveguide will experience high coupling loss to the second waveguide as adding another waveguide to the resonator, so less high Q modes exist in the microcylinder with two waveguides.

The physicists expect that a multiple-port cylinder microlaser can be a multiple light source in photonic integrated circuits with the output waveguides as light modulators, or two waveguides can form a compact Mach-Zehnder modulator.

J.-D. Lin *et al.* accepted for publication in *Electronics Letters*

ENGINEERS from National Research Council Canada claim to have fabricated the first quantum dot lasers operating at wavelengths longer than 1.5 μm that exceed the 10 mW output power requirement for optical communications.

The team's single-mode laser produces a continuous-wave output of 18.5 mW at 1.52 μm . Although the emission needs to be increased to 1.55 μm before this class of laser can serve telecom networks, lead-author Zhenguo Lu says that this next step is fairly simple. "The grating period is easily changed to obtain operation at 1.55 μm ," says Lu, "and we have demonstrated quantum dot operation over the C- and L-bands through controlling dot size."

Theoretical benefits associated with switching the active region in a laser from quantum wells to quantum dots include a narrower linewidth and superior temperature performance. The team's device fulfils the first of these promises – the linewidth is less than 150 kHz, compared to 2-20 MHz for commercial, distributed feedback (DFB) lasers with quantum-well active regions. However, the quantum dot laser falls short on the second promise. "As of yet, InP-based quantum dot lasers have not shown the dramatic improvements in the characteristic temperature predicted for dot-based lasers," says Lu. "They show values similar or slightly better than quantum well-based devices."



A cross-sectional scanning electron microscope image of the quantum-dot, distributed feedback laser structure showing the five-layer quantum-dot core and the floating grating. Distances (1) and (2) are 117 nm and 119 nm, respectively



Fiber-pigtailed packaged, quantum-dot, distributed feedback laser

Laser fabrication begins with the growth by chemical beam epitaxy of epistructures featuring InAs quantum dots on InP substrates. The undoped active region contains five stacked layers of dots with a density of $4 \times 10^{10} \text{ cm}^{-2}$, sandwiched between 30 nm-thick InGaAsP barriers. After growth of the active core, the wafer is removed to define a grating with a HeCd laser and subsequent chemical etching. Following the formation of this grating with a 236 nm period, MOCVD is employed to add a p-type contact. A single lateral mode, ridge-waveguide laser is formed from the epiwafer with a cavity length of 1 mm and a stripe width of 3 μm .

This device has a threshold current of 48 mA and produces 18.5 mW when driven at 200 mA. Relative intensity noise (RIN) for this laser is -154 to -162 dB/Hz. According to Lu, this compares favourably with both commercial quantum well DFB lasers, which have a RIN of typically -130 to -150 dB/Hz, and commercial quantum-dot-based lasers that are usually specified to have RIN values below -130 dB/Hz.

"The potential is there for high-volume commercial laser fabrication," says Lu, who explains that the quantum dot lasers were made in a commercial foundry using a standard commercial process. "The only difference was the use of a quantum dot core rather than a quantum well, but that makes no difference for the processing." Although chemical beam epitaxy is not widely used in foundries, MOCVD has been used by some groups to make quantum-dot lasers on InP.

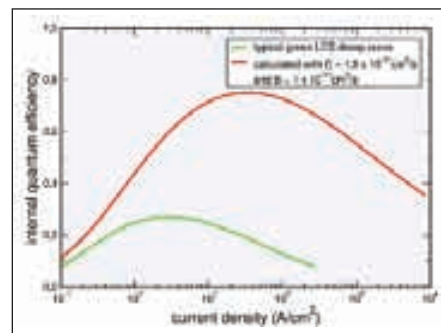
Z. Lu *et al.* *Electron. Lett* 47 818 (2011)

Don't blame Auger for LED droop

Scientists say they have shown that neither direct nor indirect Auger recombination are the primary cause of droop in indium gallium nitride quantum wells.

RESEARCHERS at the Technical University of Braunschweig, Germany, believe that they have pinned down the Auger recombination coefficient C in InGaN quantum well structures. Their value of C , which is $(1.8 \pm 0.2) \times 10^{31} \text{cm}^6/\text{s}$, is lower than previous experimental estimates. The researchers believe that this quantitatively measured Auger

coefficient is likely due to indirect (phonon-or alloy-assisted) Auger processes rather than direct Auger processes. From the small magnitude of the Auger coefficient (in relation to the radiative coefficient), the team, led by Andreas Hangleiter, says they can conclude that neither direct nor indirect Auger recombination is the primary cause



Typical experimental internal quantum efficiency of a green LED compared to calculation based on the new Auger results showing that such a small Auger coefficient can not explain the droop

of droop in InGaN LEDs. Even though Auger recombination does qualitatively produce a droop-like behaviour, it does so only at much higher current densities than those observed in LEDs.

Understanding the cause of droop is important because it limits the current density applicable to LEDs and thus the amount of light that can be generated with a single LED chip. Given the small Auger coefficient found recombination is a minor contribution to droop. Other mechanisms like carrier overflow or defect-related non-radiative recombination need appraisal. Auger recombination also has an impact on laser diodes. It may contribute to the threshold current density and may lead to different design rules for laser diodes.

The results obtained by the team at Braunschweig were based on optical gain spectra of InGaN-based laser structures. Optical gain spectra provide the unique opportunity to determine carrier density. From the dependence of the non-radiative rate on carrier density, the Auger coefficient and the defect recombination coefficient can then be determined. The researchers claim that this is in contrast to other attempts to investigate, where neither the non-radiative rate nor the carrier density are known, but are the result of a fitting procedure based on a very much simplified model.

M. Brendel *et al.* *Appl. Phys. Lett.* **99** 031106 (2011)

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Symposium Highlights

High quality technical papers will be selected from worldwide submissions for oral presentation and publication in the Symposium Digest. Invited papers and panel sessions on topics of current importance to the Compound Semiconductor IC community will complete the program. Extended versions of selected papers from the Symposium will be published in a special issue of the *IEEE Journal of Solid State Circuits*.

Compound Semiconductor Primer Course & Short Course

The Symposium will again offer the popular primer course, "Basics of Compound Semiconductor ICs," which is an introductory-level class intended for those wishing to obtain a broad overview of RFIC and High-Speed Analog-Mixed Signal technology. The Sunday evening course will cover Si/SiGe, GaAs, InP and GaN materials and processes, BJT/HBT, HEMT & FET device operation, and both analog/microwave and digital ICs. The Course will be tailored to provide the specific background needed for participants to understand and appreciate the papers presented in the Symposium Technical Program.

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As in past years, the Symposium will sponsor an exhibition of products from various vendors of materials, IC products, processing equipment, test equipment, CAD tools, and foundry services specifically addressing the Compound Semiconductor industry. Numerous vendors will be on-hand to discuss their products and to answer questions. Inquiries concerning the exhibits should be addressed to: **Jim Carroll**, AWR Corporation, Tel: +1 469-248-5462, Email: jim.carroll@awrcorp.com

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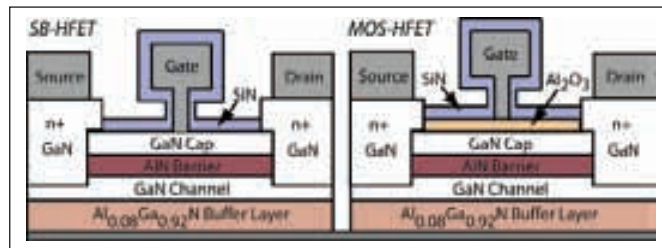
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Sapphire cuts current leakage in high-speed HEMTs

A 2 nm-thick layer of sapphire can drastically reduce the leakage current in high-speed, highly scaled HEMTs

RESEARCHERS from HRL Laboratories in Malibu, CA, have fabricated 40 nm gate-length GaN HEMTs that combine operating speeds of hundreds of gigahertz with incredibly low gate leakage currents.



It is well known that slashing the size of the gate length holds the key to producing GaN transistors operating at really high speeds, which could be used for applications including mm-wave imaging. However, reductions in gate size often come at the expense of a hike in leakage current. To combat higher gate leakage, engineers can insert a dielectric gate material, often SiN, into the device. But the dielectric constant for SiN is only 6-8 – not high enough for deeply scaled HEMTs with a gate length of 40 nm. At these dimensions, the West-coast team has shown that a far better approach is to use a 2 nm-thick layer of sapphire, which has a dielectric constant of 8-10.

These engineers have fabricated transistors containing this layer on 3-inch SiC substrates, and compared their performance to conventional HEMTs (see figure for both device designs). MBE was employed to deposit the device layers, with atomic layer deposition used to add the Al₂O₃ film. These HEMTs included AlGa_xN buffers that provide a back barrier for electrons and deliver two benefits – enhanced carrier confinement and a reduction in short-channel effects.

The novel HEMT had a forward-bias gate current that was more than two orders of magnitude smaller than the conventional equivalent. Although the addition of this sapphire layer reduced the performance of the HEMT in some areas, impact was minimal: Intrinsic transconductance fell from 622 mS/mm to 552 mS/mm; peak drain currents at a gate-source voltage of 2V decreased from 0.9 A/mm to 0.86 A/mm; and values for the cut-off frequency and maximum oscillation frequency reduced from 138 GHz and 286 GHz, respectively, to 134 GHz and 261 GHz, respectively.

Based on the results, the researchers claim that ultra-thin Al₂O₃ gate dielectrics are a promising addition to highly scaled GaN HEMTs.

A. Corrión *et al.* accepted for publication in IEEE Electron Dev. Lett.

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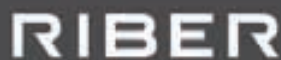


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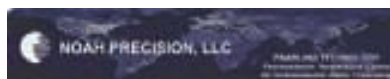
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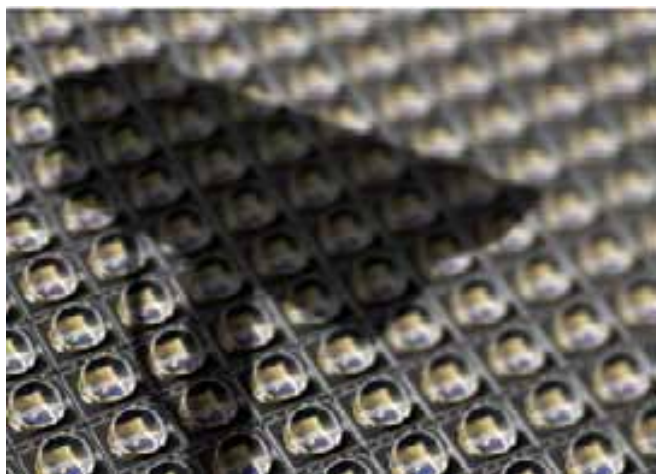
LEDs

Smallest IR LED in the 1-Watt class from Osram

The 850nm gallium arsenide based LED is suited for use in compact illumination units for CMOS and CCD cameras. Possible applications range from spotlights for IR cameras and CCTV systems via machine vision solutions to number plate recognition.

According to Osram Opto Semiconductors its IR OSOLON SFH 4715S is today's smallest infrared LED with more than one Watt optical power.

Measuring only 3.75 x 3.75 mm², the device facilitates very compact illumination units for CMOS and CCD cameras. Osram's nano-stack chip technology and a temperature stable OSOLON Black Series package paved the way for the record-breaking high performance device.



The infrared OSOLON typically provides 1070 mW optical power at 1 A operating current, and it features a typical thermal resistance of only 6.5 K/W. A lens with $\pm 45^\circ$ emission angle is integrated in the device.

Due to this adapted out coupling lens the IR OSOLON delivers 15 percent more output power than components without lens. With a wavelength of 850 nm, the IR OSOLON is particularly well matched with the sensitivity of CMOS and CCD camera sensors. The small package allows compact arrangements which enable a very high power density. Especially 3D cameras benefit from the improved power since

the IR-LED can be modulated up to very high operating currents of 5 A in the range of 10 MHz.

To achieve the "record-breaking" ratio of device size to power, Osram Opto Semiconductors combines its nanostack chip technology with the temperature stable OSOLON Black Series package. The highly efficient stack chips have two *p-n* junctions connected in series and generate nearly twice the optical power of conventional emitters.

The OSOLON Black Series package is based on a metal lead frame, and its thermal expansion matches exactly the thermal behaviour of circuit boards. Thus good cycle stability is achieved, even at heavily fluctuating temperatures as they may, for instance, occur outdoors. In other respects, too, the IR OSOLON complies with the highest quality standards, as for example with the automotive standard AEC-Q101. Together, the latest chip technology and the excellent package properties ensure an operating lifetime of up to 50,000 hours.

The IR OSOLON is fully compatible with its counterpart for the visible spectral range. Manufacturers of street lighting or CCTV systems who combine visible and infrared LEDs can use their experience with OSOLON Black Series LEDs and apply existing designs and board layouts.

With the IR OSOLON, Osram Opto Semiconductors expands its position in the field of infrared illumination and complements its range of products with an additional power class. The new device particularly addresses the security industry. Possible applications range from spotlights for IR cameras and CCTV systems via machine vision solutions to number plate recognition.

For Joerg Heerlein, Marketing Manager for infrared devices with Osram Opto Semiconductors, the IR OSOLON hallmarks the beginning of a new product family: "As our next move we plan a 940 nm version. The longer wavelength reduces the so-called red glow effect: since humans perceive intensive infrared light as a faint red glow, this IR OSOLON is especially tailored for light sources which should not be seen by people."

The infrared OSOLON of Osram Opto Semiconductors is the smallest IR LED in the 1-Watt class. It affords extremely small illumination units for cameras and security systems.

Osram & Samsung LED tug of war hots up

In the latest turn, Samsung LED says this latest infringement action by Osram appears to be an attempt to delay Samsung LED's infringement action against Osram in Korea.

Osram, a unit of the German industrial group Siemens, alleges that Samsung LED and LG have violated patents on LED lighting, which is commonly used in television sets and computer display screens.

In response to Osram's latest legal complaint, Samsung LED Co., Ltd. issued the following statement:

"We are aware of the press release from Osram reporting its legal actions against Samsung LED and Samsung Electronics in South Korea. We have not received the legal documents. However, Samsung LED previously sued Osram in Korea and the United States to stop Osram from infringing Samsung LED patents and to invalidate Osram's patents. Osram's actions in South Korea are a typical and expected response to Samsung's legal actions and appear to be an attempt to delay Samsung LED's infringement action against Osram in Korea."

Last month, Samsung LED filed a complaint with the United States International Trade Commission in which it has requested the ITC to issue an exclusion order barring importation of products of Osram, Osram Opto Semiconductors, and Osram Sylvania Inc. into the United States.

Samsung LED also filed suit for patent infringement in the United States District Court for the District of Delaware to seek damages and a permanent injunction barring Osram's infringement.

Samsung LED alleges infringement of eight patents on core LED technologies. The patented technology is used in a wide range of products, including lighting, automobiles, projectors, cell phone screens, and televisions. Osram's TOPLED, DRAGON, OSLON, CERAMOS, and OSLUX devices, and the products in which they are used, are targets of Samsung LED's complaints.

In June, Samsung LED also filed a patent infringement action against Osram in a Korean court. Samsung LED representatives explained, "Samsung LED is very proud of its innovative LED technology for which it has been awarded many patents around the world. Samsung LED is a market leader in LEDs and is proud to see its LEDs used in many of the leading consumer electronic products worldwide. Samsung LED intends to vigorously enforce its intellectual property rights, and these lawsuits reflect Samsung LED's commitment to that enforcement."

Samsung LED has applied for and registered about 4,000 patents, including 2,000 patents in Korea and 700 patents in the United States.

Elemental LED reduces LED light bulb prices by 45%

The decrease in prices by Elemental LED, which use Cree's indium gallium nitride LEDs, signals that the company is positioning itself as a viable competitor to big box retailers.

Elemental LED, a San Francisco Bay Area-based LED lighting company, recently cut prices on its popular Tess Bulbs, the LED Replacement Bulbs with a standard e26/27 screw-in base and cutting-edge Cree LED chips.

The LED lighting retailer has cut prices on three screw-in LED light bulbs by up to 45%, which it says signals a similar trend throughout the industry.



The Tess LED Replacement Light Bulb

6W Tess Bulbs, a replacement for standard incandescent 30W bulbs, were \$29.99 and are

now \$17.99. 7W Tess Bulbs, equivalent to 40W incandescent bulbs, were \$34.99 and are now \$19.99. 9W Tess Bulbs, a 60W replacement, were \$39.99 and are now \$21.99.

Elemental LED introduced the Tess Bulb to its catalogue last year as a top-of-the-line product with significant improvements in function and light quality to that of its LED replacement light bulb predecessors. Tess Bulbs are UL listed and feature Cree LED chips, top-rated for their brightness and energy-efficiency. According to Cree, "Cree LEDs combine highly efficient InGaN materials with proprietary G•SIC substrates to deliver superior price/performance for high-intensity LEDs."

The prices of LED light bulbs and fixtures are decreasing dramatically throughout the industry, making them an economically viable option for consumers. The price decrease follows similar trends of other consumer electronic products, for which a gradual increase in demand and consumption leads to a dramatic lowering of prices.

Features of the Tess LED Light Bulb include no flickering or humming, a durable housing that is difficult to break, no warm-up time required, and no mercury. Containment of toxic mercury, flickering, humming, fragility and slow warm-up are all well documented problems with CFLs. The Tess Bulb lasts for 50,000 hours, 10 to 50 times longer than a standard incandescent bulb or CFL, and uses 20% as much energy as an incandescent bulb.

The Tess Bulb is available in a warm white colour temperature, which creates an inviting, smooth, even light for indoor living spaces. It is also available in neutral white, which works well against metal and cool colour tones or outdoors.

The decrease in prices by Elemental LED signals that the company is positioning itself as a viable competitor to big box retailers. "We are top of the market when it comes to quality and customer service," says Director of Business Development Matthew John, "In the past some of our competitors have beat us in terms of price, but that is quickly changing."

Osram to sue LG and Samsung

The firm wants an export ban against LG LED products out of Korea. The LED giant has also filed nullity suits and infringement actions against LG and Samsung, in particular for what it says is patent infringement on its white light LED technology.

Osram and Osram Opto Semiconductors have filed a complaint against LG Innotek with the Korea Trade Commission (KTC).

Osram has also filed nullity suits and infringement actions against patents and companies of LG Group and Samsung in Korea. Osram is convinced that these companies are infringing core patents of Osram in Korea. LG and Samsung have already filed the respective claims in Korea in June this year.

"We respect the property rights of other companies and expect the same from other market participants. Our most important competitors have acknowledged our patents by entering into cross-license agreements with us or paying royalties," stated Aldo Kamper, CEO of Osram Opto Semi. "That is why we are setting a clear signal with our actions in Korea, not least for our customers, for whom we are a reliable partner."

In the filing with the KTC, Osram alleges that LG Innotek infringes four LED patents for generating white light. Such LEDs are used for instance in display backlighting for modern TV sets and computer monitors. Osram is requesting the KTC to issue an order banning the exports of certain LG LED products from Korea that are manufactured using patented Osram core technology.

In its infringement actions with the Seoul Central District Court, Osram stresses that LG Group and Samsung companies are infringing Osram's patents on white and surface mountable LEDs in Korea and is therefore requesting these companies to refrain from the unauthorised use of Osram technology. What's more, Osram is claiming damage compensation and has filed nullity suits against patents that both companies asserted against Osram. Osram says these patents are null and void.

In June 2011, Osram sued LG Group and Samsung

for infringing patents and filed lawsuits in the USA and Germany. Osram also filed infringement lawsuits against LG Group companies in Japan and China, where Osram requests for injunctive relief and damage compensation. In the USA (ITC) Osram also filed for an import ban.

China's LED industry lights up to nearly \$6 billion in 2011

Street lighting will be the biggest segment, reaching \$1.5 billion this year and anticipated to hit \$1.8 billion in 2012.

Buoyed by government support and increased penetration into new applications, China's LED market will jump to \$5.8 billion in 2011, up a robust 23 percent from \$4.7 billion last year, according to the IHS iSuppli China Electronics Supply Chain Service from information and analysis provider IHS.

The LED market in the world's most populous country is forecast to reach \$6.9 billion next year on its way to \$11.1 billion by 2015, equivalent to a five-year compound annual growth rate of 17.7 percent, as shown in the figure below.

"Driven by markets including backlights for liquid crystal display (LCD) TVs and street lighting, LEDs have become a hot item for manufacturing in China and also an attractive investment segment in the country," said Vincent Gu, senior analyst for China electronics research at IHS. "Moreover, official government commitments to the industry appear to be paying off dividends."

Exceedingly broad, the Chinese LED market covers a range of applications including LED displays, traffic signals, automotive use, LCD backlighting, handset key pads, digital still camera flashlights, decorative lighting, street lighting and general illumination.

Street lighting will be the biggest segment, reaching \$1.5 billion this year and anticipated to hit \$1.8 billion in 2012. The LCD backlighting market is also headed for strong growth on the strength of the rapid adoption of LEDs for large-sized LCD TVs and laptops, generating \$1.8 billion in 2015, up from \$713 million this year.

A new demand driver for LEDs in the medium to the long term will be the general lighting market.

Given the global trend to reduce carbon emissions, China demand in the general lighting segment will be strong for LEDs, which offer low-power consumption and are environmentally safe. LED shipments for general lighting will make up 15.5 percent of the total LED market this year, IHS data shows.

Despite the current popularity of LEDs in China, the domestic LED industry is still in its infancy compared to its counterpart in thriving LED-focused countries such as the United States and Taiwan.

Some reasons why China trails in the field include lagging technological capabilities currently available in the country as well as a paucity of adequately experienced management teams and R&D engineers to lead the way. Furthermore, the lack of Chinese intellectual property in core and upriver segments, such as in LED wafers, is a serious concern.

Still, China's LED players enjoy ample funding from local and government sources, which should help domestic entities capture the large Chinese end demand for LEDs in the future. To date, local governments in China subsidise at least 70 percent of the purchase price for MOCVD equipment employed in LED manufacturing, a percentage translating into some \$1.5 million for each machine. Furthermore, tax and utility payment benefits are offered to encourage investments in the domestic LED industry, proving to be an additional boon for local players.

Rubicon upgrades its sapphire furnaces

The firm's ES2-XLG3.0 tool is claimed to boast significant quality innovations that optimise yield and efficiency during the crystal growth process.

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, semiconductor, and optical industry has completed a company-wide installation of enhancements to its proprietary crystal growth furnaces bringing all furnaces up to Rubicon Furnace Version ES2-

XLG3.0.

This is the latest version of the company's proprietary furnace design for the production of high quality, large diameter sapphire material and provides even greater automation and yield consistency.

Over time, the company's Design for High Volume Manufacturing approach has led to numerous furnace design improvements that have created an industry-leading equipment platform for high volume sapphire crystal growth. Rubicon Furnace Version ES2-XLG3.0 provides even greater automation resulting in additional yield improvements. The ES2-XLG3.0 encompasses numerous innovations and now operates in Rubicon's United States high-efficiency crystal growth facilities in Batavia and Bensenville, Illinois.

"Compared to the production of other substrate materials, sapphire crystal growth is extremely complex," explains Raja Parvez, Rubicon President and CEO. "Variables such as stable power, growth profiles, cooling profiles and feedback control mechanisms must be optimally managed to maximize the yield of quality sapphire crystal. This is even more vital when producing sapphire for the expanding large diameter wafer market. With hundreds of years of combined experience and innovations such as those embedded in the Rubicon Furnace Version ES2-XLG3.0, Rubicon's design and equipment engineers and material scientists have achieved industry leading yields and performance."

The Rubicon furnace design is just one component of the company's efficient equipment platform that has differentiated the company in the large diameter sapphire wafer market. This effort, combined with Rubicon's robust process platforms and the company's ability to scale to high volume, creates superior performance factors for the LED industry. With the Batavia crystal growth facility qualified with more than a dozen customers and the Malaysia polishing facility now also qualified, Rubicon has successfully shipped more than 100,000 six inch sapphire wafers.

Market research firm iSuppli expects the global LED market to double to nearly \$14.3bn by 2013, driven by the penetration of LEDs into the general illumination market including light bulbs. LEDs

are a popular option for backlighting screens from HDTVs, traffic lights and large displays as well as in a broad range of popular consumer devices including tablets, notebooks, laptops, mobile phones, navigation devices, digital music players, digital photo frames, digital cameras and keypads. LED use in general lighting applications is also increasing significantly, particularly in applications like street lighting, industrial lighting and architectural 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.

Cree acquires Ruud Lighting for \$525 million

The addition of Ruud's BetaLED product line will strengthen Cree's position in gallium nitride based LED lighting and components.

The combination of two highly complementary LED innovators, Cree and Ruud Lighting should extend increasing the adoption of energy-efficient LED lighting. The companies have a shared focus on best-in-class LED-based systems which has led to thousands of LED lighting installations over the past several years.

Other synergies include increased access to the lighting market through expanded sales channels and operating leverage from increased economies of scale. Through a broader presence in the lighting systems market, Cree will gain additional knowledge and expertise to develop the next generation of industry-leading, lighting-class LED components.

"Cree is taking another bold step in leading the LED lighting revolution, creating a company that has an unrivalled focus and commitment to driving LED lighting adoption," said Chuck Swoboda, chairman and chief executive officer of Cree.

"Joining Cree was the right thing to do so Ruud Lighting can build on our leadership position; as leaders we create opportunities for everyone," said Alan Ruud, chairman and chief executive officer of Ruud Lighting.

Ruud Lighting will continue to be based in Racine, Wisconsin, and will operate as a subsidiary as part of Cree's lighting business. Additionally, Alan Ruud has joined the Cree board. Ruud Lighting, through its BetaLED product line, was one of the first traditional lighting companies to transform the majority of its business to LED-based systems.

Cree has acquired all of the outstanding stock of Ruud Lighting for an estimated net cost of approximately \$525 million, comprised of \$372 million in cash, \$211 million in stock (valued at market closing price of \$34.74/share), \$85 million paid concurrently with the acquisition to retire outstanding debt, offset by tax benefits noted below.

The stock portion is comprised of 6,074,833 Cree shares. The acquisition was structured for tax purposes as a deemed asset purchase, which means the cost to Cree will be offset by approximately \$143 million of expected future tax benefits related to the acquisition.

Ruud Lighting's financial and operating results will be consolidated for the balance of Cree's first quarter of fiscal 2012 and Cree is revising its targets for this quarter. These revised targets include approximately 40% of a full quarter's results from Ruud Lighting. Cree now targets revenue in a range of \$265 to \$275 million with GAAP gross margin of approximately 37% to 38%.

GAAP operating expenses are now targeted to increase by approximately \$13 million from the previous quarter to \$88 million. The tax rate for the first quarter is now targeted at 21.5%. GAAP net income, which includes expenses related to the transaction, is targeted at \$9 million to \$12 million, or \$0.08 to \$0.11 per diluted share.

Cree targets this transaction to be slightly dilutive to GAAP earnings for the balance of fiscal 2012 and the GAAP earnings per share target is based on an estimated 112.9 million diluted shares outstanding.

LED manufacturers integrate functions in new products

Strategy Analytics says that LED manufacturers are improving market penetration by increasing the functionality of their products and making them easier for consumers to use.

To increase ease of use and functionality for consumers, LED manufacturers are developing products that integrate functions like multiple diodes for higher output, ballasts, drivers, voltage converters and interfaces for dimmers.

The recently published Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) viewpoint, "Compound Semiconductor Industry Review May 2011: Optoelectronics, Materials and Equipment," captures the product, technology, contract and financial announcements for companies such as Aixtron, Riber, Cree, Philips Lumileds, GigOptix, Emcore, Opnext, JDSU, Oclaro and GT Solar for May 2011.

"LEDs are proving to be a more energy efficient alternative for a growing number of lighting applications," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service. "LED manufacturers are improving market penetration by increasing the functionality of their products and making them easier for consumers to use."

Asif Anwar, Director in the Strategy Analytics Strategic Technologies Practice added, "There is strong activity at all levels of the optoelectronics supply chain, from the companies that make processing equipment, to manufacturers of LEDs, laser diodes and optoelectronic devices to photovoltaic component and equipment manufacturers."

This viewpoint summarises May 2011 financial, product, contract and employment announcements from major optoelectronic material, device and equipment suppliers. It categorises these announcements by material and equipment, laser, LED and compound photovoltaic activity.

China makes LED investments coming and going

Gallium nitride epitaxial wafer production capacity in China will grow over 300% in just 2 years (2010-2012).

SEMI has released its China LED Fab Industry Report, summarising China's rapidly growing LED industry. It discusses capital and equipment spending, fab capacity and sales rankings of Chinese LED manufacturers.

Subsidies for China fab projects are included, along with new LED fab projects, names of China's sapphire wafer suppliers, and company profiles of China's top LED manufacturers.

China has developed a government support infrastructure for LED manufacturing and consumption. China is the world's leading consumer of solid state lighting and the leading producer of LCD TVs (the main driver for HB-LED consumption).

LED production investments have rapidly escalated in China. Last year, SEMI recorded explosive growth on equipment spending from LED fabs globally, jumping from \$606 million in 2009 to \$1.78 billion in 2010. GaN epitaxial wafer production capacity in China will grow over 300% in just 2 years (2010-2012), hitting 1,282,000 wafers per month (2" equivalents).

Regional equipment spending shows an aggressive investment trend from China. Propped up by subsidy programs from local governments in China, new LED fab projects have blossomed in the past two years in China. China now accounts for almost 50% of overall equipment spending.

MOCVD tool installations are growing from a cumulative total 323 tools in 2010 to over 1000 tools by the end 2012. 10 new sapphire substrate projects are beginning in China to catch up with the production rise and non-Chinese supplier bases.

SEMI says LEDs could go from a \$10 billion (2010) industry to over \$100 billion worldwide by 2020.

The China LED Fab Industry Report covers LED wafer and sapphire substrate manufacturing projects, government incentive programs, MOCVD tool forecasts, and emerging China-based manufacturing. The report is prepared by SEMI China-based market analysts and is based on the SEMI Opto/LED Fab Watch and Forecast service that monitors LED capital spending at over 160 fabs worldwide, and other sources.

Bridgelux takes its silicon-based LEDs to new highs

The performance gap between conventional LEDs and those built on silicon is closing fast thanks to the efforts of Bridgelux

Bridgelux, the trailblazer of white LEDs grown on 200 mm silicon, has recently made tremendous progress in improving device efficacy.

1.5 mm by 1.5 mm cool-white LEDs produced in the labs of the Californian outfit can now deliver 160 lm/W at 350 mA, a gain of 25 lm/W compared to the company's best devices reported this March. What's more, warm-white LEDs of the same size show an even bigger improvement at the same drive current – efficacy is now 125 lm/W, compared to 85 lm/W five months ago.

"The performance levels that we have announced are the highest lumen-per-Watt values yet published for GaN-on-silicon, and rival the best commercial LEDs grown on sapphire or silicon carbide," claims Steve Lester, chief technology officer for Bridgelux.

Although the company is not giving much away regarding the secrets of its recent success, vice-president of marketing, Jason Posselt, told *Compoundsemiconductor.net* that improvements in the epitaxial process have helped to deliver gains in efficacy.

"We are no longer taking a sapphire recipe and trying to figure out how to grow it on silicon," says Posselt. "We're optimising for the silicon wafer process." Some slight changes to packaging also led to efficacy improvements.

Thanks in part to these efforts, that latest blue LEDs - which are the foundation of making white emitters

- have a forward voltage of just 2.85 V at 350 mA . “The bandgap to emit light is around 2.75 V,” says Long Yang, Vice-President of Chip Technology, “[So we are] we are only about 0.1 V above the bandgap.”

Driven at 350 mA, these blue LEDs deliver 591 mW at a wall-plug efficiency of 59 percent, and when the current is cranked up to 1 A, they produce 1.52 W at a wall plug efficiency of 47 percent. Although this indicates that the devices do suffer from LED droop, the decline in efficiency as current is increased may not be as high as it is for sapphire-based devices.

Other details of Bridgelux’s white LEDs made from these blue-emitting chips include a colour temperature of 4350K for the 160 lm/W, cool-white LED, and a colour temperature of 2940K and a colour rendering index of 80 for the 125 lm/W, warm-white emitter.

In terms of where Bridgelux’s technology stands today, the efficacy of these LEDs exceeds the company’s next-generation of warm-white LEDs on sapphire, which will deliver 120 lm/W and be released within the next 12 months. “We are seeing equivalent to - and some cases even better performance now – on silicon compared to sapphire,” says Posselt.

A substantial reduction in manufacturing cost is Bridgelux’s primary motivation for developing LEDs on silicon. The company believes switching substrates could reduce costs by up to 75 percent. The benefit of silicon is not just a cheaper substrate – processing is also far less expensive, because the epiwafers can be churned into chips at under-utilised high-throughput 200 mm fabs.

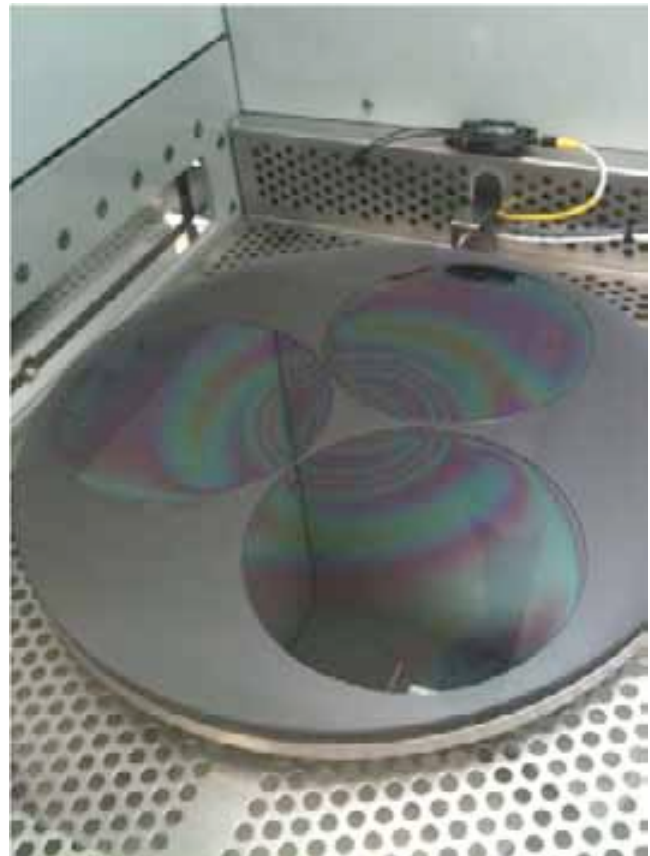
In order to tap in to this spare fab capacity, Bridgelux has to ship incredibly flat wafers to these processing partners – the bow cannot exceed 60 microns. Realising this is a challenge, because there are considerable differences in both the thermal expansion and the lattice constant of silicon and the III-Ns. To eliminate stress in the wafers, the company has developed a proprietary buffer layer.

One of the company’s latest goals is to improve the peak emission wavelength uniformity of its wafers. Engineers have fabricated wafers with a wavelength uniformity, in terms of the standard deviation, of 6.8 nm. “Our target is 3 nanometers,” says Yang.

The number of LEDs that the company is making in its R&D labs is rising fast. “Now we make these LEDs in thousands; a few months ago we made them in hundreds,” says Yang

Sampling of products will follow, but potential customers should not expect to get their hands on Bridgelux’s silicon-based LEDs in the next month or so. “We are building prototypes of products, but this is not a tomorrow technology,” says Posselt.

According to Yang, pilot production of the GaN-on-silicon LEDs should begin within a year. Once any processing issues related to this are ironed out, Bridgelux will invest in capital equipment for the growth of the wafers in high volume. According to the company, large-scale commercial production is still two years’ away.





Cree, Osram, Philips and DOE to headline LEDs 2011

The LED giants will present at the 12th annual conference which takes place on October 24-26 in San Diego, California.

Hundreds of lighting professionals will gather at the 12th instalment of IntertechPira's industry leading LEDs conference and exhibition to hear from Cree, Osram, Philips and more.

"LEDs 2011 : Bringing Lighting to Life" will be held at the Hilton San Diego Resort & Spa from October 24-26, 2011 in San Diego, California, US and will provide coverage of the latest technology, applications and end uses, lighting design and luminaires and market expectations and analysis most relevant to the LEDs and lighting sectors.

"To ensure that our attendees – whether they are new to the industry or come with years of experience – receive the industry connections and insights into technology advances and emerging markets they need to succeed is our primary goal for LEDs 2011," said Patricia Kinzer, head of US events for IntertechPira.

"This year's delegates will have the opportunity to learn from the standard bearers of the industry like Cree, Osram, Nichia and Philips, as well as the key fixture manufacturers like Acuity Brands, BETALED/RUUD Lighting, and Nexxus Lighting. Bringing together R&D personnel, investors and executives, LEDs 2011 is the must-attend event of the year for the LED and lighting sector," she continued.

This year's program will focus on the reliability of LEDs in systems and its adoption in general lighting. Topics that will be covered at this year's conference include designing for reliability; prospects for LEDs in emerging markets, including Brazil; and future directions for research and development.

Organisations presenting at LEDs 2011 include ABILUX (Brazilian Lighting Industry Association), Acuity Brands Lighting, ASBAI (Brazilian Association for Architectural Lighting Designers), BetaLED, Cree, Excelitas LED Solutions, IMS Research, Inventronics, Lithonia Lighting, Lighting Science Group, MSi, Nexxus Lighting, Nichia, Osram Sylvania, Osram Opto Semiconductors, Philips Lumileds Lighting, Switch Lighting and the U.S. Department of Energy.

The exhibition area will feature the latest in technology and LED applications. Free passes to the exhibits are available.

GLG illuminates Australia and NZ with Illumitex LEDs

Gerard Lighting Group is also investing \$3 million in Illumitex as part of the LED company's latest round of private equity funding.

Illumitex, a developer of industry-shifting high-brightness LEDs and emerging LED technologies, has signed a Strategic Alliance Agreement with Gerard Lighting Group Limited, one of the largest lighting manufacturers and distributors in Australia and New Zealand.

In addition, GLG has invested \$3 million into Illumitex for a small minority interest as part of the LED company's latest round of private equity financing.

Under the strategic agreement, effective immediately, GLG will become the exclusive general lighting integrator and distributor of Illumitex's innovative LED products in Australia, New Zealand and the Pacific Islands.

"Gerard Lighting's commitment to our technology and enterprise provides an extraordinary opportunity for Illumitex to grow and be recognised

as an industry leader,” said Matt Thomas, CEO of Illumitex. “We are gearing up for a strong entry into the Australian market and look forward to a productive and long-term strategic alliance with GLG.”

GLG Managing Director Simon Gerard said, “The strategic alliance with Illumitex is consistent with our approach of working with the world’s best suppliers of lighting components, in this case an innovative light source that can be integrated with many of our existing and future luminaires.”

“Additionally, our investment in Illumitex will provide Gerard Lighting with a direct link to the company’s growth and provide Illumitex with additional capital to continue developing their unique technologies.”

Illumitex claims to have transformed traditional LED design and greatly increased functionality with the creation of an LED package that emits light in a uniform, highly-precise beam directly from the source, increasing lighting efficiency and eliminating the need for secondary optics to control the angles of emitted light beams. GLG will incorporate Illumitex’s technology and components into a number of its LED lighting products, enhancing the range of high-end lighting solutions available to its customers.

Mouser to distribute Cree products worldwide

For design engineers and manufacturers, this means faster access to Cree’s LED lighting solutions and silicon carbide power products on a global basis.

Mouser Electronics, a design engineering resource and global distributor for semiconductors and electronic components, has signed a global distribution agreement with giant Cree, a provider of LED lighting and SiC power products.

The global agreement enables lighting designers worldwide to quickly find, compare, select, and order Cree’s latest products, including their innovative line of lighting-class XLamp LEDs, high brightness LEDs, LED modules, and power products.

Cree LED components and solutions are driving improvements worldwide in applications such as general lighting, electronic signs and signals. Cree also is among the world’s leading manufacturers of SiC-based diodes for power control and management, providing increased efficiency in a variety of applications from solar inverters to industrial motor drivers to wireless technologies.

Cree gains access to Mouser’s highly-successful design engineering marketing programs and to Mouser’s state-of-the-art fulfilment operations. The award-winning distributor offers 17 customer support locations across multiple continents with 42 country websites. Mouser’s Product Knowledge Centres and application guidance tools will give lighting designers easy access to view Cree’s product advantages, technical specifications and data sheets.

“Cree is a progressive company known for top-of-the-line innovations in the LED industry and we are pleased to align with them,” says Russell Rasor, Mouser’s vice-president of advanced technology. “For design engineers and manufacturers, this means faster access to Cree’s LED lighting solutions and SiC power products on a global basis.”

“With the distribution might of Mouser behind our products, our customers will not only have worldwide access to our products, but will also have the search and comparison resources available through Mouser’s award-winning online catalogues and websites,” says Mark Despotos, Cree vice president of global channels. “The service and support Mouser offers as an authorised worldwide distributor is invaluable to us and to our customers.”

The agreement reinforces Mouser’s commitment to support new solid-state lighting designs by offering a comprehensive line-up of Cree LED components. In support of Cree’s products, Mouser says it will provide engineers with the most innovative optical and mechanical products along with IC-based LED drivers from key suppliers such as Texas Instruments, On Semiconductor, STMicroelectronics and Maxim Integrated Products. This strategically positions Mouser, the design-fulfilment distributor, to deliver advanced lighting technology components to enable a successful new design project.

Sapphire supplier GT Solar changes name

The company says its new name GT Advanced Technologies is now more closely aligned with its strategic vision and provides a new platform for it to grow and strengthen its global brand in markets such as LEDs

GT Advanced Technologies Inc. has announced the name change from GT Solar to its new name, GT Advanced Technologies Inc., is now complete.

As part of the rebranding and new corporate identity, the company is now trading under its new GTAT stock ticker symbol on NASDAQ.

“Our transition from GT Solar to GT Advanced Technologies reflects our broader strategic market focus,” said Tom Gutierrez, GT Advanced Technologies’ president and CEO. “We are growing beyond our historic focus on the solar industry to include other growth markets such as the LED industry. We also continue to look for strategic expansion opportunities into other adjacent markets that leverage our core competencies in crystal growth technology and the commercialisation of equipment that drives the growth of new industries. Our name is now more closely aligned with our strategic vision and provides a new platform for us to grow and strengthen our global brand.”

In July 2010, the company entered the fast-growing LED market through its acquisition of Crystal Systems, a pioneer in the field of crystallising sapphire material for a wide range of industries. GT is both a producer of sapphire material as well as a supplier of Advanced Sapphire Furnaces (ASF) which it sells to companies that produce sapphire material. Since the company introduced its ASF in December of 2010, it has booked nearly \$1 billion in orders, quickly establishing itself as a leading provider of sapphire crystal growth equipment.

Lumiled’s expands colour portfolio

The firm’s new deep red colour LED with a wavelength of 650-670 nanometres supports horticulture, signaling and entertainment

applications.

Demand for coloured LEDs is on the rise and Philips Lumiled’s LUXEON Rebel colour portfolio is increasing with new colours being added to the family.

‘Deep Red’, the most recent colour added to the portfolio, delivers light in the 650-670 nm range. This wavelength range is essential for horticultural applications and is required by some governments around the world for applications like road and railway signaling.



Guangzhou TV Tower

LUXEON Rebel Colours and Specifications

Wavelength (nm)	Colour	Light Output
650-670	Deep Red	720 mW
620-645	Red	53 lm
610-620	Red-Orange	72 lm
584.5-597	Amber	61 lm
588-592	PC Amber	91 lm
520-550	Green	102 lm
490-520	Cyan	83 lm
460-490	Blue	41 lm
440-460	Royal Blue	1120 mW

All colours at 350 mA except royal blue and deep red at 700 mA

“We are committed to the continuous improvement of our colour portfolio and have delivered substantial light output increases,” said Steve Barlow, Sr. VP of Sales and Marketing. “For more than a decade, LUXEON LEDs have been the first choice for enlivening city centres and architectural wonders, bringing drama to concerts and performances, and ensuring people can move

safely on our public transit systems.”

The drive for improved energy efficiency and the desire to deliver better lighting solutions is as strong today for colored applications as it is for white light applications. Lumileds says its LUXEON portfolio provides designers with a more sustainable lighting component and new creative license to show the world what LED light can do.

Cree reveals new Royal Blue LED and patent licensing program

The firm has optimised the XLamp LED system design to lower system costs. Cree is also offering lighting-fixture companies access to its remote-phosphor patents to drive the LED lighting revolution forward.

Cree, an innovator in LED lighting, has announced the commercial availability of a new XLamp XT-E Royal Blue LED.

The module is optimised for use in remote-phosphor lighting and other applications with similar requirements.



XLamp XT-E Royal Blue LED

Cree says its new XLamp XT-E LED delivers the industry's tightest wavelength bins combined with category-leading brightness to simplify remote-phosphor designs and lower system costs.

In addition, Cree is announcing a remote-phosphor-component patent licensing program that provides access to Cree's pioneering remote-phosphor patents. The program is designed to drive the LED lighting revolution by enabling lighting-fixture companies to develop and introduce their own high-quality LED system products using LEDs such as the XLamp XT-E Royal Blue.

With a license under the new program, lighting OEMs can gain access to a number of fundamental Cree patents required to manufacture and use the combination of a remote-phosphor optical element with blue LEDs in LED lighting applications.

“Customers using remote-phosphor designs for their lighting products need both high output and consistent color,” said Mike Watson, Cree senior director of marketing, LED components. “The new Cree XLamp XT-E Royal Blue LED outperforms the competition in both elements enabling our customers to design high-performance and low-cost systems.”

Built using Cree's Direct Attach LED technology that delivers higher flux, lower forward voltage and lower thermal resistance than other technologies, the XLamp XT-E Royal Blue LED delivers up to 525 mW at 350 mA and 85°C. The new XT-E Royal Blue LED is also available in 2.5-nm wavelength bins to allow customers to achieve desired colour consistency.

XLamp XT-E Royal Blue LEDs are available now with standard lead times.

LUXEON Rebel LEDs win Electron D'Or 2011 award

Philips Lumileds has been awarded for its innovation in LED lighting.

LUXEON Rebel LEDs were honoured in Paris, France with the Electron D'Or award from ElectroniqueS.

The LUXEON Rebel was awarded for meeting the stringent requirements of the lighting industry and was selected by the editors of ElectroniqueS and evaluated by a jury of experts from business and research. In total, thirteen innovative products in different categories were recognised for excellence.



Over the last year, the LUXEON Rebel portfolio has continued to expand in order to meet the needs of the lighting community. With new combinations of correlated colour temperature and colour rendering for white LEDs as well as a broadening of the colour portfolio, LUXEON Rebel LEDs are positioned to meet the needs of the lighting community. By ensuring that there's light by LUXEON in each selected solution, Lumileds says lighting designers, specifiers, architects and end-users can adopt LED based lighting solutions with confidence knowing that the quality of light, reliability of the LED, and efficacy provided by the LUXEON LEDs is unmatched.



Model K1 sapphire growth facilities expanded in California

Thermal Technology says its modified-Kyropoulos method is the most productive tool on the market with large crystal size and a short growth cycle.

Manufacturer of crystal growth equipment and high temperature furnace systems, Thermal Technology, has recently tripled its manufacturing capacity with its new production facility in California.

The new location is dedicated to Model K1 sapphire crystal grower production and neighbours Thermal Technology's sales and manufacturing site in Santa Rosa, California.



Thermal Technology's new production facility, which is dedicated to Model K1 sapphire crystal grower assembly

"Market response to the K1 grower is strong. Potential customers see our machines in full production elsewhere and are convinced of our technology," says Matt Mede, Thermal Technology president and CEO. "Utilising the modified-Kyropoulos method, our growers remain the most productive tool in the market with large crystal size and a short growth cycle. We also have the most growers in successful production, compared to our competitors."

Thermal Technology says it is shipping multiple sapphire growers weekly. The new high-volume production facility enables the company to meet its customers' rising demand for the Model K1.

"The new manufacturing facility significantly increases our production capacity and improves the overall flow of our production processes. The expansion was fuelled by continued growth in our Model K1 sales," says Jim Coffey, Thermal Technology's production manager.

Thermal Technology designs and manufactures crystal growing systems and high temperature vacuum and controlled atmosphere furnaces for the advanced processing of metals, ceramics, glass and quartz. Thermal Technology has 60 years of experience with more than 3000 installations in 40 countries.



Interior of Thermal Technology production facility

at the new "Model K1" facility in Santa Rosa, California.

Cree exceeds DOE's latest Lamp L prize requirements

The firm's latest prototype lamp delivers over 1,300 lumens at 152 lumens per Watt and Cree says full deployment of this lighting could reduce U.S. energy consumption by 16.5%.

Cree has just unveiled a concept LED light bulb which it says redefines what is possible with high-performance LED lighting.

The lamp delivers more than 1,300 lumens at 152 lumens per watt (LPW) using Cree TrueWhite Technology.

Cree's prototype LED light bulb exceeds the performance goals set by the U.S. Department of Energy (DOE) for the 21st Century Lamp, the third category in its L Prize competition.



Figure: Cree's prototype LED light bulb

"Cree's concept lamp is a far cry from its 20th century counterparts," said Gerry Negley, Cree LED lighting chief technology officer and co-inventor of Cree TrueWhite Technology. "No one has fully envisioned what the lighting of the future will look

like, which allows Cree to continue to innovate without constraint."

Neal Hunter, Cree co-founder, added, "Not long ago, fixture efficacy of 100+ lumens per watt was impossible, but Cree is shipping fixtures at 110 LPW today. We calculate that if fully deployed, LED lighting at 150 LPW could bring a 16.5 percent reduction in the nation's electric energy consumption, returning it to 1987 levels. By pushing the limits of what is possible in LED lighting, Cree continues to design products that help reduce global demands for energy."

LED lighting at this level of performance is only made possible by advancements across all elements of the LED lighting system – lighting-class LEDs, optical elements, drivers and power supplies. Optimizing each element was critical in achieving the performance reached by Cree's prototype LED lamp. As an efficiency comparison, a traditional 75 watt incandescent light bulb produces 1,100 lumens at only 14.6 lumens per watt.

"Cree's innovation, technology breakthroughs and focus on energy-efficient lighting solutions continue to re-shape the LED lighting market," said Dave Morton, Courtyard Program Director, Marriott International.

Third-party testing by independent lab OnSpeX confirmed that Cree's lamp delivered more than 1,330 lumens and consumes only 8.7 watts. The lamp uses Cree TrueWhite Technology to deliver a high-quality, energy-efficient light with a CRI of 91 at a warm white colour of 2800 K. This project benefits from technology developed under DOE-funded contracts, which are part of Cree's ongoing collaboration with DOE to advance the successful adoption of energy-saving solid-state lighting.

The Energy Independence and Security Act of 2007 directed the DOE to establish the Bright Tomorrow L Prize competition. The 21st Century Lamp competition is the third category in the legislation, joining competitions to create replacements for some of the most widely used and most inefficient lighting technologies on the market today, 60W incandescent lamps and PAR 38 halogen lamps. The preliminary specifications for the 21st Century Lamp include: >1200 lumens, >150 lumens per watt, >90 CRI and CCT between 2800-3000K.

Real Time LED Display for the ‘Visual Factory’!

Patlite report the introduction of the new VE series LED Display; a Lean Manufacturing Tool for achieving ‘Kaizen’ on the factory floor.

Two models (1” or 4” character height) are available providing 3 lines of display showing goals, targets, progress, balance, and efficiency, as well as overall or piece-by piece times. Patlite state that this is a simple, economical system for reducing down time and eliminating waste by keeping all of your production line in step for maximum output efficiency. 3 programmable DC24V outputs are provided for visual or audible signaling of critical situations. Setup is easily accomplished using a PC or an optional remote control.



China’s LED industry speeds up

China’s LED industry has seen significant development after the initiation of the National Semiconductor Illuminating Project in 2003.

In 2008, the industry’s growth rate was affected by the sluggish downstream demand, which was a result of the global financial crisis. In 2009, with the state’s various supporting policies, the industry’s growth rate began to pick up. In 2010, driven by the rapid development of the downstream full colour LED display, LED backlight, LED lighting and other applications, the size of China’s LED industry covering substrate, epitaxial, chip and packaging

surged to RMB 29.46 billion, up 33.8% from 2009. Meanwhile, the CAGR of China’s LED industry stayed at 18.7% from 2006 to 2010.

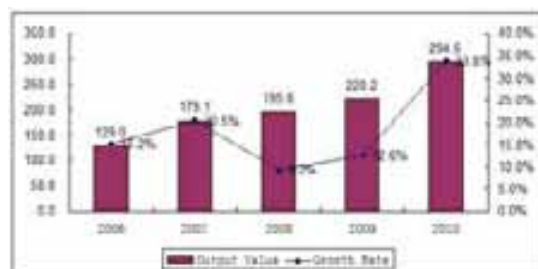


Figure 1 Size of China’s LED Industry, 2006-2010

Although the substrate sector still features low-end products, the sapphire sector has geared up for expansion.

In recent years, the development of China’s substrate sector has been relatively slow compared with epitaxial, chip, and packaging sectors due to its backward technology and the fierce market competition. In 2010, as various sapphire substrate projects were still under construction or in the process of equipment testing, which kept the production capacity from a significant expansion, the substrate sector still featured low-end products with a limited production capacity of sapphire substrate. In 2010, China’s substrate sector had a capacity of 3.525 million square inches, up 34.4% from 2009, with an output value of RMB 140 million, up 50.8% from 2009.

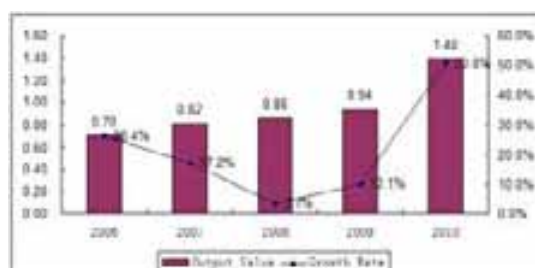


Figure 2 Size of China’s LED Substrate Sector, 2006-2010

Supported by National Semiconductor Illuminating Project and State 863 Program, China’s GaAs/InP/ GaP substrate technologies used for red light and green light LED production have achieved great progress. Mass production of the materials has been realized in enterprises including Compound Crystal Technology Co., Ltd, Guorui Electronic Materials Co., Ltd, Shanghai Pujia Optoelectronic Materials Co., Ltd. and the 46th Research Institute

of CETC. Their total LED substrate output account for around 30% of the country's total, which makes China self-sufficient on such types of substrate. In 2010, driven by the rapid development of the downstream LED backlight and LED illumination sectors and the rapid expansion of GaN epitaxial and chip production capacity, supplies of the upstream sapphire, SiC, GaN substrates applied in blue light and white light LEDs went tight with prices continuing to rise. Despite the yet immature technologies for such materials and the lack of qualified talents, many domestic enterprises started to enter the field of sapphire substrate field in pursuit of the high profit in 2010 and continued to increase investment and introduce key technologies. Most of those enterprises were located in the eastern coastal area and the southwest, along with a few in the inland areas. Among them, Tianjin Sapphire, Qingdao iStarWafer and Peter Stone Love have begun to supply sapphire substrate products, while Silian Group, which entered the sapphire substrate sector in 2008 through the acquisition of the internationally renowned manufacturer Honeywell's sapphire substrate factory in Canada and its technologies, is constructing a sapphire substrate base in Chongqing Municipality. By the end of 2010, the first phase of Silian Group's sapphire substrate project had been commissioned, and production had begun at partial capacity. Meanwhile, YunanCrystaland, Harbin Aurora Optoelectronics Technology Co., Ltd and other enterprises with independent crystal bar technology have been producing sapphire substrate at a small scale. Xiexin Optoelectronics, Eurasian Rainbow Optoelectronics Technology and TDG Holding began to enter the sapphire crystal bar and substrate sector in 2010, while Zhejiang Crystal-Optech and Xi'an ShengguangAnrui Optoelectronics Technology are preparing to enter in 2011 and the first phase of ZheJiang East Crystal Electronic Co., Ltd's 7.5-million sapphire wafer for LED technical upgrade project is planned to start mass production by the end of 2012. Generally speaking, the supply of sapphire substrate will remain tight in the coming three years at least judging by the capacity expansion rate. However, as the sector starts to absorb massive investment in 2011 to expand production capacity, the proportion of sapphire substrate output against the total LED substrate output is sure to surge and overtake the quaternary system products. Epitaxial sector sees rapid capacity expansion and product upgrade.

LED epitaxial is the core of the LED industry. Driven by high-speed development of China's downstream application market, GaN MOCVD has seen an explosive growth in China since 2009, which provided great momentum for the epitaxial sector of China's LED industry. In 2010, the number of MOCVD under construction and commissioned was close to 300, more than 200 of which had begun mass production, and the output value of China's LED epitaxial sector reached RMB 1.25 billion, up 78.4% from 2009.

As for the specific products, AlGaInP epitaxial mainly used in red light LED products is a leading product in China due to its stable growth mechanism and material properties. However, its growth rate is far behind that of GaN epitaxial wafer because the demand from its relatively mature application market is expanding slowly.

In 2010, the output of AlGaInP/AlGaAs/GaAsP/GaP epitaxial wafer accounted for 60.2% of the total epitaxial wafer output, down 15.8% from 2009. Besides, supported by the rapidly expanding application market of blue and white light LEDs in landscape lighting and backlight and technical breakthroughs, the GaN epitaxial wafer output accounted for 39.8% of China's total epitaxial wafer output in 2010. It is expected that the GaN epitaxial wafer output will exceed that of AlGaInP epitaxial wafer in 2011.

With regard to supplies, China is basically self-sufficient on epitaxial wafer supplies for normal-bright red light LEDs, but still relies on imports of quality AlGaInP epitaxial wafer from Taiwan and Korea for the production of super bright red light LEDs. Besides, the country also has to import GaN epitaxial wafers due to the small production capacity and interior quality of domestic products.

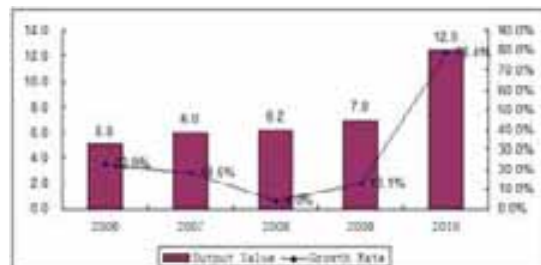


Figure 3 Size of China's LED Epitaxial Sector, 2006-2010

As the production of LED epitaxial products requires massive investment, advanced technologies and experienced professionals, most of the epitaxial wafer manufacturers are located in China's wealthy

areas in the east and the south.

With the expansion of the epitaxial market demand, new enterprises will continue to enter this sector, while the existing ones will seek to expand their capacity. For example, Sanan Optoelectronics has started to establish LED facilities in Tianjin and Anhui Provinces' Wuhu City in addition to its existing plants in Xiamen. Meanwhile, apart from the favoured locations of Shanghai, Xiamen and Yangzhou, new comers are also beginning to locate their facilities in central China.

OLED Lighting Falls Short

Lux Research looks at applications for organic light emitting diode (OLED) lighting, and finds only a few niche markets, totalling \$58 million in 2020

Organic light emitting diode (OLED) lighting has the potential to create cheap, pleasing light in unique, flexible form factors. However, the technology is immature and costly today. According to a new report from Lux Research, OLED lighting costs will drop by more than an order of magnitude over the course of this decade – but the technology will still remain uncompetitive with other lighting options, and amount to a mere \$58 million market in 2020. The report, titled “Finding the End of the Tunnel for OLED Lighting,” analyzes prospects for OLED lighting fixtures which emit diffuse, glareless illumination from either glass or flexible panels. It projects that OLED lighting costs will drop from \$18/lumen today to \$0.71/lumen on glass and \$0.18/lumen on flexible substrates by 2020. Despite this marked improvement, OLED lighting costs will still lag behind competitive illumination sources, limiting broad adoption.

“Developers are still looking for the ‘killer application’ for OLED lighting that will allow them to make initial sales and bootstrap their way to larger scale” said Jonathan Melnick, a Lux Research Analyst and the report’s lead author. “The problem is that OLED lighting is so much more expensive than incumbent and emerging alternatives – it’s only the most cost-insensitive markets that would use it for aesthetic value for the foreseeable future.” To forecast the OLED lighting market, Lux Research built detailed models by market segment to look at potential applications for OLED lighting in target markets, such as designer lighting, luminaires,

general illumination, wearable lighting, automotive, and aerospace. Among the report’s key findings:

- Designer lighting takes advantage of the form factors of OLED lighting. While OLEDs won’t challenge incandescent, fluorescent, or LEDs on a cost basis, they will find opportunities in designer lighting where aesthetic imperatives can trump price. OLEDs particularly suit applications that can absorb high-priced fixtures, such as high-end hotels, casinos, and upscale bars and restaurants. Once commercial flexible panels emerge in 2015, adoption will see a bump for this market. All told, the designer lighting market for OLEDs will reach \$32 million in 2020.

- OLEDs’ high costs will limit growth in luminaires. OLED panel manufacturers are targeting this market through strategic partnerships with luminaire designers, and Lux Research projects it to be the second largest, after designer lighting, with a 2020 market size of \$22 million. The cost of OLED lamps, which can reach to thousands of dollars each, will be prohibitive for many prospective customers.

- By technology, flexible OLED lighting will predominate in the second half of the decade. Once flexible OLED lighting panels become commercially available in 2015, they will immediately begin taking market share from glass panels. Further, their projected lower costs and the unique applications that flexibility enables will propel them to become the leading OLED technology entering the next decade. In 2020, of the \$58 million OLED lighting market, we project 63% will be flexible substrates. “Finding the End of the Tunnel for OLED Lighting,” is part of the Lux Printed Electronics Intelligence service. Clients subscribing to this service receive ongoing research on market and technology trends, continuous technology scouting reports and proprietary data points in the weekly Lux Research Printed Electronics Journal, and on-demand inquiry with Lux Research analysts.

Compact goniophotometer for packaged LEDs and small LED modules

The compact LEDGON 100 Goniophotometer from Instrument Systems was specially developed for analysis of the spatial radiation patterns from individual LEDs and small LED modules.

The entire hemisphere can be measured in the forward direction of the LED. The angular resolution of 0.1 means that exact measurement values can be obtained for narrow-angled LEDs with excellent reproducibility.

Combined with a spectroradiometer from Instrument Systems, all spectral parameters, for example color coordinates or color temperature can be measured as a function of angle. This is particularly relevant for white LEDs where these parameters can undergo significant change depending on the radiation angle.

The LEDGON 100 setup is located in a light-tight enclosure with a folding lid which eliminates the need for a dark room. If larger measuring distances are required, an opening in the side wall also allows light to be measured from the outside. The goniometer unit is mounted on a small optical bench in type C configuration allowing the test specimen to be rotated in phi and theta axis. An optional sample table also permits measurement of LED arrays and small modules. This sample table can be upgraded with an XY translation stage that allows the optical axis of an LED module to be positioned in the center of rotation. Optical probes with diffusers and a cosine corrected optical probe optimized for modules can be supplied.

The LEDGON 100 is operated using SpecWin Pro Software from Instrument Systems. A graphics window is used to visualize the measurements in five different display modes. The measured data can be exported in the IES and EULUMDAT format for further processing in simulation programs. By integrating of the scanned measurement data the luminous flux of the test specimen can be determined automatically.

LED metrology company Instrument Systems records results

Specialist manufacturer of solutions for light measurement Instrument Systems has closed another business year very successfully.

The company has continued to extend its market leadership in LED metrology. Sales for the business

year completed in June 2011 rose by 112% to 21.9 million euros – after 10.3 million euros in the business year 2009/10. A number of major contracts were responsible for this success, including a contract from a leading brand manufacturer of PCs and consumer electronics.

“We are proud of this record result and the outstanding performance of our dedicated professionals,” comments company founder and President Richard Distl. He added that the key drivers for the enormous growth were the sustained boom in the LED industry, display metrology and applications in general lighting. “Instrument Systems wants to continue this success and we are committed to reaffirming the trust and confidence our customers have placed in our products and services.”

New UV LEDs Combine 10X Longer Lifespan and Up To 50% Cost Savings

Lumex announces the global expansion of the QuasarBrite UV family of LED technologies to include three new standard wavelengths and also announces the availability of custom UV LED arrays.

QuasarBrite UV LEDs provide up to 10 times longer lifespan, up to 50% cost savings, up to 70% energy consumption savings, and superior light performance compared to alternative technologies.

The RoHs compliant QuasarBrite UV LEDs are now available in standard 355nm, 365nm and 377nm wavelengths in a through-hole format. They are ideally suited for a wide range of applications including:

- security (counterfeit detection for currency, passports and other travel documents)
- forensic (applications related to forensic analysis of bodily fluids)
- photo catalyst (for air and water purifier applications in homes, offices and automobiles)

“Previously widespread use of UV LED technology,

especially in the shorter UV wavelengths, was hindered because the materials used in the epoxy LED lens degraded the lifespan of UV LEDs to less than 5,000 hours,” explained Kay Fernandez, Product Technology Manager at Lumex. “Recent technological developments have allowed the epoxy lenses to be replaced by a robust TO-46 package with a glass lens, making it possible for QuasarBrite UVs to last 10 times longer- with life spans of over than 50,000 hours.”

In addition to enhanced life span, QuasarBrite UV LEDs provide several key benefits compared to alternative technologies like CCFLs. QuasarBrite UV LEDs provide a uniform beam pattern. To match this performance CCFLs would require a secondary lens resulting in additional cost and space investment. Additionally, QuasarBrite UV LEDs do not use the hazardous mercury material found in CCFL technology and are more durable in their design, thereby significantly reducing maintenance costs. Finally, Lumex’s UV LEDs have up to 70% lower energy consumption than CCFLs. These factors combined allow Lumex’s QuasarBrite UV LEDs to provide up to a 50% cost savings compared to CCFLs.

“Because of significant cost and performance benefits UV LEDs provide over alternative technologies such as CCFLs, there is a dramatic growth in demand for UV LED technology worldwide,” explained Fernandez. “Lumex now offers a total of six standard UV wavelengths (355, 365, 377, 385, 405 and 415nm) as well as an almost limitless number of custom options to meet the needs of this growing market.”

The new 355nm, 365nm and 377nm QuasarBrite UV LEDs feature a 80° viewing angle and operating temperature range from -40°C to 100°C. Samples of these devices are available immediately from stock. Standard and custom production lead times range from 18-20 weeks. Pricing is dependent on quantity ordered, and is approximately \$20 to \$28 per unit in production quantities dependent on size and quantity ordered.

Pressureless Silver Sintering Technology from Henkel

Henkel Electronic Materials has announced its success with a revolutionary silver (Ag) sintering technology that enables high volume production of modern power packages in a process that does not require pressure

In its market debut, Henkel’s Ag sintering capability has been designed into Ablestik SSP2000, a high reliability die attach material well-suited for use with power modules such as IGBTs and high power LED products.

Sintering is a process in which particles are joined together by heating the material in a sintering furnace below its melting point until there is particle adhesion. Conventional Ag sintering is achieved by applying both heat and pressure to the material, or device, until the metal joint is formed. The drawback to the pressure application technique in semiconductor packaging, however, is its volume limitation, as devices must be processed individually on capital-intensive die bonding systems. With Ablestik SSP2000, because the silver particles are joined via a unique surface tension mechanism, the pressure requirement is eliminated and the material can be cured in a standard batch oven at a temperature as low as 200 degree centigrade. In addition, Ablestik SSP2000 can be processed on standard die bonding systems, eliminating the need to reinvest in specialist equipment and making the transition from existing materials simple, fast and cost-effective.

“The ability to now exponentially increase UPH from traditional silver sintering techniques at roughly 30 units per hour to a remarkable 6,000 units per hour with the Henkel technology is incredible,” enthusiastically explains Henkel’s Dr. Michael Todd, Vice-President of Product Development and Engineering. “Now, semiconductor packaging specialists can have high volume and high reliability with a silver sintering material.”

While high UPH is a central advantage of Ablestik SSP2000, even more notable is the material’s thermal resistance and reliability. When compared to high-lead soft solders, which are the current material of choice for power semiconductor devices, Ablestik SSP2000 has far superior power cycling

reliability. In power cycle testing where solder failed at 200 cycles, Henkel's Ag sintering technology was able to reach more than 2,000 cycles before the first failure. With thermal conductivity and thermal resistance that are superior to that of solder, Ablestik SSP2000 offers better performance and reliability. For high power devices such as IGBTs, that presents tremendous latitude as compared to traditional solutions.

"Because of Ablestik SSP2000's superior power handling performance, IGBT designers and manufacturers are now able to reduce the number of chips in a package and save on valuable device real estate," comments Todd. "This material provides a technical solution that popular high-lead soft solders simply don't have. What's more, all the performance is achieved in a non-pressure process with lower curing temperatures, which is icing on the cake!"

Not only do semiconductor packaging specialists want higher throughput, higher performance materials, but are also actively seeking viable replacements to high-lead solders – particularly in the power device segment. The RoHS deadline for the elimination of lead-based materials from the power device market is currently set for 2014, which means that in less than three years suitable alternatives must be in place. For power device manufacturers, Henkel already has the solution with the first Ag sintering die attach material of its kind.

As Todd concludes, the flexibility of Henkel's solution is simply untouchable. "The lead-free advantage, design latitude, thermal and electrical performance, reliability and high UPH capability – it's all there. Our silver sintering technology is already proving its worth in the power device market, has shown great promise in the high power LED market and, frankly, is ideal for any application that requires high thermal capability in high volume. This will no doubt be a game-changer."

For more information on Ablestik SSP2000, please log onto www.henkel.com/electronics



With Ablestik SSP2000, the pressure requirement is eliminated and the material can be cured in a standard batch oven at a temperature as low as 200 degree centigrade.

Cree's high power LEDs illuminate Magnalight's bar

Twenty-four Cree XLamp MC-E LEDs are used in Magnalight's light bar which is designed for boating and sailing applications.

Magnalight is marketing the LEDPB10W-240X2E LED light bar which produces 20,640 lumens of intensely bright light output in a compact housing size.



Magnalight says its high intensity LED light bars offer excellent high lumen output coupled with low power requirements.

Unlike similar units which align 24 LEDs in a single row, resulting in a very long housing, the LEDPB10W-240X2E places LEDs in two rows of 12, resulting in the same power output from a housing that is half as long.

IP68 rated and waterproof to 3 metres, the LEDPB10W-240X2E LED light bar is designed to resist the destructive effects of salt water and the elements, and is made of extruded aluminium with an unbreakable LEXAN lens and stainless steel mounting hardware for extreme durability

and resistance to the usual corrosive effects of the marine environment on lighting equipment. Cree's high intensity 24 XLamp MC-E LEDs offer excellent high lumen output coupled with low power requirements and provide intense illumination with a lifespan rated at 50,000 hours with 70% lumen retention. Advanced LED drivers and PWM energy management technology allows these lights to actively monitor and adjust the current sent to the LEDs to provide unsurpassed heat management.

Capable of operating with voltages ranging from 9 to 46VDC, the LEDPB10W-240X2E LED light bar draws only 20 A at 240 W from a 12 V electrical system. It is designed to be shorter than similar units with the same number of LEDs yet produce the same output, and can be mounted in positions where mounting space is more limited.

Additionally, these LED drivers and PWM control offer the ability to connect this unit to an external pulse modulator or dimmer controller to produce dimming, strobing and flashing effects according to the users' needs. These LED light bars are highly resistant to impacts, shocks and vibrations as well as able to withstand rapid temperature changes of -40 degrees Celsius to 85 degrees Celsius. Available in 20 degree spot and 40 degree flood configurations, this LED light bar is ideal for commercial fishing applications as well as private boats and water craft, military and police vehicles, ATVs, and civilian cars and trucks.

"This LED light represents the pinnacle of our LED related electronics and optics technology, providing a bright, colour correct, definitive spot or even flood beam with minimal amp draw," said Rob Bresnahan with Larson Electronics' magnalight.com. "Housed in a weather-tight, IP68 enclosure operators will find application for this light not only in boating and heavy equipment applications but also as a component to high speed vision systems, blasting light applications and vandal proof security systems."

Asia Pacific lights up the competition

The Asia Pacific region now accounts for more than 50 percent of the global semiconductor market,

compared to less than 20 percent for the United States.

According to the World Semiconductor Trade Statistics, the global semiconductor market grew 96 percent over the last ten years and is expected to continue to grow at a compounded annual growth rate of 8 percent.

The Asia Pacific region has seen the most rapid growth over the past ten years and now accounts for more than 50 percent of the global semiconductor market, compared to less than 20 percent for the United States. The analogue power management market is expected to grow to \$12.1 billion in 2014, up from \$9.9 billion in 2010 according to Gartner market research.

In its latest report, Equity Markets has reviewed Cree and TriQuint. Cree develops and manufactures compound semiconductor materials and devices primarily based on SiC and GaN related compounds and focuses its expertise on LED products although it develops power RF products. Equity Markets says Cree derives the largest portion of its revenue from the sales of its LED products, which include LED components, LED chips, LED lighting products and SiC wafers.

Miniature LEDs provide super low-profile optical touch screens

Osram Opto Semiconductors says its new infrared III-V CHIPLEDs are ideal for small and medium size touch displays.

Super low-profile and incredibly powerful – these are the demands that touch screens place on infrared components.

Osram says that's no problem for the new CHIPLED SFH 4053 with its tiny dimensions which make it one of the smallest on the market. Combined with its high performance the CHIPLED is ideal for low-profile all-in-one computers and laptop displays. And the IRED is so small that it can be easily integrated in smartphones.



The CHIPLED can be used in multi-touch displays as installed in everything from tablet PCs to all-in-one PCs. Items can be selected, moved and zoomed.

Although optical touch screens are available in a wide variety of designs they do share a common principle in that the touch of a finger will either cast a shadow or reflect light. In basic versions an array of infrared emitters (IREDs) and detectors create a grid of vertical and horizontal beams. The components are housed in a low-profile frame, known as the bezel, measuring a half to one millimetre in depth around the screen.

“To make this frame even shallower particularly small IREDs and detectors are needed,” said Bianka Schnabel, Product Marketing Manager at Osram Opto Semiconductors. “This is especially important for mobile devices such as tablet PCs and laptops because of the positive effect on the design aspect.” The new CHIPLED SFH 4053 measures just 0.5 x 1 mm so it takes up very little space. With a height of 0.45 mm in industry standard 0402 (length/width) it is one of the smallest on the market.

In addition to size, the high light output of these components plays an important role, particularly for camera-based touch screens. Such a display setup requires considerably fewer IR emitters than the basic version but the emitters must have a very high output because they flood the display with infrared light from two corners. Next to the IR emitters are camera chips that detect a change in the signal when a pen or finger touches the display.

Thanks to Osram’s thin-film chip technology, the SFH 4053 is another high-efficiency IRED that offers high output from a small package for this application, rated at 35 mW from an operating current of 70 mA. In pulse mode it can achieve as much as 260 mW from 700 mA. “This CHIPLED therefore provides enough light to make it easy

and cost-effective to expand camera-based touch screen systems to larger screen diagonals,” added Bianka Schnabel.

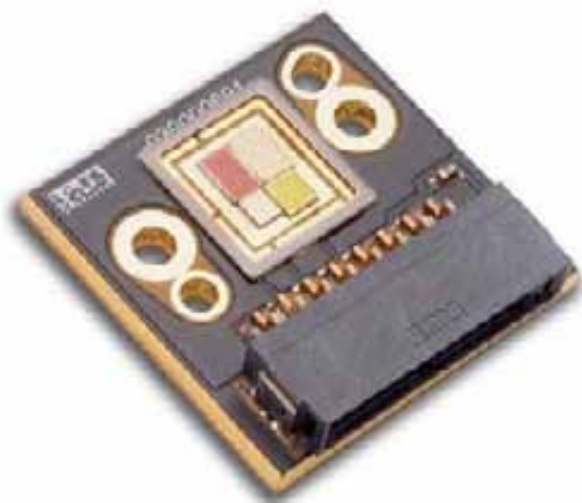
The new CHIPLED is part of a broad range of components that are being used in more and more applications – from narrow-angle emitters for light grids to low-profile components for optimum injection into light guides. LEDs are available in 0603 sizes with lens types from + - 40° to + -10° and different chip technologies such as thin film and nanostack.

The wavelength of the CHIPLED is ideal for the requirements of these applications. At 850 nm the light from the IRED is barely discernible to the human eye but receiver components exhibit very high sensitivity to this wavelength.

Luminus big chip LED invigorates Philips

The company says its VARI*LITE VLX CBM-380 wash luminaires deliver performance, reliability and reduced maintenance.

Luminus Devices has announced that the Philips Vari-Lite VLX Wash luminaires, powered by its CBM-380 colour mix Big Chip LED are at the heart of the replacement lighting rig recently installed at the iconic Grand Ole Opry House in Nashville.



Phlatlight LED from the CBM-380 Series

Not only did the new rig need to replace the flood damaged rig, it also had to be flexible enough to light a wide variety of stage performances and TV broadcasts yet mobile enough to make the Opry's seasonal move for their Winter Series performances.

"When we started conceptualising what fixtures would be in the rig, I remembered a demo done by Thommy Hall with the VLX Wash at Bandit Lites, and how I was instantly impressed with its colour and colour-mixing," said Tyler Bryan, lighting director, at the Opry.

"Chris Barbee suggested that we use the VLX as our primary wash and with the reduced maintenance issues of using a solid-state LED light source, they were a no-brainer. I love their ability to have colour with punch from an LED source that also has a fantastic white for TV. Maintenance needs are minimal, which is a huge selling point for us," he continued.

Luminus says that lighting designers prefer the VLX Wash for a variety of reasons; the deep and rich colours that come from the LED source which are unmatched by any other LED wash available today, the fact they are more powerful, the special effects that can now be achieved, the drastically reduced maintenance, the increased efficiency and the reliability.

The artistic freedom a VLX Wash enables, earned Kevin Adams a Tony Award in Lighting Design for the Broadway production American Idiot. He credits the VLX fixtures for being "bright," and for reacting quickly and making "saturated light look great."

"The most exciting aspect of the VLX, besides the true LED white, is that it can strobe between multiple colours faster than the eye can perceive. I literally structured the opening of American Idiot around them and I can't imagine this design without them," commented Adams.

The VLX Wash is claimed to require minimal maintenance and continues to surprise rig maintenance personell. "Our lighting rig is working roughly 40 hours per week, 160 hours per month, or 1920 hours per year. With a normal wash fixture in a typical Broadway rig, you have to swap out a fixture once or twice a month for various issues, but it took us nine months to touch our first VLX

Wash, because there is no bulb in it and the amount of heat generated is significantly less than other moving lights," said Eric Abbott, head electrician of American Idiot.

"Since the vital parts of the VLX are protected inside as a self-contained unit, and with minimal fans that may bring in dust or debris, we spend significantly less time per light than with any other fixture in the rig. I would estimate that by using the VLX Wash as our primary wash fixture we are saving at least 5-6 hours per week in crew time which brings down our overall production costs. From a production costs standpoint it would seem that the more VLX Wash you have in your rig, the larger the savings due to the elimination of bulb costs and the reduction in crew work costs. Plus you can definitely count on the VLX Wash to look the same on the very last performance as they did on the day you opened."

Luminus' CBM-380 chip that is the solid-state light engine of the VARI*LITE VLX Wash luminaire is also used in several other Philips fixtures: the VARI*LITE VLX3 Wash, as well as the Selecon PL1 and PL3. The benefit of all these fixtures is their colour quality that can do the aesthetic work of traditional fixtures efficiently enough to require less maintenance while continually delivering more reliability and brightness.

"When we began this program with Vari-Lite, our goal was to deliver a new kind of LED stage light, one that not only offered the obvious advantages of LED; efficiency, reliability, intense saturated colour and blindingly fast colour changes; but a fixture that also produced intense high quality white light, freedom from colour shadows and a traditional moving head form factor previously available only from lamp based fixtures," says Don McDaniel, Director of Global Entertainment for Luminus.

"It's gratifying to see the VLX receive the awards and accolades specifically validating our success in every one of these objectives. We're very proud of this fixture and our role in making it a reality and we're looking forward to seeing Philips Vari-Lite take these unique attributes to new users with products like the Selecon PL3 and the new VLX3 Wash."

Samsung LED countersues Osram

The firm has filed infringement lawsuits against Osram to eight LED patents related to use in a wide range of products including lighting, automobiles, projectors, cell phone screens, and televisions.

On July 15, Samsung LED Co., Ltd. filed a complaint with the United States ITC in which it has requested the ITC to issue an exclusion order barring importation of products of Osram, Osram Opto Semiconductors, and Osram Sylvania Inc. into the United States.

Samsung LED also filed a suit for patent infringement in the United States District Court for the District of Delaware to seek damages and a permanent injunction barring Osram's infringement.

Samsung LED alleges infringement of eight patents on core LED technologies. The patented technology is used in a wide range of products, including lighting, automobiles, projectors, cell phone screens, and televisions.

Osram's TOPLED, DRAGON, OSLON, CERAMOS, and OSLUX devices, and the products in which they are used, are targets of Samsung LED's complaints. Although Samsung LED has named only the above Osram companies in the ITC case, as new information becomes available it will continue to evaluate the potential to add additional parties who may be importing, using or selling the accused Osram LEDs in the U.S. market.

In June, Samsung LED also filed a patent infringement action against OSRAM in a Korean court.

Samsung LED representatives explained, "Samsung LED is very proud of its innovative LED technology for which it has been awarded many patents around the world. Samsung LED is a market leader in LEDs and is proud to see its LEDs used in many of the leading consumer electronic products worldwide. Samsung LED intends to vigorously enforce its intellectual property rights, and these lawsuits reflect Samsung LED's commitment to that enforcement."

Samsung LED has continuously invested in its LED

technology development and maintained its core technology related to LED lighting, including LEDs for televisions. Samsung LED has applied for and registered about 4,000 patents, including 2,000 patents in Korea and 700 patents in the United States.

The ITC is an independent U.S. agency empowered to take direct action to stop certain unfair trade practices, including patent infringement. It can prohibit importing infringing products into the United States. It typically takes about 15-18 months after the start of an investigation for the ITC to announce its final determination.

ESI unveils innovative products for LED manufacturing

The firm is introducing advanced systems for LED micromachining, wafer scribing and testing, which are all designed to deliver the lowest cost of ownership.

Supplier of laser-based manufacturing solutions for the microtechnology industry, Electro Scientific Industries (ESI) is showcasing its expanded suite of LED manufacturing systems and applications at Semicon West 2011 this week.

The first of the new systems is the Model 5390 micromachining system for advanced LED packaging. This tool is uniquely designed for creation of electrical interconnections on LED packages and is optimized for industry-leading via placement accuracy and high yields.

"Our customers are demanding new, innovative manufacturing processes that enable them to enhance light output and product reliability on smaller and smaller LED packages," said Martin Orrick, senior director in ESI's Interconnect and Micromachining Group. "Our Model 5390 enables the industry's fastest and highest via placement accuracy."

Featuring a high-speed compound beam positioner coupled with a high-power CO₂ laser, the Model 5390 provides user-definable variable pulse width and pulse repetition frequencies of up to 300 kHz

for wide range of applications. The system can produce more than 100 vias per second in typical single layer dielectric materials. The company shipped the first unit to a leading LED manufacturer in the last quarter.



The firm is also unveiling its most advanced LED wafer scribing system, the AccuScribe 2600. ESI's AccuScribe 2600 is built on patented, industry-leading technology enabling customers to extract the maximum light output from LED's. ESI developed the AccuScribe 2600 based on customer requirements for high brightness LED (HB-LED) manufacturing, including Patterned Sapphire Substrate (PSS), Distributed Bragg Reflector (DBR), Metal Mirror (MM) and other advanced light extraction technologies.

"ESI pioneered the laser scribing of LED wafers with our patented technology for LED sapphire substrates," said Jonathan Sabol, general manager of ESI's LED μ Engineering Division. "Industry wide expansion of high brightness LEDs is driving rapid changes in LED architecture and manufacturing processes to continuously increase lumens/watt. The AccuScribe 2600 is specifically designed to match our customers' most demanding technology roadmaps while achieving industry best yield, performance and cost."

Multiple customers have recently confirmed that the AccuScribe 2600 delivers the industry's highest brightness scribing for a wide range of HB-LED technologies including PSS, DBR and MM.

Increased light output results in increased revenue and profitability for LED manufacturers. This, coupled with achieving the highest yield, lowest cost, least environmental impact, and complete elimination of the employee work hazards related to chemical etching, will allow ESI Accuscribe 2600 customers to lead in the most profitable segment of the HB- LED market.

The firm is also introducing the high-speed Model

3800 production-scale LED Tester. The 3800 features an innovative architecture that utilizes a patented, dual-track, bulk-to-bin handler that has demonstrated in excess of 100 percent throughput improvement and yields in excess of 99.9%. It processes two LEDs simultaneously, while achieving productivity rates up to 48,000 LEDs/hr (800/min). The system has multiple test stations to maintain the highest possible throughput and each system can be configured to test multiple LED types and testing requirements.

What's more, the rotary loader is gentle on LED packages to drastically reduce chip damage and indexed carriers maintain LEDs in a "nest" to eliminate dropped and scrapped devices. The simple, parallel binning process does not require actuated gates/switches and virtually eliminates mis-binning, and does not limit throughput.

"Consumer adoption of high brightness LED technology depends largely on our customers' ability to drive down their production costs and improve LED light efficiency through advances in manufacturing technology," said Vernon Cooke, product manager in ESI's Components Group. ESI says the Model 3800 is the most advanced LED tester on the market.

ESI has a long, proven history as one of the market leaders in the delivery of automated systems designed for mass-production testing and inspection of small, electronic components, such as multi-layer ceramic capacitors (MLCCs). The company has applied its core technologies of component handling, testing and binning to significantly reduce the cost of ownership for LED manufacturing.

ESI expects to ship its first system to a leading LED manufacturer this quarter.

The firm is showcasing its solutions for LEDs at SEMICON West at booth #5871 in the North Hall at San Francisco's Moscone Convention.

Samsung develops nitride LEDs on 200 mm silicon

Following the lead of Bridgelux, the Korean LED maker Samsung is developing a process to produce LEDs on 200 mm silicon.

Samsung Advanced Institute of Science and Technology (SAIT) has developed a process to produce LEDs on 200 mm silicon. Using this platform instead of sapphire, the widely used substrate for making LEDs today, promises to cut the cost of LED deposition and processing.

A paper presented by SAIT at the ninth International Conference on Nitride Semiconductors (ICNS) described the method used to produce LED epi-structures with an internal quantum efficiency of 65 percent.

Growth of high-quality GaN layers on silicon is not easy, due to differences in both the lattice constant and the thermal coefficient of expansion of the two materials.

SAIT has addressed both these issues by creating a crack-free template featuring AlN/AlGaIn buffer layers, intermediate layers and an n-type GaN layer.

On this template engineers have created an LED structure featuring five quantum wells and a p-type AlGaIn electron blocking layer. Photoluminescence (PL) mapping of this epiwafer produced an average emission wavelength of 429.5 nm, with a standard deviation of 10.3 nm.

Temperature-dependent PL measurements suggest that the internal quantum efficiency of the LEDs is 65 percent.

The research team have also employed a substrate transfer technique to fabricate vertical-LED chips from 8-inch epiwafers.

Toshiba addresses the green gap in LEDs

Inserting a thin AlGaIn layer between the InGaIn quantum well and the gallium nitride barrier delivers a tremendous hike in the output power of green LEDs.

One of the biggest problems facing the nitride community is the 'green gap' – the rapidly declining efficiency of green light emitters at longer and longer wavelengths.

But this issue can be combated, according to Toshiba's Tamonari Shioda, by inserting thin AlGaIn layers in the active region of a conventional device.

Shioda revealed to delegates at the ninth International Conference on Nitride Semiconductors (ICNS) that this approach could increase the output power of green LEDs by a factor of almost ten.



The engineer from Toshiba began by highlighting the big issues associated with propelling LEDs to longer wavelengths: deterioration of the crystal structure and greater phase separation, which can be addressed by improving the growth process; and an increase in electron-hole separation via the Quantum-confined Stark effect, which can be mitigated by switching the growth platform to a semi-polar or non-polar orientation.

Shioda explained that the company wants to improve its green devices on *c*-plane sapphire, and to do this its engineers have worked to improve the band structure of the device. The primary goal of this effort has been to increase radiative recombination efficiency through greater overlap of electrons and holes.

Initial efforts in this direction involved the growth

of multiple quantum well structures featuring 1.5 nm-thick AlGaIn layers with a range of aluminium compositions up to 30 percent. Cross-sectional transmission electron microscopy analysis on this set of samples revealed no degradation in any of the structures. And probing these structures via photoluminescence studies showed that the greater the aluminium composition in the layer, the greater the suppression of the decline in efficiency at longer wavelengths.

Shioda and his co-workers have produced 600 μm by 600 μm LEDs with an active region featuring AlGaIn layers, which were grown at the same temperature as the InGaIn quantum wells. The output power of these LEDs increases with the proportion of aluminium in the interlayer.

Driven at 20 mW, a 532 nm LED incorporating an AlGaIn layer with an aluminium content of 0.3 produces an output of 12 mW at an external quantum efficiency of 25.9 percent. One downside of this structure is its higher operating voltage – insertion of this aluminium layer increases the forward voltage from 3.5 V to 4.6V.

NCKU scientists strike gold at 2011 INPEX

The Taiwanese researchers have been honoured for their novel gallium nitride LED that can last 420 minutes, which they say is 140 minutes longer than traditional LEDs. With its compact size and high energy-saving properties, it is ideally suited to backlighting applications.

A research team led by Wen-Chau Liu of the Department of Electrical Engineering at National Cheng Kung University (NCKU) has won a gold award at the 2011 Invention & New Product Exposition (INPEX) for its highly efficient GaN based LEDs.

Held each year in Pittsburgh, INPEX offers over 1,000 innovations, new product ideas and technologies that can be licensed, manufactured, marketed or applied to a brand or product line. Taiwan took home 26 gold, 12 silver and 5 special awards this year, making it the biggest winner in one of the world-recognised invention shows. Among them, the gold-winning high current spreading efficiency GaN LED was the result of a

collaboration between Wen-Chau Liu, Wei-Chou Hsu and students Yi-Jung Liu, Chi-Hsiang Hsu and Jian-Kai Liou, all based in NCKU.



According to Liu, the new invention is 520 μm^2 by 250 μm^2 in size and can last 420 minutes, which is 140 minutes more than traditional LEDs which only last 280 minutes, having at least 50% of battery life than traditional LED lights.

The compact and high energy-saving LED is ideally suited for use as backlighting in laptops, cell phones and outdoor billboards.

“Companies are asking about technology transfer and we have already applied for patent, so the possibility in commercialisation is very high,” Liu said.

Wen-Chau Liu has also won gold medals in the 2010 International Exhibition of Inventions of Geneva and the 2010 International Trade Fair “Ideas-Inventions-New Products” (iENA) Nuremberg, Germany.

LEDs speed up effective diagnosis of tuberculosis

A novel technique known as LED-FM can diagnose tuberculosis more quickly and efficiently than current methods.

Researchers led by Luis E. Cuevas and Mohammed Yassin from the Liverpool School of Tropical Medicine have found that LEDs can be used to diagnose tuberculosis (TB).

The findings have important implications for the ways in which diagnosis for the endemic infectious disease, TB, can be done in poor countries. They

suggest that a faster laboratory test can be used while maintaining the same level of accuracy for diagnosis as the currently used method. Also, testing using the alternative technique, known as LED Fluorescence Microscopy (LED-FM), is less labour-intensive and more convenient for patients.



A roentgenogram showing an infection of tuberculosis

In the study, the researchers examined nearly 2,400 patients from Ethiopia, Nepal, Nigeria and Yemen who had had a cough for more than two weeks (a characteristic symptom of tuberculosis). The researchers used a variant form of smear microscopy (LED-FM) and identified more people with TB than the standard smear microscopy test (in which technicians use a stain called Ziehl-Neelsen from a patient's sputum). The LED-FM technique was also faster than the standard test.

According to the scientists, a further advantage of LED-FM could lead to more people without TB being needlessly treated, as it picks up more false positives. In other words, it detects people who don't have TB but who are incorrectly classified as test-positive for the disease.

The authors conclude, "This study has shown that LED-FM can play a key role in reaching the World Health Organisation targets for TB detection, reducing laboratory workloads, and ensuring

poor patients' access to TB diagnosis and prompt treatment."

The study was jointly coordinated with Andrew Ramsay at WHO-TDR Special Programme for Research and Training in Tropical Diseases.

The research was funded by the Bill & Melinda Gates Foundation and the United States Agency for International Development through grants awarded to the UNICEF/UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases. The LUMIN and the QBC Paralens Fluorescence Microscopy Systems were provided free of charge by LW Scientific, which also paid the costs of shipping the systems to study sites.

Further details of this work are published in the paper, "LED Fluorescence Microscopy for the Diagnosis of Pulmonary Tuberculosis: A Multi-Country Cross-Sectional Evaluation" by L.E. Cuevas *et al*, *PLoS Med*, 8(7): e1001057 (2011). doi:10.1371/journal.pmed.1001057

Tyndall spin-out InfiniLED is launched

InfiniLEDs micro LED technology is said to extend battery life by up to five times relative to the current state-of-the-art for any device with an LCD display.

Ireland's Minister for Research and Innovation, Sean Sherlock T.D., launched high-tech spinout InfiniLED Limited at Tyndall National Institute, UCC last Friday.

InfiniLED is commercialising a new generation of LED technology, which significantly extends the battery life for portable devices such as cameras, mobile phones and laptops as well as for various medical and analytical instrumentation by producing more usable light, using less energy.



From left to right: Minister for Research and Innovation, Sean Sherlock T.D.; Roger Whatmore; CEO Tyndall National Institute; Joe O’Keeffe, CEO InfiniLED

At the launch Sherlock commented, “As we strive to embed the knowledge economy in Ireland it is vital that we maximise the return on the significant investment Government is making in research and development. InfiniLED is an excellent example of the type of company that we want to see emerge from this investment. One that will grow, develop and create the jobs this economy needs.”

The Micro LED technology was invented by a team of researchers led by Brian Corbett at Tyndall National Institute, supported and funded by Enterprise Ireland. Under the EI Business Partner Programme, Entrepreneur Joe O’Keeffe, who has already spun out a series of successful companies, evaluated the commercial potential of the Micro LED leading to the launch of the company, InfiniLED.

Portable device manufacturers are continuously in search of new technologies that provide end users with extended battery life, while reducing energy usage. “Our Micro LED technology extends battery life by up five times relative to the current state-of-the-art for any device with an LCD display” commented Joe O’Keeffe, Interim CEO of InfiniLED.

The Micro LED technology is said to bring performance advantages across a broad spectrum of applications. Already, products have been developed to serve LCD display, medical and analytical instrumentation and maskless lithography markets. InfiniLED is actively seeking new applications, new customers and new licensing opportunities. “We are in the process of raising investment and we invite any interested investors to contact us at info@InfiniLED.com”, added O’Keeffe.

“This is an excellent example of a successful collaboration between researchers, UCC’s Technology Transfer team and external entrepreneurs. We are delighted that Dr. Bill Henry, who as a Tyndall employee worked on identifying commercial opportunities for the technology, has now joined InfiniLED as Chief Commercial Officer. InfiniLED will continue to access our facilities and expertise in the further development of the Micro

LED technology under an access agreement between InfiniLED and Tyndall”, explained Roger Whatmore, CEO Tyndall National Institute.

InfiniLED is initially targeting three market segments, where it believes its LED’s advantages will be most effective. Firstly, in backlighting for mobile phones, TVs and monitors, where the benefits would be reduced energy consumption and extended battery life. The firm is also interested in using its products in analytical and medical instrumentation, where the advantages would be battery life extension and size reduction via simplified heat sinking and the elimination of optics. Finally, InfiniLED is targeting maskless lithography, which can be enabled through the production of micro arrays of LED’s

First long wavelength InGaN LED grown on silicon

RSL hopes to commercialise its indium gallium nitride-on-silicon technology in the next 2-3 years and then develop it further for growth on 200mm silicon substrates.

Scientists from RoseStreet Labs (RSL) have demonstrated what they claim is the world’s first long wavelength LED device grown on low cost silicon wafer substrates.

Green and longer wavelength LEDs have been sought after by both science and industry for a long time because they would fill a high-value gap in the rapidly growing global LED market for lighting and illumination where energy efficiency, low cost and miniaturisation are critical product characteristics.



RSL’s breakthrough device compliments its proprietary thin-film InGaN-on-silicon technology for high efficiency photovoltaic applications and power devices. These RSL longer wavelength devices

are fabricated utilising commercial scale deposition tools at RSL's Nitride Research Centre in Phoenix, Arizona. Silicon substrates have a substantial cost advantage over the more traditional sapphire or SiC substrates typically utilised in LED fabrication.

Efficient long wavelength LEDs are essential milestones in the roadmap for Solid State Lighting (SSL), LED backlighting and next generation display technology. Green or longer wavelength nitride based LEDs are very challenging to fabricate compared to UV and blue LEDs due to decreasing quantum efficiencies and have remained a tough milestone for the LED industry.

RSL plans to eventually package the green and longer wavelength LEDs through its sister company, FlipChip International (FCI). Using its extensive experience in packaging semiconductor power devices, FCI plans to provide a proprietary packaging solution for these LED devices.

RSL scientists have also demonstrated initial tunability of this technology to multi-colour and white light spectrums. This RSL device illustrates great promise due to its potential for high intensity, low energy consumption and a roadmap to a very low commercial cost. RSL believes this technology can be commercialised in 2-3 years with migration to 200mm silicon substrates.

Bob Forcier, CEO, of RSL, stated, "These longer wavelength and green LED breakthrough devices fit perfectly into RSL's roadmap for disruptive energy innovation at all levels on a global scale and leverages its GaN and InGaN-on-silicon investments."

Wladek Walukiewicz, CTO, announced, "Green LED's have been elusive due to material challenges of producing a high efficiency device in the green region and the longer wavelengths of the spectrum...we are quite excited about the potential of this device."

Ushio's two new "UX4-LEDs" tools prepare for lift off

The new models achieving better cost of ownership by further enhancing productivity and yield for high-volume manufacturing of III-nitride HB LED chips.

Japanese firm Ushio has started shipping what it says is the world's first 200-mm wafer full-field projection lithography tool "UX4-LEDs FFPL 200" for manufacturing High-Brightness LED chips.

The firm has also completed development of the laser lift-off system "UX4-LEDs LLO 150" for volume manufacturing of vertical-structure LED chips.

The latest models of the UX4-LEDs are based on the same platform as Ushio's field-proven UX series, which has an installed base of more than 1,100 systems.



Common UX4-LEDs Platform

The UX4-LEDs 150-mm wafer full-field projection lithography tool, released last November, has already been used for high-volume manufacturing of LED chips at leading LED manufacturers in Japan, Korea, Taiwan, and China, where it has proved its high performance and high reliability.

The UX4-LEDs FFPL 200 is mounted with a full-field projection lens of 200 mm in diameter on the common UX4-LEDs platform to enable full-field projection exposure of a 200-mm wafer. It can achieve a high throughput of 120 wafers per hour. Unlike the stepper systems that lower their

productivity as the wafer becomes larger, the UX4-LEDs FFPL 200 uses the full-field projection method to enhance its productivity by increasing the wafer size. Therefore, it allows further enhancement of the productivity and reduction of the cost of ownership in the LED lithography process.

Designed to automatically handle wafer size conversions for up to 200-mm wafers, the UX4-LEDs FFPL 200 is completely non-contact so as to cause no mask damage. The special alignment technology ensures low visibility alignment marks and the large depth of focus and special wafer chucking allows it to cope with warped wafers. What's more, the modular platform can be upgraded for different wafer sizes. There is also an optional backside alignment function to support LED wafer-level-packaging applications.

The laser lift-off (LLO) technology, for stripping a GaN film from a sapphire substrate, is indispensable to increase LED brightness. Leveraging the photolithography excimer laser known for high repetitive frequency and high stability as well as proven DUV optical technologies, Ushio has developed the UX4-LEDs LLO 150 laser lift-off system. The tool, which is designed to process 150-mm sapphire substrates, can achieve both high yield and high throughput. This system also contributes to significant reduction in LED manufacturing costs because it allows reuse of a sapphire substrate by stripping the GaN film from the entire sapphire substrate surface.

ARC Energy delivers 100th CHES Furnace for sapphire crystal growth

The highly automated "c-axis" growth furnaces are used to produce sapphire boules, and significantly drive down the cost of producing LEDs.

Provider of innovative c-axis sapphire growth technologies and turnkey solutions for the LED solid-state lighting, Advanced Renewable Energy Company, (ARC Energy), has shipped its 100th CHES Furnace.

ARC Energy's highly automated, leading-edge c-axis sapphire growth technology is generating

tremendous demand worldwide, and is being used by leading LED manufacturers throughout Asia.

By significantly increasing material utilisation and efficiency for sapphire manufacturers, ARC Energy says its products enable semiconductor volume production and commercialisation of cost effective, large diameter sapphire wafers for LED applications.

"ARC Energy's vision from the beginning was to create an innovative technology to address the world's energy problems. Our unique approach achieves that vision by significantly driving down the cost of producing LEDs, benefiting consumers worldwide," said Kedar Gupta, ARC Energy's co-founder and chief executive officer.

"The delivery of our 100th furnace shows that our products have wide market acceptance and that our mission is being realised. We are excited about this opportunity to help revolutionise the LED industry, and are committed to providing our customers with the best possible service while maintaining a leadership position in solid-state lighting technology," he continued.

Designed specifically for LED applications, ARC Energy's CHES Furnaces are highly automated "c-axis" growth furnaces that are used to produce sapphire boules. Cores from these crystals are turned into LED wafers, and finally into the high brightness and ultra-high brightness LED chips that are used in LED backlighting, general lighting, and automotive and signage applications.

ESI revolutionises LED manufacturing

The firm has recently expanded its portfolio of LED manufacturing systems and applications whilst delivering the lowest cost of ownership.

Supplier of innovative laser-based manufacturing solutions for the microtechnology industry, Electro Scientific Industries (ESI) is showcasing its new and expanded suite of LED manufacturing systems and applications at Semicon West 2011 this week.

ESI's says its new state-of-the-art products deliver the industry's highest light output LED wafer

scribing and the most advanced LED packaging solution with the highest throughput and accuracy.

“ESI has long been recognised as a pioneer and innovator of breakthrough technologies for laser-based LED manufacturing processes,” said Nick Konidaris, president and CEO of ESI. “In working closely with our LED customers, ESI has developed revolutionary systems that are directly aligned with their production roadmaps targeting the next generation of devices for high brightness solid state lighting applications. We are proud to be delivering these state-of-the-art platforms, which are providing the industry’s most attractive cost-of-ownership and ROI.”

Samsung LED and KOPTI to enhance LED lighting technology

The Korean LED chip manufacturer and research institute will collaborate to become more competitive in the LED market

On 30 June 2011, Samsung LED and the Korea Photonics Technology Institute (KOPTI) signed an agreement to accelerate the development of LED lighting technology.

With the manufacturing know-how gained from years of experience in the LED business, Samsung LED is now seeking to achieve maximum synergy by utilising the assets that KOPTI has obtained over many years such as technical skills, highly skilled researchers and equipment.

Through early development of the supplementary yet essential technologies within the centre, both organisations are aiming to obtain global competitiveness.

“Technologies and the infrastructure that KOPTI has developed for many years will help Samsung LED in great deal to become a leading global company.” said Jae Kwon Kim, CEO of Samsung LED.

Osram completes acquisition of Siteco

The purchase of the supplier of professional lighting applications opens up new growth potential for LED applications. Osram has also appointed Klaus-Günter Vennemann as head of the business unit Professional Lighting.

On 1 July 2011, Osram successfully completed the acquisition of Siteco Lighting GmbH based in Traunreut, Germany.

Siteco offers professional lighting applications for commercial and public areas, including municipal infrastructure such as buildings, streets, tunnels, airports or sport stadiums.

“With this acquisition Osram is strengthening its position in the solution business. This applies to both classic energy-saving and LED-based lighting technology,” says Wolfgang Dehen, CEO of Osram.

To aid this development, the firm has appointed former CEO of Siteco, Klaus-Günter Vennemann, 57, as head of the business unit Professional Lighting.



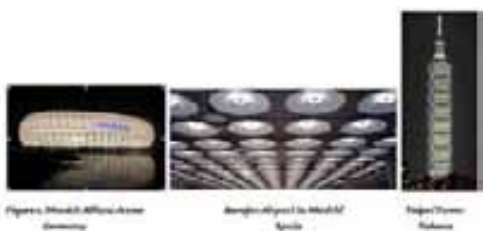
Klaus-Günter Vennemann

CEO Business Unit Professional Lighting (PL)

More than two thirds of the global lighting market is already covered by luminaires and lighting systems.

With the acquisition of Siteco, Osram gains broad market access for lighting solutions and a modern range of products in the field of interior and exterior lighting. The acquisition supports the Professional Lighting business unit, which offers components such as lamps, LED and control gear. What's more, it provides complete luminaires, light management systems and lighting solutions.

In addition to this, Siteco is a strong supplement to the competences of the established Osram joint venture Traxon, which is active in the shop-lighting, architectural, entertainment and hospitality lighting sectors.



Siteco is responsible for lighting provided at the Munich Allianz Arena, Barajas Airport in Madrid, and the Taipei Tower in Taiwan. Moreover, in the development of new products Osram can benefit from Siteco's extensive experience in collaborating with customers, architects, light designers, and fitters.

Klaus-Günter Vennemann, the new CEO of the business unit Professional Lighting is replacing Claus Regitz, 54, who will be taking on new responsibilities outside of Osram. Vennemann came to Siteco in July 2009 where he took up the position of Chief Executive Officer of the management board. Within 18 months he led the company by regaining momentum and continued to prepare it for the key issue of LED. Prior to this, Vennemann was a member of the management board of LUK for 16 years. LUK is a supplier for the international automotive industry and belongs to the Schaeffler group.

Cree and Veeco migrate to profitable LED sectors

Cree is now focusing on general LED lighting applications while Veeco is also concentrating much of its efforts on LED manufacturing equipment after its profit more than doubled in the last quarter.

According to the latest Bedford Report, despite near-term headwinds, the LED market remains well positioned for growth.

While the "backlighting" market for LEDs has slowed significantly this year, LEDs are on the verge of overtaking both incandescent and fluorescent light bulbs, in terms of use, as governments, businesses and consumers seek to curb emissions.

IMS Research's latest "LED Supply and Demand Report" expects longer-term strength in the LED market. The firm estimates 36 % revenue compound annual growth rate from 2010 to 2015 for packaged LEDs to \$6.3B, up from \$1.75B in 2011.

In the short term, IMS predicts a slowdown in the backlighting market, however. Backlighting, which ranges across consumer electronics such as flat panel TVs and cell phones, is expected to grow at a mere 2 % this year, while the general lighting market for LEDs will be the fastest-growing market, up 29 %.

Cree has taken steps in recent quarters to distance itself from the backlighting market, and focus more on the general lighting space. Cree expects fourth quarter revenues of \$225 million to \$245 million, with earnings seen at 25 cents to 31 cents per share.

Veeco CEO John Peeler said the company is confident it is in a good position to grow its LED and solar, and data storage businesses this year and beyond. In the most recent quarter Veeco said that its profit more than doubled as improved orders for data storage and its line of LED and solar products helped drive a surge in revenue.

Plants shoot up with Illumitex LEDs

Surexi LEDs combine progressive plant-growth science with advanced LED technology to provide the highest standard for the rapidly emerging global horticulture lighting market.

Illumitex, a developer of high-brightness LEDs and emerging LED technology, has released a full line of LEDs manufactured specifically to accelerate plant growth while promoting maximum plant size and vitality.

Developed in partnership with university and corporate research facilities, the Surexi LED will serve the emerging global horticulture market by providing an optimal light source for indoor vertical farms, growth chambers and greenhouses. Surexi LEDs are also ideal for tissue culture and biopharmacology laboratories where plant-based vaccines and pharmaceuticals are developed.



“The considerable investment of time and resources to develop the Surexi LED has proven to be one of our most rewarding innovations,” said Matt Thomas, CEO of Illumitex. “We are pleased to contribute to the exciting global horticulture market with both our research and our products. And this

is just the beginning. In the coming months, we will be launching an expanded portfolio of plant-growth LED products utilizing our patented LED technology.”

Illumitex claims that the Surexi is the only LED on the market that includes a custom light spectra in a single LED package, eliminating the colour separation issues inherent in other horticulture LED lighting. Utilising Illumitex’s patented square light pattern and precision beam control, the firm says that Surexi LEDs produce unrivalled edge-to-edge light uniformity while ensuring all plants receive the same amount of light – leading to more uniform growth.

Surexi LEDs are available in multiple wavelength combinations to allow consumers and researchers to precisely target the desired photoreceptors, such as phytochromes and cryptochromes.

The Surexi package design is also optimised for practical applications: at only 7mm tall, maximum plant density in vertical growth environments can be achieved, and an IP66 rating ensures the unit is protected against water in humid and wet locations. All Illumitex LEDs, including the Surexi, deliver light directly from the package without the need for inefficient and costly secondary optics.

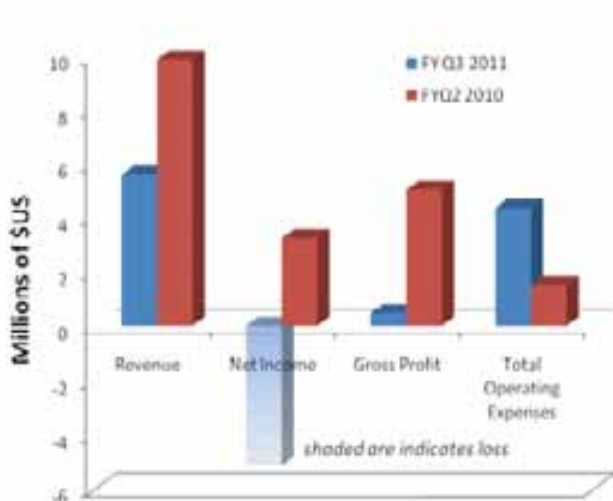
SemiLEDs FY Q3 2011 revenues plummet by 43%

The firm says the latest quarter was challenging as pricing pressure and end demand weakness continued from the fiscal second quarter although it is now seeing prices stabilise.

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

Revenue for the third quarter of fiscal 2011 was \$5.6 million, a 43% decrease compared to \$9.9 million in the third quarter of fiscal 2010.

GAAP Financial Results for
FY Q3 2011 & 2010



“Our fiscal third quarter was challenging as pricing pressure and end demand weakness continued from the fiscal second quarter. However, we are seeing pricing stabilise,” said Trung Doan, Chairman and CEO of SemiLEDs.

“We remain focused on improving our cost structure by accelerating our efforts to transition to four inch wafer production at our Taiwan facility, continuing to ramp four inch production volume at China SemiLEDs, as well as supporting our customers to maximise the benefits of our metal vertical chip structures to reduce the total cost of ownership.”

GAAP net loss for the third quarter of fiscal 2011 was \$5.1 million, or a loss of \$0.19 per diluted share, compared to GAAP net income of \$3.2 million, or \$0.09 per diluted share, for the third quarter of fiscal 2010. The Company recorded a foreign currency transaction loss of \$0.2 million in the quarter.

GAAP gross margin for the third quarter of fiscal 2011 was 9%, compared with 51% in the third quarter of fiscal 2010. Operating margin for the third quarter of fiscal 2011 was negative 70%, compared with 36% in the third quarter of fiscal 2010. Margins were negatively impacted by a charge of \$1.1 million for the write-downs of inventory.

The Company’s cash and cash equivalents was \$94.4 million at the end of the third quarter, compared to the prior quarter ending balance of \$102.6 million. Cash used in operations was \$3.3

million in the third quarter of fiscal 2011.

For its fourth quarter of fiscal 2011 ending August 31, 2011, SemiLEDs expects revenue in a range of \$5.5 million to \$6.5 million with GAAP net loss of \$6.7 million to \$6.4 million, or a loss of \$0.25 to \$0.23 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.

Phosphide based nanostructures could be used as LEDs

InAsP segments embedded in indium phosphide nanowires emit light, whose direction can be altered by adjusting the position of the InAsP active region.

Researchers from Netherlands based FOM Institute AMOLF, together with colleagues from Philips Research, Eindhoven University of Technology and Delft University of Technology, have made special compound semiconductor nanostructures that could be used as LEDs.

The scientists, led by Jaime Gomez Rivas, have demonstrated the directional emission of light by InAsP segments embedded in InP nanowires. The nanowires are arranged in a periodic array, forming a 2D photonic crystal slab.

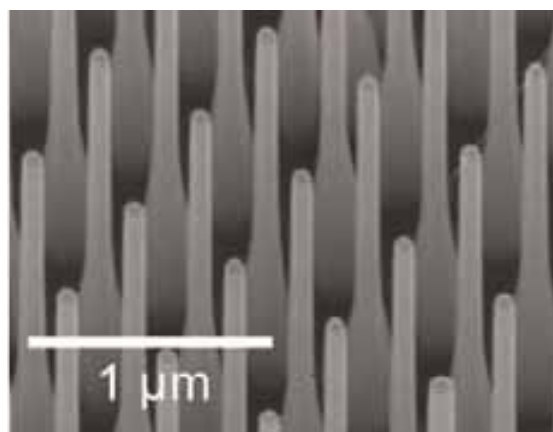


Figure 1. Electron microscope image of InP nanowires

Controlling the direction of the light is vitally important for increasing LED efficiency. The direction in which a LED emits light is mainly determined by the surface between the LED and the surrounding air. As light can only escape from the LED at small angles, the direction of emission is usually straight on (perpendicular to the surface).

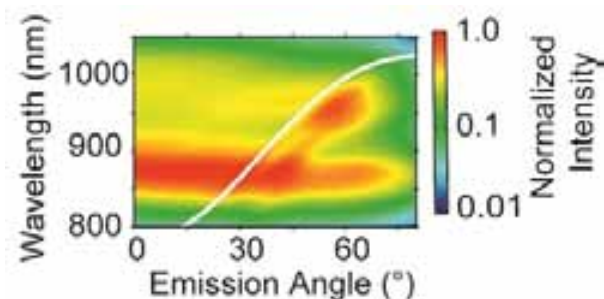


Figure 2. Diagram of the light intensity. Measurement of the intensity of the light emitted by the nanowires as a function of the wavelength (i.e. colour) and the angle of the light emitted. The maximum depends on the emitter, which is located in the nanowires. In this case it is at 950 nm and 55 degrees.

However this can be influenced by nanostructures in the surface of the LED. Inspired by these nanostructures, the researchers have developed a new technology with which the direction of the light can be changed.

The new method consists of growing partially-emitting nanowires in an ordered pattern. This pattern forms a 'photonic crystal' that sends the light in specific directions. Furthermore, the researchers have shown that the emission can be optimised by a smart positioning of the emitting part within the nanowire.

This knowledge could lead to an increased efficiency of LEDs. Moreover, the researchers say it provides opportunities for a next generation of LEDs, based on semiconducting nanowires.

This research is part of the Industrial Partnership Programme 'Improved solid-state light sources' of the Foundation for Fundamental Research on Matter (FOM) and Philips and the FOM Programme 'NanoPhotovoltaics'. It also received support from

Technology Foundation STW.

Further details of this work can be obtained from the paper entitled, 'Controlling the directional emission of light by periodic arrays of heterostructured semiconductor nanowires', by Diederhofen *et al* in *ACS Nano* (2011), doi: 10.1021/nn201557h.

SETi takes lifetime of 280nm UV LEDs to another level

The firm has achieved more than 10,000 hours lifetime on its aluminium gallium nitride UVTOP ultraviolet LEDs.

Under its continuous improvement program, Sensor Electronic Technology, Inc. (SETi) has demonstrated lifetimes of over 10,000 hours on its UVTOP275 LEDs.



Figure: SETi's UVTOP LEDs

The lifetime demonstration has been performed on a statistically valid group of LEDs from several batches which are representative of UVTOP275 products; the LEDs were packaged in TO-39 metal-glass packages with flat windows and emit at a wavelength of 280nm \pm 5nm at an average power of 0.8mW after burn-in.

Lifetime analysis was performed to SETi standard procedure; driven with a current of 20mA DC at room temperature (approximately 23°C ambient) with no heatsink or thermal management. The LEDs were physically life tested to approximately 2,000 hours and L50 levels (50% of the LED's original power) modelled from these tests.

In the past, short wavelength UVLEDs have exhibited lifetimes of just a few hundred hours, but over the past several years, SETi has been steadily increasing this performance and having now achieved over 10,000 hours, the firm believes it has reached a milestone.

This demonstration represents a massive leap in operational performance for SETi and far exceeds lifetime for other conventional UV light sources. Based in Columbia, SC, SETi manufacture LEDs from 240nm through 360nm, all manufactured in compliance with ISO9001 certification and is currently one of the leading commercial manufacturers of UV LEDs shorter than 365nm.

While this lifetime has not been released in the UVTOP product specifications, SETi does expect its UVTOP275 LEDs to exhibit L50 lifetimes approaching 5,000 hours and is developing future products to meet extended lifetime specs.

MOCVD reactors for GaN LEDs just got bigger

The 16x4inch or 69x2inch tool for gallium nitride based LED production has been unveiled by German headquartered compound semiconductor equipment manufacturer, Aixtron.

Aixtron is raising the bar again by setting a new benchmark for MOCVD reactor capacity, throughput and LED production cost.

With the introduction of the new Aixtron CRIUS II-L, what the firm says is the world's largest capacity MOCVD reactor is now available with a 16x4 inch or 69x2 inch capacity. This new reactor evolution is based on the already market proven CRIUS II platform which was introduced very successfully in 2010, guaranteeing customers a seamless transfer of qualified high performance LED processes.

"Reduction of manufacturing cost is a key issue in the LED industry, in particular when looking at the required cost reduction for solid state lighting products. After having analysed MOCVD related manufacturing cost, it was obvious that the reactor capacity remains the key parameter with the strongest influence on operating cost", states Rainer Beccard, Vice President Marketing at

Aixtron.

"This new CRIUS II-L is the largest capacity manufacturing-proven MOCVD reactor available in the world today, allowing a fast reduction in LED chip cost. It offers unsurpassed capacity and throughput, combined with an outstanding yield due to its excellent uniformity and reproducibility. The CRIUS II-L reactor is design optimised for wafer sizes from 2 to 8 inch and offers the potential for even further productivity enhancements."

As with previous generations, the CRIUS II-L reactor is based on the Close Coupled Showerhead (CCS) concept, which as a key-enabling technology has a well proven track record in being easily scalable with a seamless and short process transfer. The CCS technology is well established in many markets with an excellent reputation and known to enable straight-forward process tuning, stable and robust processes and superior performance of LEDs.

Avago oval LEDs raise the bar for viewing full-colour displays

The company says its latest through-hole indium gallium nitride and phosphide LED series reduce power consumption and provide consistent light from all angles.

Supplier of analogue interface components for communications, industrial and consumer applications, Avago Technologies, has released three series of high-brightness oval through-hole LEDs.

The new red AlInGaP LEDs are available at 626-nm dominant wavelength, and the new green InGaN and blue InGaN LEDs are available at 530-nm and 470-nm, respectively. The maximum luminous intensity at 20 mA of the new LEDs is as follows (measured in millicandelas):

* 4 mm standard oval HLMP-Lx75 LEDs: Red – 2400, Green – 6050 and Blue – 1660

* 5 mm standard oval HLMP-Hx74/75 LEDs: Red – 2400, Green – 6050 and Blue – 1380

* 5 mm mini oval HLMP-Ax74/75 LEDs: Red –

4200, Green – 7260 and Blue – 1990

Additional HLMP-Lx75, HLMP-Hx74/75 and HLMP-Ax74/75 Features

- * Standoff packages for all series and non-standoff packages for HLMP-Hx74/75 and HLMP-Ax74/75 LEDs
- * Lead-Free and RoHS 6 compliant
- * Tinted and diffused
- * Operating temperature range of -40° to +100° C for red LEDs and -40° to +85° C for green and blue LEDs
- * Electro-static discharge sensitivity: JEDEC Class 1C HBM

Avago says that they have set a new performance standard for electronic signage applications. The new HLMP-Lx75, HLMP-Hx74/75 and HLMP-Ax74/75 LEDs deliver industry-leading brightness for oval through-hole LEDs, reducing the current required to drive systems.

The LEDs' matched RGB radiation pattern is designed to maintain consistent light and uniform colour mixing from all viewing angles. This combination enables sharper viewing quality with lower power consumption for full-colour signage such as billboards, stadium video screens, building video walls, as well as for simpler roadway and commercial signage.

The HLMP-Lx75 and HLMP-Hx74/75 LED series offer a typical viewing angle of 40 by 100 degrees, while the HLMP-Ax74/75 LEDs offer 30 by 70 degrees. The wide typical viewing angles and the high luminous intensity of the LEDs deliver optimal performance for outdoor applications.

The package epoxy of the LEDs contain UV inhibitors to reduce the effects of long-term exposure to direct sunlight, and also offer superior resistance to moisture, providing enhanced durability for outdoor environments. Avago provides design flexibility with the option of shipping tight colour and intensity bins, up to 4 nm per bin for the new blue and green LEDs.

“Our customers already recognise the quality Avago LEDs bring to full-colour electronic signage applications, and we believe these new offerings will add to our reputation and success in this quickly

growing market,” said Francis Khor, director of marketing for the optoelectronics products at Avago. “These efficient and durable new LEDs provide superior viewing performance, along with cost savings realised from lower power consumption and reduced maintenance.”

U.S. Pricing and Availability

The green and blue HLMP-Lx75, HLMP-Hx74/75 and HLMP-Ax74/75 LEDs are priced at \$0.21 each in minimum quantities of 2,000 pieces, and the red LEDs are priced at \$0.12 each in minimum quantities of 2,000 pieces. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

Telecoms

WI GaAs device market to shoot up to \$320 million in 2015

The number of base station sector shipments, which use gallium arsenide based technology, will increase to slightly more than 9.2 million in 2015 where more than half of these sectors will be for lower power, smaller cells.

With mobile data consumption continuing to skyrocket, operators are refining their wireless infrastructure network architecture to support the increasing data demand.

The recently released Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) Forecast and Outlook, “Wireless Infrastructure RF Power Device Demand: 2011 - 2015,” forecasts that developments like MIMO (Multiple Input/Multiple Output) antennas, heterogeneous networks, remote radio heads and small cells will increase the number of base station sectors, but reduce the transmit power required from each sector. Both trends will lead to a consistent growth rate from GaAs devices, bringing the market value to \$320 million in 2015.

The firm's latest report forecasts that the number of base station sector shipments will increase to slightly more than 9.2 million in 2015. More than half of these sectors will be for lower power, smaller cells. Additionally, Strategy Analytics details the history and latest trends for antennas, power amplifiers, low noise amplifiers, transceivers and front-end components.

"Mobile data consumption is rapidly pushing the wireless infrastructure market to an inflection point," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service. "Operators are implementing networks that rely on smaller, lower power cell footprints to ensure that consumers continue to embrace data applications. This architecture expands opportunities for GaAs components."

Asif Anwar, Director in the Strategy Analytics Strategic Technologies Practice added, "4G technologies, like LTE, are forcing the network evolution to larger numbers of lower power infrastructure sectors which will increase the opportunity for GaAs amplifiers."

The report segments the wireless infrastructure amplifier market by function (power, driver, low noise) and technology. It also forecasts the number of base station sectors by geography, frequency and output power. It also addresses trends in subscriber growth, antenna technologies and power amplifier designs.

Finisar announces schedule for investor conference presentations

The telecom solutions provider will be presenting its latest results in New York and Las Vegas on 8th and 14th September respectively.

Finisar Corporation, a global provider of high-speed optical communication products, has announced that the Company's management will speak at two upcoming investor conferences in the U.S.

These events can be viewed from the Company's website at www.finisar.com. An archive of each presentation will be available following the live

event.

2011 Citi Technology Conference
Presenter: Jerry Rawls, Executive Chairman
Date: Thursday, September 8, 2011
Time: 9:00am EST/12:00pm PST
Location: The Hilton New York Hotel

Deutsche Bank 2011 Technology Conference
Presenter: Jerry Rawls, Executive Chairman
Date: Wednesday, September 14, 2011
Time: 2:45pm PST/11:45am EST
Location: The Cosmopolitan of Las Vegas

Advanced Photonix hires Jeffrey Anderson as CFO

Anderson has a varied background and run accounting organisations with only 5 employees and as many as 140 in over 14 different countries.

The new appointment by Advanced Photonix of Chief Financial Officer, Anderson is effective August 29, 2011.

Richard (Rick) Kurtz President and CEO of Advanced Photonix, stated, "Jeff has over 30 years of business experience, starting in public accounting and moving into a number of high technology companies with annual revenues ranging from \$50 million to over \$3 billion. He has guided companies through merger and acquisitions and he has completed over ten financings involving bond and equity raises. He has run accounting organisations with as few as 5 employees and as many as 140 in over 14 different countries. To complement his business background he has a BA, MBA, CPA and CMA, this unique combination of skills will be important in managing the growth of API. We look forward to having Jeff be part of the API Team and we will continue to look to build on our strong internal management talent pool in the future."

In connection with his appointment as the Chief Financial Officer of API, API entered into an employment agreement with Anderson on August 29, 2011. Anderson's employment agreement provides, among other things, that he will receive upon the commencement of his employment a grant of restricted stock under the API 2007 Equity

Incentive Plan covering 100,000 shares of API Class A Common Stock. He will also have an option to acquire 160,000 shares of API Class A Common Stock pursuant to the API 2007 Equity Incentive Plan at an exercise price per share equal to fair market value of the shares on the grant date.

Finally, Anderson will receive a one-time relocation bonus of \$50,000. The restricted stock and options granted to Anderson upon the commencement of his employment vest in quarterly instalments on each of the first four anniversaries of the date of the grant.

IQE supports Asia Pacific region with new sales manager

Based at the Group's Singapore facility, Norio Hayafuji will provide customers with a technical focus for IQE's wireless, optoelectronic and photovoltaic products across the APAC area.

IQE, a global supplier of advanced semiconductor wafer products and services to the semiconductor industry, has appointed Norio Hayafuji as Head of Sales and Marketing for the Asia Pacific region.

Norio has more than 27 years' experience in manufacturing, business development, sales and marketing and general management within compound semiconductor technology companies including Mitsubishi Electric, Procomp and Century Epitech.

Norio will be based at the Group's Singapore facility. He will coordinate sales and marketing activities and provide a technical focus for wireless, optoelectronic and photovoltaic products across the Group's Asia Pacific customer base.

CEO and President, Drew Nelson, said, "We confidently expect China, Taiwan, Korea and Japan to become major global powers in emerging technologies over the next decade. We already have a considerable presence in the Far East with a solid customer base and state-of-the-art manufacturing facility. The appointment of an acknowledged industry expert with extensive knowledge and experience of our industry in the

region will help ensure that IQE is well positioned to exploit this growth potential."

IQE's comprehensive wireless portfolio includes III-V PHEMT, HBT, and BiFET epi-wafers grown by MBE and MOCVD at IQE's manufacturing sites in the US, UK, and Singapore.

Oxford Instruments receives Queen's Award

The award for enterprise was based on the firm's comprehensive product range addressing a wide spread of markets combined with an aggressive strategy of developing new markets, primarily in Asia.

The manufacturer of high performance capital equipment for the semiconductor industry received the award for International Trade, for more than doubling overseas earnings over six years of sustained growth, and exporting over 90% of production.

This outstanding performance was based on the Company's comprehensive product range addressing a wide spread of markets combined with an aggressive strategy of developing new markets, primarily in Asia. This is the 3rd time the company has been honoured in the Queen's Awards.



Lady Gass, Lord Lieutenant of Somerset presents the Queen's Award to Andy Matthews, Managing Director, Oxford Instruments Plasma Technology

Following a short presentation, the Lord Lieutenant toured Oxford Instruments' manufacturing plant, research laboratories and offices in Yatton, North Somerset, and was accompanied by John Cullum,

High Sherriff of Somerset, and Graham Turner, Chief Executive of North Somerset Council.

“It was an honour to welcome the Lord Lieutenant and other dignitaries to our facility again”, said Andy Matthews, Managing Director of Oxford Instruments Plasma Technology, “We were able to demonstrate our technology, and show the extensive improvements and growth in both facilities and workforce that have taken place recently. This award for International Trade recognises the hard work and commitment of the entire team at Oxford Instruments, and I was delighted to receive it on their behalf. This outstanding performance was based on our comprehensive product range addressing a wide spread of markets combined with an aggressive strategy of developing new markets, primarily in Asia.”

Infinera opens office for Asia Pacific customers

The facility in Hong Kong is aimed at demonstrating the firm’s indium phosphide digital optical network innovation as Infinera expands in the APAC.

Infinera has announced the opening of a new full-service facility in Hong Kong, demonstrating its commitment to provide enhanced levels of service and support to customers in Asia Pacific.

The new facility provides a localised environment for product demonstrations, training, and support for the growing number of APAC customers who deploy Infinera’s innovative Digital Optical Network technology to offer services more rapidly and more profitably.

Staffed with sales, engineering, technical and operational support teams, the new presence in Hong Kong will also enable Infinera to gain ongoing, in-depth understanding of market requirements and respond faster to customers’ needs.

Infinera changed optical networking in 2004 with the introduction of the DTN, which remains the industry’s first and only solution that integrates Dense Wave Division Multiplexing (DWDM) directly with OTN switching through the use of InP based Photonic Integrated Circuits (PICs). This pioneering integration of DWDM and OTN via PICs enables the

Digital Optical Network to work faster, simpler and more profitably by removing many of the challenges found in traditional analogue optical networks.

According to recent research from Ovum, the global optical networking equipment market is driven by the continuing need for bandwidth and expected to reach \$20 billion by 2015 with a compound annual growth rate (CAGR) of 5 percent; Asia-Pacific was identified as the number one growth region for optical networking sales. As an innovation leader reputed for quality and highly scalable solutions, Infinera is well-positioned to meet the growing need for efficient and reliable networks.

“Infinera is focused on growing our footprint in the expanding Asian market,” said Tom Fallon, Infinera CEO. “Building on our success in North America, we have achieved significant growth in EMEA and are now determined to extend this success to APAC. Infinera has made optical networking faster, simpler and more efficient, and we are excited to demonstrate this innovation to our existing and future customers in APAC.”

“This new facility marks the beginning of a long-term investment by Infinera in APAC,” said Andrew Bond-Webster, Vice President APAC, Infinera. “We will continue to listen to our customers, make ourselves more accessible to them, and expand our local team of expertise to create winning opportunities for everyone in the long term.”

Avago debuts first 16 Gigabit fibre channel transceiver

The new module, which incorporates an 850 nm gallium arsenide based VCSEL, is claimed to increase port density and deliver twice the data bandwidth of the current generation of fibre channel devices at nearly the same power level.

Avago Technologies has announced production availability of a 16 Gigabit Fibre Channel transceiver with industry-standard signalling rates up to 14.025 GBd.



The new AFBR-57F5PZ SFP+ transceivers support high-speed serial links over multimode optical fibre with double the data throughput of existing 8 Gigabit Fibre Channel modules. The modules address 16 Gigabit Fibre Channel switches, routers, host bus adapters, RAID controllers, tape drives and video switching, as well as inter-switch and inter-chassis aggregated links.

The AFBR-57F5PZ SFP+ transceiver reduces the number of ports required for inter-switch connectivity by a factor of two compared to existing 8 Gigabit Fibre Channel solutions and operates at essentially the same power level. The SFP+ module's transmitter and receiver can operate at different data rates, as is often required during Fibre Channel speed negotiation. The module maintains compatibility with legacy 8 Gigabit and 4 Gigabit Fibre Channel devices, simplifying design migration.

"Our new 16 Gigabit Fibre Channel SFP+ module continues the Avago tradition of setting new performance standards and bringing innovative form-factors to market first," said Victor Krutul, director of marketing for the Fiber Optics Products Division at Avago. "Avago has worked closely with our top customers to develop solutions with the bandwidth and port-density they require, which has helped us to establish a position as the market's leading Fibre Channel optical supplier in the storage networking segment."

The AFBR-57F5PZ transceiver incorporates Avago's 850 nm Vertical-Cavity Surface Emitting

Laser (VCSEL) technology and PIN detector technology. This combination ensures that the multi-rate SFP+ module is compliant with FC-PI-5 and 16G/8G/4G Fibre Channel specifications. The module will respond to both rate select pin and control bit inputs, which simplifies Fibre Channel host auto-negotiation algorithms, layout and software.

The lead-free and RoHS-compliant device has a temperature operation of 0° to 70° C and supply voltage of 3.3V ± 5% and digital diagnostic features of the SFF-8472 module. The LC Duplex optical connector interface also conforms to ANSI TIA/EIA604-10 (FOCIS 10A) and has enhanced EMI performance for high port density applications.

U.S. Pricing and Availability

The AFBR-57F5PZ 16 Gigabit Fibre Channel transceiver is priced at \$215.35 each in 100 piece quantities. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

GigOptix upgrades share trading to top tier of OTCQX

The company says increased trading transparency and more prominent access through the U.S. broker-dealer will enhance value for shareholders.

GigOptix, a supplier of semiconductor and optical components that enable high-speed information streaming, has announced that its common stock will begin trading on the quality-controlled OTCQX U.S. Premier trading platform on Tuesday, August 16, 2011.

Avi Katz, chairman and chief executive officer, commented, "We are very pleased to announce the upgrade of our primary trading venue to the OTCQX trading platform, a designation that indicates to investors that GigOptix meets the highest financial standards among OTC traded companies. Since its inception four years ago, GigOptix has advanced from a start-up to an industry leader by successfully executing on our business plan and growth strategies. As a result of these efforts, we have consistently increased quarterly product revenue, while strictly managing expenses and cash as

reflected by our solid financials and debt-free balance sheet. GigOptix's transition to the OTCQX is the next step toward further increasing investor awareness through the platform's increased trading transparency and more prominent access through U.S. broker-dealers. As a result of this upgrade from the OTCQB platform, we have reached a level of recognition that will enhance value for our shareholders as we continue to pursue our ultimate goal of listing on a national exchange."

The OTCQX U.S. Premier platform distinguishes the best companies traded over-the-counter (OTC) from more than 9,000 securities traded on the OTCBB and OTC Link that are not required to meet any financial standards or undergo a qualitative review, attesting to the highest financial standards adhered to by GigOptix

Anadigics InGaP PA revolutionises LG's Android

The firm's HELP4 LTE power amplifier, which uses indium gallium phosphide technology enables the LG Android smartphone.

Anadigics, a manufacturer of RF products is shipping production volumes of its ALT6713 fourth generation High-Efficiency-at-Lower-Power (HELP4) LTE power amplifiers (PAs) to LG Electronics.



The ALT6713 is powering the Revolution by LG VS910smartphone for Verizon Wireless. The featured-packed Revolution by LG handset

includes a large 4.3" capacitive touch screen, 1 GHz Snapdragon processor, 5.0 megapixel rear-facing camera, 720p video capability, Android 2.2 operating system, and 4G LTE connectivity. Anadigics' ALT6713 PA is also used to power LG Electronics' VL600 USB LTE modem.

"The selection of Anadigics' power amplifiers for the Revolution by LG demonstrates the strength of the relationship forged between Anadigics and LG Electronics," said Michael Canonico, senior vice president of worldwide sales at Anadigics.

"We understand the challenges facing handset manufacturers today as the demand for power-hungry multimedia and high-speed data features continues to threaten battery-life. Leveraging our technology leadership, RF design expertise and engineering prowess, Anadigics has responded to these challenges by delivering the industry's most efficient LTE power amplifier. We look forward to working with LG Electronics on the design of future platforms."

Anadigics' HELP4 4G PAs use the Company's exclusive InGaP-Plus technology to achieve optimal efficiency across low-range and mid-range output power levels. The ALT6713 helps improve battery life by combining the industry's highest efficiency with an exceptionally low quiescent current. This world-class performance reduces average PA current consumption by 30%, compared with previous generation devices.

With a 35% PAE @ +27.5 dBm operating in the 777 MHz to 798 MHz frequency band (Band 13 and Band 14), the Anadigics ALT6713 has a low quiescent current of 3 mA. Optimised for LTE applications, the highly integrated module is claimed to have best-in-class linearity at maximum output power. It comes in a 3 mm by 3 mm by 1 mm footprint, has Internal voltage regulation and has an integrated "daisy chainable" directional RF coupler.

JDSU honoured for test and measurement in Asia-Pacific

The company has been recognised for its collaborations and providing industry-leading LTE, mobile video, next-generation broadband and fibre optic test solutions.

Frost & Sullivan has awarded JDSU as its 2011 Asia-Pacific Communications Test & Measurement Company of the Year.

JDSU's collaboration with in-region communications service providers and its proven expertise in innovative test and measurement solutions were cited as factors that led JDSU to outperform its competition.

"JDSU's diverse communications test and measurement solutions portfolio coupled with significant market strategies, both organic and inorganic, have resulted in a strong presence in the Asia-Pacific region," said Sriram Venkatasubramanian, consultant for Frost & Sullivan's Asia-Pacific Measurement and Instrumentation practice.

"With the Asia-Pacific region witnessing increased adoption of LTE technology, for example, JDSU's end-to-end LTE test solution complements the goals of mobile operators in the region such as commercialising this technology, increasing the customer base, and attaining considerable success in the coming years."

Venkatasubramanian added, "JDSU makes its presence felt across most of the communications test segments in the region and the company is essentially a one-stop-shop for communications test and measurement solutions in the Asia-Pacific region."

JDSU serves network equipment manufacturers and operators in the Asia-Pacific region with test and measurement solutions to quickly and cost-effectively deploy next-generation networks and services. In the study, JDSU's leadership position was attributed to enabling LTE/4G, fibre optic, xDSL as well as other critical networks, services and technologies.

Last year, CSL of Hong Kong, SingTel of Singapore

and Chunghwa Telecom of Taiwan chose JDSU as their partner in LTE network trials and deployments. In addition, JDSU established one of its largest wireless research and development (R&D) sites in Singapore for wireless services/LTE test portfolio R&D. The Singapore facility joins JDSU's major operations in Beijing, Shenzhen, Suzhou, Tokyo, Penang and New Delhi providing JDSU with a significant in-region presence to expand its relationships with Asia-based customers and suppliers.

"Given that this is one of the fastest growing regions for wireless services, JDSU is committed to continuing its collaborative innovation with our customers throughout Asia-Pacific," said David Heard, president of JDSU's Communications Test and Measurement business segment. "As use of mobile devices and bandwidth-intensive services drive increasing network complexity, we look forward to continue helping our customers in the region deliver a quality experience to their customers."

The Frost & Sullivan Company of the Year award is presented annually to the organisation that exhibits excellence in growth strategy and implementation, innovation in new products and technologies, and leadership in customer value and market penetration.

Avago accelerates ethernet communication in harsh environments

The company's new compact transceiver, which incorporates a phosphide based 650nm LED and other III-V compound semiconductor components, offers reliable data transmission of up to 100 Mbps.

Avago Technologies, a supplier of analogue interface components for communications, industrial and consumer applications, has revealed a fast ethernet transceiver that provides reliable data transmissions over plastic optical fibre (POF).

The new AFBR-5972Z transceiver provides the ability to implement fast communication up to 100 Mbps and is suitable for networking in harsh environments such as factory automation or power

generation and distribution applications. Featuring a compact design using an Avago Versatile Link duplex connector, the transceiver reduces board footprint.



AFBR-5972Z Fast Ethernet transceiver

An extension of the Versatile Link connector series, the AFBR-5972Z transceiver eliminates the electromagnetic interference, crosstalk, and electrical ground problems that are common with copper wire solutions, while also providing easier, more flexible installation. The transceiver's new AFBR-4526Z duplex connector is similar in size to electrical RJ-45 sockets and is compatible with existing simplex Versatile Link connectors.

In addition to the smaller size, Avago says the transceiver is more cost-efficient than comparable PROFINET industrial Ethernet standard connector solutions. Offering robust operation in the -40° to $+85^{\circ}$ C extended industrial temperature range, the device is suitable for industrial applications and supports various Ethernet Fieldbus protocols and is compatible with quasi-industry standard IEEE 802.3 100BASE-FX.

The AFBR-5972Z device's transmitter is based on a high-power, 650-nm LED with an integrated driver that operates at 3.3V. The transmitter receives a LVPECL/LVDS electrical input and converts it into a modulated current, driving the LED. The LVPECL digital interface enables a direct connection to Ethernet PHY ICs. The high-bandwidth receiver contains a PIN photodiode. The PIN photodiode is

packaged in an optical subassembly that couples the optical power efficiently from POF fibre to the receiving PIN.

With link lengths up to 50m POF (NA0.5) or 70m POF (NA0.3), the module is lead-free and RoHS-compliant and has LVPECL signal detect output.

The AFBR-5972Z Fast Ethernet transceiver is priced at \$24.18 each in 100 piece quantities. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

Infinera PICs speed up optical networks in Africa

SEACOM, a leading pan-African telecommunications provider, has used Infinera's indium phosphide PICs to achieve what both firms believe is the first ever 500Gb/s successful trial in Africa.

Infinera and SEACOM have successfully completed a trial of five 100 Gigabit per second (100Gb/s) coherent optical signals transmitted over 1732 km in Africa.

Believed to be a first of its kind in Africa, the 500Gb/s trial ran over and was looped back across SEACOM's newly built 930 km Dark Fibre Africa fibre route which links the SEACOM Mtunzini cable landing station in KwaZulu Natal to the Teraco data centre in Johannesburg.

The live demonstration was witnessed by members of Africa's scientific, research and development community at Teraco's data centre in Johannesburg. The trial used Infinera's 500Gb/s InP based Photonic Integrated Circuits (PICs), each of which integrates five 100Gb/s coherent channels onto a single chip.

The PICs were used for both transmitting and receiving the five 100Gb/s signals during the trial, the first time the PICs have been used to transmit and provide real time coherent processing for all 500Gb/s simultaneously on a production network. The trial also demonstrated Infinera's FlexCoherent functionality by switching between QPSK and BPSK modulation.

Infinera plans to deliver the 500Gb/s PICs as part of a system which integrates 5 Terabit per second (Tb/s) OTN switching and 100Gb/s coherent optical transmission in early 2012. Enabling seamless upgrades from existing 10Gb/s networks without having to upgrade the underlying fibre infrastructure, this technology is designed to provide SEACOM's land-based network in South Africa with a total capacity of over 8Tb/s per fibre, which is an effective 10 fold increase on its current capacity. This is in line with and in support of SEACOM's plans to expand the marine portion of the cable to over 4.8Tb/s.

"The trial is a landmark achievement for SEACOM and Infinera because it demonstrates our commitment to increase the pace at which African networks are deploying cutting-edge telecommunications infrastructure technology to support Africa's rise as a primary scientific and business destination," said Brian Herlihy, SEACOM CEO.

Fibre optic transmission technologies have been developing considerably to satisfy demand for large-capacity digital transmission in public telecommunication networks worldwide. At the consumer level, the 500Gb/s PIC technology enables the download of 30 high-definition Blu-Ray movie files in 60 seconds, or supports the streaming of 4,000 simultaneous high definition video channels over a single optical channel.

At the network level, 100Gb/s systems based on PIC technology will have important implications for the economics of future networks. Infinera's 500Gb/s PICs incorporate more than 600 optical functions on a pair of indium phosphide chips enabling cost effective 100Gb/s coherent transmission as well as integrated OTN switching to deliver the Digital Optical Network.

These capabilities provide an effective means for network operators to scale network capacity while lowering operational costs, increasing reliability and providing for superior network economics.

"With Internet traffic growing at exponential rates, driven by video, cloud computing, and mobility, the 500G PIC technology is designed to support the required growth in network capacity, while reducing the per-bit cost, space, and power consumption," said Tom Fallon, Infinera CEO. "These attributes

are in-line with SEACOM's vision to providing world-class infrastructure as African traffic continues to increase at record speeds."

GaAs entices electrons to 'dance' and form a new state

Using temperatures close to absolute zero and a magnetic field, researchers have captured electrons in ultrapure gallium arsenide microscopic wells and forced them to interact only with each other.

A team of Purdue University researchers is among a small group in the world that has successfully created ultrapure material that captures new states of matter and could have applications in high-speed quantum computing.

The team has used GaAs based structures to observe states in which electrons no longer obey the laws of single-particle physics, but instead are governed by their mutual interactions.

Michael Manfra, who leads the group, commented, "These exotic states are beyond the standard models of solid-state physics and are at the frontier of what we understand and what we don't understand. They don't exist in most standard materials, but only under special conditions in ultrapure gallium arsenide semiconductor crystals,"

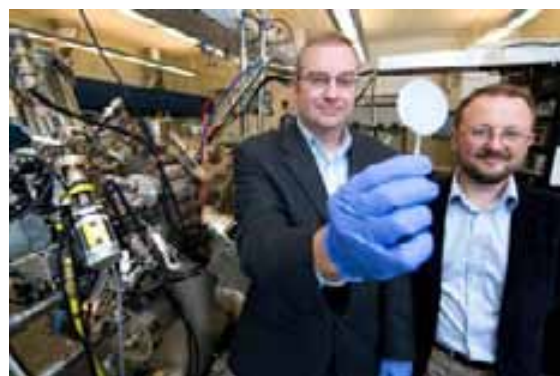


Figure: Michael Manfra (left) and Gabor Csathy stand next to the high-mobility GaAs MBE system at the Birck Nanotechnology Centre. Manfra holds a GaAs wafer on which his research team grows ultrapure GaAs semiconductor crystals to observe new electron ground states that could have applications in high-speed quantum computing. (Purdue University photo/Andrew Hancock)

Quantum computing is based on using the quantum mechanical behaviour of electrons to create a new way to store and process information that is faster, more powerful and more efficient than in classical computing.

It taps into the ability of these particles to be put into a correlated state in which a change applied to one particle is instantly reflected by the others. If these processes can be controlled, they could be used to create parallel processing to perform calculations that are impossible on classical computers.

“If we could harness this electron behaviour in a semiconductor, it may be a viable approach to building a quantum computer,” Manfra said. “Of course this work is just in its very early stages, and although it is very relevant to quantum computation, we are a long way off from that. Foremost at this point is the chance to glimpse unexplained physical phenomena and new particles.”

Manfra and his research team designed and built a tool which they refer to as a high-mobility GaAs MBE system, which is housed at Purdue’s Birck Nanotechnology Centre. The tool is capable of growing ultrapure semiconductor materials with atomic-layer precision.

The material is a perfectly aligned lattice of gallium and arsenic atoms that can capture electrons on a two-dimensional plane, eliminating their ability to move up and down and limiting their movement to front-to-back and side-to-side.

“We are basically capturing the electrons within microscopic wells and forcing them to interact only with each other,” continued Manfra. “The material must be very pure to accomplish this. Any impurities that made their way in would cause the electrons to scatter and ruin the fragile correlated state.”

The electrons also need to be cooled to extremely low temperatures and a magnetic field is applied to achieve the desired conditions to reach the correlated state.

Physicist Gabor Csathy is able to cool the material and electrons to 5 millikelvin - close to absolute zero or 460 degrees below zero Fahrenheit - using special equipment in his lab.

“At room temperature, electrons are known to

behave like billiard balls on a pool table, bouncing off of the sides and off of each other, and obey the laws of classical mechanics,” Csathy said. “As the temperature is lowered, electrons calm down and become aware of the presence of neighbouring electrons. A collective motion of the electrons is then possible, and this collective motion is described by the laws of quantum mechanics.”

The electrons do a complex dance to try to find the best arrangement for them to achieve the minimum energy level and eventually form new patterns, or ground states, he said.

Csathy, who specialises in quantum transport in semiconductors, takes the difficult measurements of the electrons’ movement. The standard metric of semiconductor quality is electron mobility measured in centimetres squared per volt-second. The group recently achieved an electron mobility measurement of 22 million centimetres squared per volt-second, which puts them among the top two to three groups in the world, he said.

Manfra and Csathy presented their work at Microsoft’s Station Q summer meeting on June 17 at the University of California, Santa Barbara. This meeting, sponsored by Microsoft Research, brings together leading researchers to discuss novel approaches to quantum computing. They also received a \$700,000 grant from the Department of Energy based on their preliminary results.

The research team also includes several physicists from Purdue.

“A broad team is necessary to probe this type of physics,” Manfra concluded. “It takes a high level of expertise in materials, measurement and theory that is not often found at one institution. It is the depth of talent at Purdue and ability to easily work with researchers in other areas that made these achievements possible.”

Kopin - Smartphones Continue to Drive III-V Business

Kopin Corporation Announces Second Quarter 2011 Financial Results

- Total revenues of \$31.4 million, up 4% from the same quarter in 2010
- Company reiterates 2011 revenue guidance of \$130 million to \$140 million

Kopin Corporation, supplier of advanced semiconductor products and micro displays for mobile applications including smartphones, tablet PCs, military thermal weapons sights and wearable computers, today announced financial results for the second quarter ended June 25, 2011.

Financial Highlights

Total revenues increased 4 percent to \$31.4 million from \$30.2 million for the same quarter of last year. III-V revenue increased to \$16.0 million, compared with \$15.9 million in the second quarter of 2010. Display revenue increased to \$15.4 million from \$14.3 million for the same quarter last year.

Gross margin increased to \$10.5 million, or 35 percent of product revenues, compared with \$7.3 million, or 25 percent of product revenues, for the comparable period of 2010.

Operating expenses were \$31.0 million in the second quarter of 2011, compared with \$30.9 million in the second quarter of 2010. R&D expenses were \$7.1 million, or 23 percent of revenues, compared with \$4.9 million, or 16 percent of revenues, in the second quarter of 2010, reflecting Kopin's investments in its Golden-i technology, III-V smartphone products and capacity expansion, military display products, and the inclusion of Forth Dimension Display's (FDD) expenses. Selling, general and administration (S,G&A) expenses were \$4.7 million in the second quarter of 2011, compared with \$4.2 million for the same period of last year. The increase in S,G&A expenses is attributable to the inclusion of FDD's expenses.

Net income was \$0.8 million, or \$0.01 per diluted share, for the second quarter of 2011 compared

with \$1.9 million, or \$0.03 per diluted share, for the second quarter of 2010. Net income for the second quarter of 2010 included a \$1.9 million gain from the sale of investments and a \$0.7 million gain related to foreign currency fluctuations. Kopin's 2011 second quarter results included a net gain of \$0.4 million from the sale of investments and a net loss of \$0.3 million from foreign currency fluctuations.

Kopin's cash and marketable securities balance at the end of the second quarter was \$99.3 million and no long-term debt.

"Our second-quarter operating results reflect a continuation of the strategy we set forth at the beginning of the year – balancing short-term financial performance with a focus on long-term growth," said Kopin President and Chief Executive Officer Dr. John C.C. Fan. "We are in the enviable position of having strong growth projections for our III-V products, the opportunity to add a new military display product category, night vision systems, to our current portfolio of thermal weapon sight products and the development of a potentially game-changing, hands-free wireless industrial computing product in Golden-i. Because of the current strong growth of smart phones, the requirement for those competing for an award of the Enhanced Night Vision program in 2012 to provide qualification units in 2011 and our drive to be a leader in voice activated cloud computing, these opportunities have required significant investments this year."

"Yet with all of our development efforts, through the first half of fiscal 2011 we have maintained strong operating results," Dr. Fan said. "Overall our revenues are up 19%, with our III-V revenues up 10 percent over the same period last year as we head into what historically has been our strongest part of the year. Although the current federal budget situation has impacted the timing of display product sales, we expect another year of strong military revenues as evidenced by our recently announced \$23.2 million in follow-on orders for the TWS Bridge (TWS-IIB) program. Our income from operations is \$2.6 million for the first half of 2011 compared with a loss of \$0.8 million through the same period last year, we have generated \$3.5 million in cash flow from operating activities and repurchased \$1.9 million of our common stock."

Smartphones Continue to Drive III-V Business

“Our III-V technology is helping to drive the rapid adoption of advanced 3G and 4G technologies across the major smartphone and tablet platforms,” Dr. Fan said. “These advanced new devices not only require more III-V transistors, but structures that are more technologically complex and challenging to produce. As these phones continue to become more complex, Kopin is benefitting with higher and higher dollar content per handset. Our ability to produce these advanced products in volume and at a competitive price is simply unmatched in the industry.”

Display Business Excels through System Expertise

“Just as with our III-V business, our display customers also require products that are technologically more complex to produce,” Dr. Fan said. “The trend today is toward full system solutions, including displays, backlights, optics, ASIC chips, hardware and software. Once again this trend plays to our strength, as we believe that our decades of technology expertise and display system manufacturing experience differentiate us in the market.”

Golden-i Program on Schedule

“Together with our business partner Motorola Solutions, we continue to make excellent progress in bringing our Golden-i® hands-free mobile computing solution to market in 2012,” Dr. Fan said. “Initial response to field tests of Golden-i by select customers has been extremely positive. Golden-i was demonstrated this month at the Microsoft®-hosted Imagine Cup 2011 in New York and the World Future 2011 in Vancouver.”

Business Outlook

“With revenues for the first six months of 2011 at \$66 million and the third and fourth quarters traditionally our strongest, we are on course to achieve our full-year revenue guidance of \$130 million to \$140 million,” Dr. Fan said. “Robust smartphone demand should continue to fuel our III-V business, just as the TWS-IIB and a number of military R&D programs are expected to generate momentum for our display unit.”

TriQuint revenue for Q2 up 10% from Q2`10

TriQuint Semiconductor, an RF solutions supplier and technology innovator, announces its financial results for the quarter ended July 2, 2011, including the following highlights:

- Revenue for the quarter was \$228.8 million, up 10% from Q2`10
 - Mobile Devices revenue for the first half of 2011 grew 29% over the first half of 2010
 - GAAP Net Income for the quarter was \$16.6 million, or \$0.10 per diluted share
 - Non-GAAP Net Income for the quarter was \$28.9 million, up more than 10% from Q1`11. Non-GAAP EPS was \$0.17 per diluted share
- Named industry veteran James Klein as Vice President and General Manager of TriQuint's Defense & Aerospace business
- Released a new base station amplifier family with innovative, patent-pending technology to protect systems from disruptive power, ESD & RF spikes
- Announced key GaN results: 'Trusted Foundry' accreditation, new standard products and University of Notre Dame's report citing industry-leading performance
- Commenting on the results for the quarter ended July 2, 2011, Ralph Quinsey, President and Chief Executive Officer, stated “Driven by strong demand in the Smartphone market, we experienced 10% revenue growth over Q2 2010. Despite short term headwinds, TriQuint's long term growth story remains intact. During 2011, we have sharpened our focus and invested in innovation to ensure we support our customers for the long term growth opportunities ahead of us. Based on the current design wins and customer forecasts, I expect to return to strong revenue growth in Q4.”

Summary Financial Results for the Three and Six Months Ended July 2, 2011:

Revenue for the second quarter of 2011 was \$228.8 million, up 10% from the second quarter of 2010 and up 2% sequentially. Revenue for the six months ended July 2, 2011 was \$453.1 million, up 17% from the six months ended July 3, 2010. Mobile Devices revenue grew 19% year over year for the second quarter and 29% on a year to date basis.

GAAP

Gross margin for the second quarter of 2011 was

40.3%, down from 41.2% in the second quarter of 2010 and up sequentially from 39.0%. Gross margin for the six months ended July 2, 2011, at 39.6% was consistent with the gross margin for the six months ended July 3, 2010.

Operating expenses for the second quarter of 2011 were \$70.9 million, or 31% of revenue, up from \$58.8 million in the second quarter of 2010 and \$67.1 million in the previous quarter. Operating expenses for the six months ended July 2, 2011 were \$138.0 million, up from \$114.0 million for the six months ended July 3, 2010.

Net income for the second quarter of 2011 was \$16.6 million, or \$0.10 per diluted share, up sequentially from \$12.4 million or \$0.07 per diluted share. Net income for the six months ended July 2, 2011 was \$29.0 million or \$0.17 per diluted share.

Non-GAAP

Gross margin for the second quarter was 41.4%, down from 42.3% in the second quarter of 2010 and up sequentially from 40.0%. Gross margin for the six months ended July 2, 2011 and July 3, 2010 was 40.7%.

Operating expenses for the quarter were \$65.6 million or 29% of revenue, including \$7.5 million of litigation expense. Operating expenses for the six months ended July 2, 2011 were \$128.8 million or 28% of revenue, including \$12.9 million of litigation expenses.

Net income for the second quarter of 2011 was \$28.9 million, or \$0.17 per diluted share, up sequentially from \$0.15 per diluted share and down from \$0.20 in the second quarter of 2010. Net income for the six months ended July 2, 2011 was \$55.0 million or \$0.32 per diluted share.

Please see the discussion of non-GAAP financial measures below and the attached supplemental schedule for a reconciliation of GAAP to non-GAAP financial measures.

Outlook:

The Company believes third quarter revenue will be between \$225 million and \$235 million. Litigation expense is expected to be approximately \$5 million. Third quarter non-GAAP net income is expected to be between \$0.16 and \$0.18 per share. The Company is 88% booked to the midpoint of revenue guidance.

NeoPhotonics Enters the Cloud

NeoPhotonics Corporation, a designer and manufacturer of photonic integrated circuit, or PIC, based modules and subsystems for bandwidth-intensive, high speed communications networks, today announced sample availability of its first 40G transceiver module for high speed Ethernet client side applications.

The new pluggable transceiver increases the data rate per module from 10G, in the case of XFP or SFP+ transceivers, to 40G, and is designed to meet increasing bandwidth demand in today's data centers. Compared to a traditional 10G approach, the new module transmits four times the data over single mode fiber at distances up to 10 kilometers. "We are excited to announce our first 40G client-side transceiver module for cloud and data center applications," said Tim Jenks, Chairman and CEO of NeoPhotonics. "We have provided samples to our customers as they serve the rapidly expanding 40G Ethernet market with cost-effective pluggable solutions. The new module complements our existing broad portfolio of line side products, such as our Integrated Coherent Receiver (ICR) for 40G and 100G DWDM transport applications, and underlines our commitment to the ultra-high speed segment of the transceiver market," concluded Mr. Jenks.

The new 40G CFP module is the latest addition to the company's expanding high speed transceiver portfolio, which includes a range of XFP, SFP+ and 10G EPON/XG-PON1 modules plus high speed receivers for coherent applications. The new NeoPhotonics product is designed primarily to connect gigabit and terabit routers and switches with next generation high capacity transport systems. The 40G transceiver is designed to comply with the IEEE 802.3ba 40GBASE-LR4 specification and to support OTU3 rates and 44.4G for future applications. The new 40G CFP module is now available in sample quantities.

Santur ramps up production of 100Gbps CFP optical modules

The new 10X10 MSA compliant module is enabled by photonic integrated architecture and is claimed to slash costs and power by 50%.

To extend its leadership in delivering photonic integrated solutions with disruptive cost per bit and unmatched energy efficiency, Santur has announced the general availability of its 100Gbps CFP optical modules compliant with 10X10 MSA (Multi Source Agreement).



The 2 km reach of this new version of Santur's 100Gbps CFP Optical Modules bridges the gap between 100m multi-mode and 10 km Single Mode Fibre (SMF) solutions enabling the roll-out of new networks capable of delivering exponentially higher bandwidth at a significantly lower cost per bit. Unlike 100m Multi Mode based on ribbons of fibre, this solution operates on a conventional Single Mode Fibre (SMF) enabling extended reach of 2Km. Compared with other 4x25G 100Gbps implementations for single-mode fibre, this approach does not require 25Gbps electronics such as gearbox ICs to convert 10Gbps data streams to intermediate 25Gbps lanes.

"For more than 20 years, we have been discussing the possibility of integrating multiple active optical components on a single chip to reduce cost and power. Over time, several companies have tried but none offered such high level of integration that allowed us to meet our cost and power targets," said Paul Meissner, President and CEO of Santur.

"The hybrid integration platform scales to higher data rates and wider WDM lanes to create many product variants based on a common architecture targeted at cost effectively meeting the needs to expand the global Internet infrastructure."

Santur's new 100Gbps CFP Optical Modules, which entered full-scale production in early June, deliver disruptive cost per bit at 100Gbps comparable to that of 10G XFP modules shipping today. Based on volume production pricing, the new 100Gbps CFP module will have an entry point of below \$5K in 100 units or higher volumes. In addition to enabling lower cost, the new modules further improve the energy efficiency by slashing max power dissipation down to 13W to match power per bit metrics comparable to 10Gbps SFP+ optical modules.

Santur Corporation is a leading integrated device manufacturer of Photonic Integrated Circuits. Having established its position as a leader in high-performance tunable laser arrays for metro and long-haul WDM systems, Santur now is the world leader in photonic integrated products for SMF 40Gbps and 100Gbps client and coherent applications.

M/A-COM and MIT multifunction radar panel hits the spot

The MPAR system developed by both organisations has won an R&D 100 award and consolidates eight separate radar systems that currently perform four unique missions.

M/A-COM Technology Solutions (M/A-COM Tech) has announced that its Multifunction Phased Array Radar (MPAR) Panel has been named as one of R&D Magazines' 2011 R&D 100 Winners.

The MPAR Panel has applications in next generation air traffic control and weather surveillance. It was co-developed by M/A-COM Tech and the Massachusetts Institute of Technology (MIT) Lincoln Laboratory under sponsorship from the Federal Aviation Administration. The MPAR Phased Array Panel is the enabling system building block for an advanced, scalable multifunction radar system offering improved performance and

added efficiency in the field of air traffic control and weather radar.

“MPAR is an excellent example of the pioneering work M/A-COM Tech is pursuing that applies commercial manufacturing practices to high performance Government, Aerospace and Defence systems,” said Douglas Carlson, head of M/A-COM Tech’s Aerospace and Defence Business Development.

“The MPAR Panel represents a new approach to the manufacture of phased array radar having broad applicability across many future systems platforms. We and MIT Lincoln Laboratory are honoured to receive this recognition. We believe that the underlying technology represented by the MPAR Panel can enable adoption of affordable phased array systems across many communications and radar applications.”

The MPAR was developed as a next generation alternative to the existing civil radar network currently supplying air traffic and weather surveillance. The MPAR system consolidates eight separate radar systems that currently perform four unique missions --Terminal Air Surveillance, En-Route Air Surveillance, Weather Radar, and Terminal Doppler Radar.

M/A- OM Tech says that the MPAR enables increased resolution and faster operation, providing improved data for weather forecasting together with leading air traffic control capability. An MPAR system is constructed of multiple MPAR Panels functioning coherently to radiate and receive pulses of radar energy used to detect, locate and track both aircraft and weather features.

Say hello to M/A-COM’s new VGA

The firm’s latest amplifier is designed for 3G, 4G and LTE base stations.

M/A-COM Technology Solutions has introduced a new analogue control Variable Gain Amplifier (VGA) for cellular infrastructure applications.

The MAAM-009320 is designed to lower bill of

materials cost and complexity for OEM design engineers who are designing next generation 3G/4G/LTE base stations.

New base station designs have multi-band capabilities but numerous space constraints. The MAAM-009320 delivers higher levels of integration and space savings by performing three circuit functions in a single 4mm PQFN package. The MAAM-009320 has a wide frequency range complimented by high gain and excellent input and output return loss.

Packaged in a RoHS compliant 4mm, 24-Lead PQFN package, the VGA is designed for operation from 400MHz – 2700MHz. External matching components are used to set the centre frequency and achieve return loss performance while analogue control is accomplished through a single control pin of 0 to +3V.

“With excellent IP3 for only 231 mA of current, the MAAM-009320 is a great choice for applications requiring gain with a wide attenuation range while maintaining linearity,” said Jack Redus, product manager. “The MAAM-009320 balances linearity and noise figure for optimal performance in cellular base station applications.”

Production quantities and samples of MAAM-009320 are available from stock.

University engineer made Fellow of the Royal Academy

University of Manchester scientist made a Fellow of the Royal Academy of Engineering for his work on MBE and compound semiconductors.

Mohamed Missous, Professor of Semiconductor Materials and Devices at the University of Manchester, was awarded the accolade for the quality of his research and industrial experience. In total, 50 UK Fellows have been elected with six International Fellows and three Honorary Fellows.



Mohamed Missous, Professor of Semiconductor Materials and Devices

Missous, from the School of Electrical and Electronic Engineering, joined the University in 1989, having previously gained his MSC and PhD from UMIST – now part of The University of Manchester. His professional activities are centred on the growth of complex multi-layer semiconductor films by the technique of MBE.

Over the years he has concentrated, with considerable success, on establishing practical approaches and techniques required to meet stringent doping and thickness control, to sub monolayer accuracy, for a variety of advanced quantum devices.

Further work has involved working on amplifiers and Analogue to Digital converters for a range of applications including the Square Kilometre Array project (SKA). Close industrial involvement with leading players in optoelectronic and microwaves is key to his work, including the design of Intelligent Cruise Control systems in cars.

Missous has given keynote speeches in many of the major gatherings of his disciplines, including terahertz technology, infrared sensing, MBE and ultra high speed devices and has over 190 publications in the field.

He also co-founded integrated compound semiconductors and advanced Hall sensors to exploit advanced semiconductor devices in ultra high sensitivity position sensing, Terahertz imaging, mid infrared detection, automotive car radars and radio astronomy.

Commenting on the recognition, Missous said, "I am

obviously delighted and honoured to be elected a Fellow of the RA Engineering. However this is very much a team effort and I would like to pay tribute to my past and present PhDs and Postdoctoral Research Associates and my wonderful technical support staff without whom none of these achievements would have been possible".

At its AGM in London, Fellows of the Royal Academy of Engineering confirmed Sir John Parker FREng as the Academy's new President, succeeding Lord Browne of Madingley who steps down after five years in office.

Infinera welcomes Mike Kelly as Vice President, Cable Sales

The indium phosphide based PIC provider is expanding its sales force to support the company's success in the cable and key vertical markets.

As a result of the company's growing success among top performing cable operators in the U.S., Infinera has created a new position and appointed Mike Kelly as Vice President of Sales for the Cable Market.

The appointment will strengthen Infinera's focus on this important market segment, and is part of a broader initiative to apply more focus on key market segments and global geographies as the company grows.

Kelly has been involved with cable television and network infrastructure companies for more than 30 years, including senior sales roles at Antec (now Arris), C-Cor, and Juniper Networks. He joins a team that has built a strong position in the U.S. cable market, with every one of the top five U.S. cable systems deploying Infinera solutions.

In addition to cable, Infinera is growing its sales force to provide additional focus on key vertical markets such as incumbent operators and submarine service providers, and is expanding its international geographic coverage in APAC and EMEA.

"The competitive advantages of our PIC-based

approach and our DTN platform have enabled Infinera to maintain our market leadership in North America,” commented Infinera Senior Vice President of Worldwide Sales Ron Martin. “Our growth in new segments and countries will let us capitalise on our innovative approach and help additional service providers build Digital Optical Networks that will lower their costs and make them more competitive.”

Semiconductor analyst Terence Soh joins ABI Research

Soh will initially be concentrating on mobile communications, in which he has broad industry experience, having worked for Motorola, Delphi and Fujitsu Microelectronics.

Semiconductors are at the heart of modern electronics and central to ABI Research’s market intelligence services. As such, ABI Research has recruited an additional semiconductor expert, Terence Soh, to its team of experienced analysts, as Principal Analyst, Semiconductors.

Based in ABI Research’s Singapore office, Soh will initially focus on mobile device and mobile handset semiconductor current market performance data and forecasts, and on vendor competitive analysis.

He has broad industry experience in the fields of mobile communications, automotive, and semiconductors where he has held various positions in R&D, marketing and project management, in technology companies such as Motorola, Delphi, Fujitsu Microelectronics and local startups.

Chief Research Officer Stuart Carlaw says, “Terence’s long track record in the semiconductor industry provides ABI Research with much-needed expertise that, when combined with our recent teardown acquisition, allows us to better serve our growing Asian client roster as well as providing significant localised expertise to our wider partner community.”

Terence Soh holds a B.Eng. (Electrical) from the University of Tasmania in Australia.

II-VI acquires Aegis Lightwave

The acquisition will enhance II-VI’s telecommunication product portfolio for the increasing deployments of 40G and 100G products. II-VI is also updating its revenue guidance from a range of \$565 million to \$580 million to a range of \$595 million to \$615 million as a result of the transaction.

II-VI Incorporated has acquired all of the outstanding shares of Aegis Lightwave, Inc. (Aegis), including Aegis’ wholly-owned subsidiary AOFR Pty Ltd (AOFR).

The initial consideration consists of cash of \$52 million. In addition, the purchase price is subject to customary closing adjustments including a working capital and debt adjustment which could increase the purchase price by an additional \$3 million.

Founded in 2000, Aegis is headquartered in Woburn, Massachusetts with additional locations in New Jersey and Australia. Aegis is a privately-held company that is an industry leader in tunable optical devices required for high speed optical networks that provide the bandwidth expansion necessary for increasing internet traffic.

Aegis offers a broad portfolio of cost-effective optical channel monitors specifically designed for reconfigurable optical add-drop multiplexing (ROADM) applications in high speed optical networks featuring 10G/40G/100G transmissions.

Its AOFR subsidiary is an industry leader in fused fibre components including those required for fibre lasers used in material processing applications. AOFR also manufactures optical couplers used primarily in telecom markets. Aegis and its subsidiaries had revenues of \$26.6 million during the year ended December 31, 2010.

Francis J. Kramer, president and chief executive officer of II-VI Incorporated stated, “Aegis will further strengthen our telecommunication product offerings and will partner with our Photop Technologies, Inc. (Photop) operations to enhance our ability to address our customers’ growing needs for an advanced product portfolio for the increasing deployments of 40G and 100G in flexible and

reconfigurable optical networks, including those aimed at delivering fibre to the home (FTTH) services over passive optical networks. Aegis and AOFR will operate as part of our Near-Infrared Optics segment, and will work cooperatively with Photop to further leverage and expand our combined offerings and continue to provide exceptional quality and customer service around the world. We are excited to welcome the employees of Aegis and AOFR to our company.”

Jeffrey D. Farmer, president and chief executive officer of Aegis commented, “We are delighted to team with II-VI Incorporated. We believe that by joining forces with II-VI we will have access to significantly more resources and markets, especially through its Near-Infrared Optics business segment, further securing our capabilities on research and product development, sales and marketing, and manufacturing operations. We are looking forward to a bright future and great growth prospects for our company and our employees.”

For the fiscal year ending June 30, 2012, II-VI is updating its revenue guidance from a range of \$565 million to \$580 million to a range of \$595 million to \$615 million as a result of the transaction. II-VI is updating its guidance for earnings per share (adjusted for the Company’s previously announced two-for-one stock split that occurred in June 2011) from a range of \$1.40 to \$1.48 to a range of \$1.43 to \$1.52 as a result of the transaction. II-VI plans to release its financial results for the fourth fiscal quarter ended June 30, 2011 on August 2, 2011

RF Electronics

Skyworks supports ZTE with multiple front-end products

One of the devices that ZTE will incorporate in its products is the EDGE RF subsystem, which employs the firm’s indium gallium phosphide HBT technology.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors

enabling a broad range of end markets, has announced it is supporting ZTE’s ramp of next generation tablets and laptops with EDGE and WCDMA/LTE front-end solutions.

Skyworks’ innovative modules are powering data cards and USB modems to help deliver greater mobility for tablet users that are equipped with cellular connectivity.

With these wins, Skyworks is broadening its relationship with ZTE, one of the world’s fastest growing handset OEMs. ZTE already leverages several of Skyworks’ TD-SCDMA and CDMA solutions for handsets and will soon utilise Skyworks’ antenna switch modules in several forthcoming smart phone platforms.

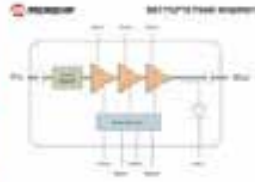
According to both IDC and Strategy Analytics, independent market research firms, ZTE was ranked as the fifth largest global handset maker in the second quarter of 2011, growing both its unit shipments and market share.

“Skyworks is delighted to be expanding its partnership with ZTE, particularly as they are well positioned to capture a disproportionate share of the smart phone segment in emerging markets such as China, India and Latin America,” said Bradley C. Byk, senior vice president of worldwide sales at Skyworks. “These markets are predicted to deliver the greatest number of wireless customers in the coming years. Skyworks is pleased to be playing a key role in this upgrade cycle that will enable greater mobility and wireless connectivity for consumers around the world.”

Microchip unveils InGaP/GaAs RF PA for 5 GHz Wi-Fi

The compact SST11CP15 is a versatile power amplifier based on the firm’s indium gallium phosphide / gallium arsenide HBT technology.

Provider of microcontroller, analogue and Flash-IP products, Microchip Technology, has revealed its new SST11CP15 RF power amplifier for 5 GHz IEEE 802.11a/n WLAN embedded applications.



The device operates on the 4.9 to 5.9 GHz band, and offers a wide operating voltage of 3.3V to 5V. The SST11CP15 features a high linear output power of 18 dBm at 2.5 percent EVM, using 802.11a OFDM 54 Mbps at 3.3V, and 20 dBm at 5.0V, and offers an output power of 23 dBm at mask compliance of 6 Mbps, at 3.3V.

Offered in a compact, 2 mm x 2 mm x 0.55 mm, 12-pin QFN package, the device is ideal for 5 GHz WLAN applications where small size and high-efficiency operation are required. Ideal applications are in wireless multimedia and MIMO applications for broadband gateway and consumer-electronics equipment.

The SST11CP15 meets the needs of designers who must reduce DC current consumption in their portable multimedia and MIMO applications. With its high power-added efficiency, the device reduces battery current drain and extends battery operation. Its 4.9 to 5.9 GHz linear operation enables 802.11a/n operation and increases data rates, while its small size is ideal for space-constrained applications.

“With the addition of the SST11CP15 to Microchip’s Wi-Fi power amp portfolio, Microchip now offers reliable, high-efficiency operation across the 5 GHz band,” said Daniel Chow, vice president of Microchip’s Radio Frequency Division. “This meets customer demand for a broad portfolio of reliable RF power amps, with high power-added efficiencies.”

Developers can begin designing today with the SST11CP15 Evaluation Board (part # 11CP15-QUBE-K), which is available now, via any Microchip sales representative.

The SST11CP15 RF power amplifier is priced at \$0.66 each, in 10,000-unit quantities. Samples are available today, at <http://www.microchip.com/get/TNQ6>. Volume-production quantities can

be ordered today at <http://www.microchip.com/get/9JD6>.

Microchip secures \$750 million credit agreement

The provider of indium gallium phosphide / gallium arsenide HBTs has an option to increase the amount available to \$1 billion and has a five-year term.

Microchip Technology has executed a \$750 million unsecured credit agreement with a group of lenders. These include JP Morgan Securities and Wells Fargo Securities who served as Joint Bookrunners and Joint Lead Arrangers for this transaction.

Loans under this facility are expected to be used for general corporate purposes. The agreement has an option to increase the amount available to \$1 billion and has a five-year term.

Steve Sanghi, President and CEO, said, “Microchip’s strong execution and business model have allowed us to put this revolving line of credit in place under very favourable terms. The facility provides us with additional flexibility to pursue our business objectives.”

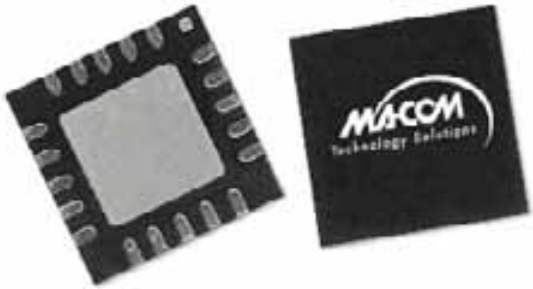
M/A-COM Tech unveils GaAs broadband push-pull amplifier

Suited to CATV Infrastructure applications, the firm’s new gallium arsenide based 8.0 V, 20.5 dB gain amplifier is configured as a pair of cascade structures and claimed to have excellent broadband performance.

M/A-COM Technology Solutions (M/A-COM Tech), a supplier of high performance analogue semiconductor solutions, is marketing a new GaAs broadband push-pull CATV amplifier.

The amplifier features 20.5 dB gain, with broadband linear performance. Packaged in a 4mm QFN, 20-lead plastic package, the MAAM-009455 is an ideal

inter-stage or output amplifier.



“With the introduction of the MAAM-009455, we continue to expand our portfolio of high performance amplifiers for CATV infrastructure applications,” said Graham Board, Product Manager. “The MAAM-009455 utilizes M/A-COM Tech’s established 0.5 μm MESFET process to deliver a highly linear, 75 Ω , push-pull amplifier with 20.5 dB of small signal gain.”

The MAAM-009455 targets next generation CATV HFC, FTTx, HDTV, and EdgeQAM infrastructure applications, where high gain and low distortion are a requirement. The MAAM-009455 is a highly linear amplifier, with low noise figure and power dissipation. This differential amplifier uses M/A-COM Tech baluns, input and output, in order to ensure best-in-class second order performance. The amplifier also features external feedback, allowing for gain tuning.

The MAAM-009455 exhibits an excellent gain flatness of 0.5 dB typical over the 50 to 1000 MHz operating band. Input return loss has been optimized to achieve better than 20 dB across the band. Very low distortion characteristics provide excellent composite second order (CSO), and composite triple beat (CTB) performance. This amplifier exceeds DOCSIS 3.0 DRFI specifications making it an ideal output stage solution for EdgeQAM head-end infrastructure.

M/A-COM Tech says production quantities and samples of MAAM-009455 are available from stock.

RFMD shareholders approve all proposals at 2011 AGM

Eight elected directors will serve a one-year term and the RFMD Cash Bonus Plan has also been reapproved.

RF Micro Devices, a designer and manufacturer of high-performance radio frequency components and compound semiconductor technologies, has announced that all agenda items at RFMD’s 2011 Annual Meeting of Shareholders were approved by the shareholders.

Eight directors have been elected to serve a one-year term. Approved on an advisory, non-binding basis, the Company’s executive compensation was decided and will be reviewed once a year.

The shareholders also reapproved the RFMD Cash Bonus Plan, pursuant to the provisions of Section 162(m) of the Internal Revenue Code of 1986, as amended.

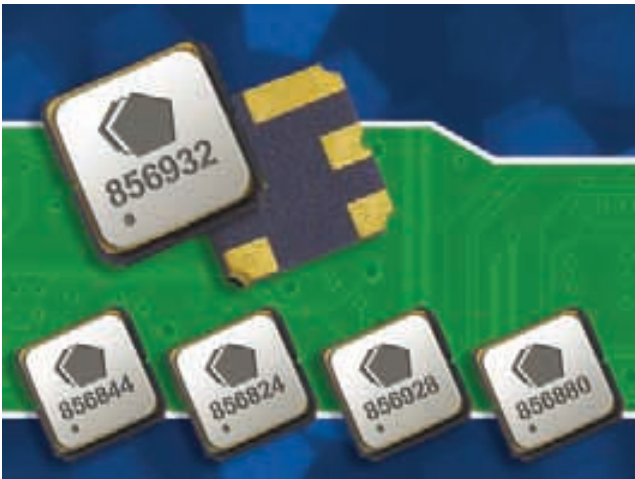
Finally, the firm has appointed Ernst & Young LLP as its independent registered public accounting firm for the fiscal year ending March 31, 2012.

RFMD is celebrating its 20th anniversary throughout 2011 by continuing to deliver innovative, breakthrough products that reshape its respective product categories. Examples of RFMD’s product and technology leadership include RFMD’s PowerStar power amplifiers and high-power GaN technology.

TriQuint 3G/4G base station filters simplify RF design

The firm says its new family of BTS RF SAWs handle more power, have lower losses and provide very good attenuation.

TriQuint Semiconductor has released five new RF SAW filters that improve performance in 3G/4G network infrastructure designs, offering cost-effective, simplified solutions for LTE, WCDMA and TD-SCDMA applications.



TriQuint is focused on bringing performance innovation to essential building blocks in the global network. This network is fraught with demand, and it's not going to let up; by 2015, the amount of mobile data traffic contributed by tablets alone is expected to equal that of mobile data traffic from all devices combined in 2010.

“Customer input continues to guide TriQuint’s ongoing development and product releases for advanced base station RF systems,” remarked Vice President Brian P. Balut. “Consumer demand for smartphones and tablets means more bandwidth through the network.”

“TriQuint’s innovative products simplify base station RF design and connectivity by offering discrete as well as integrated packaged solutions that ease assembly. Advanced networks need filters that lower loss, deliver high attenuation and handle greater power for more efficient, cost-effective designs—these new devices deliver in every way,” he continued.

TriQuint’s base station, CATV, optical, point-to-point, automotive telematics, defence/aerospace and mobile device innovations include integrated RF modules and discrete components based on GaN, GaAs, surface acoustic wave (SAW) and bulk acoustic wave (BAW) technologies.

New TriQuint RF SAW Filter Technical Details

856864	Band 33 (782 MHz) offers 10 MHz BW, max 2.5dB IL and attenuation of 40dB at 843 MHz, plus high power handling: +22 dBm
856932	Band 10 (847 MHz) offers 30 MHz BW, max 2.0dB IL and attenuation of 30dB at 892 MHz, plus high power handling: +22 dBm
856824	Band 8 (897.5 MHz) offers 35 MHz BW, max 2.5dB IL and attenuation of 60dB at 895 MHz, plus high power handling: +22 dBm
856928	Band 11 (1415.4 MHz) offers 45 MHz BW, max 2.5dB IL and attenuation of 20dB at 1405.0 MHz, plus high power handling: +22 dBm
856880	Band 2 (1880 MHz) offers 60 MHz BW, max 3.0dB IL and attenuation of 30dB at 1790 MHz, plus high power handling: +22 dBm

AWR opens the library doors to Mitsubishi’s RF models

This means that AWR’s customers have timely access to Mitsubishi Electric’s nonlinear gallium arsenide and gallium nitride based RF models.

AWR Corporation has announced the availability of a Microwave Office model library for Mitsubishi Electric’s nonlinear GaAs and GaN RF devices.

The model library includes high power and low noise HEMT devices, which are commonly used in base station and DBS receivers and other radio communications equipment, given their high power, high efficiency, broadband and low noise advantages.

This new model library helps designers better explore design alternatives while meeting demanding performance specs with a cost-effective solution.

“The good collaboration between AWR’s engineers and our own resulted in a robust and reliable model library,” said Takao Ishida, Manager of Wireless Communication Device Application Engineering Section at Mitsubishi Electric High Frequency & Optical Device Works. “This now means that AWR’s customers have timely access to our nonlinear RF models.”

AWR’s Microwave Office library for Mitsubishi Electric’s nonlinear RF models are free for use within Microwave Office software (release 2010 and later) for active, licensed AWR customers.

New pHEMT process technologies available

RFMD is offering foundry customers the gallium arsenide based processes which are suited to wireless applications.

RF Micro Devices (RFMD), a global designer and manufacturer of high-performance RF components and compound semiconductor technologies has expanded its Foundry Services business unit portfolio of process technologies to include two additional GaAs process technologies.

These are RFMD's FD25 low noise pHEMT process and its FET1H switching pHEMT process. The two additional GaAs pHEMT process technologies are available immediately to foundry customers.

RFMD's 0.25-micron FD25 pHEMT process technology delivers low noise, medium power and high linearity for applications including low noise front ends and transmitter MMICs. RFMD's 0.6-micron FET1H pHEMT process technology delivers low noise and high linearity switching of RF signals for applications including wireless front ends, transmit/receive modules and phased arrays.

The two new process technologies complement RFMD's existing 0.3-micron FD30 pHEMT process technology, which was made available to foundry customers in 2010 and is optimised for applications including X-band phased array power amplifiers and 8-16 GHz wideband military EW jammers.

The rapid growth in the wireless communications, aerospace and defense, and radar/radar jammer markets continues throughout the world, driven by end applications requiring the higher levels of integration enabled by leading semiconductor technologies.

This increases the need for semiconductor foundries to develop and offer world-class technologies with flexible high performance capabilities. RFMD's low noise FD25 and high linearity switch FET1H technologies, along with RFMD's existing FD30 0.3-micron power process technology, offer customers the ability to design and manufacture world-class devices for a wide range of application needs.

Bob Van Buskirk, president of RFMD's Multi-Market Products Group (MPG), said, "Our FD25 0.25-micron and FET1H 0.6-micron processes further expand on our goal to provide the wireless industry a technically advanced semiconductor foundry service offering. We are pleased to expand and grow our foundry services business beyond our current GaN and GaAs offerings to assist our customers in meeting their individual market and product needs."

NXP awarded by Assodel for RF and wireless products

The electronic industry award recognises best-in-class manufacturers from design collaboration to distribution. The firm's products include next generation products based on gallium nitride technology.

The Italian Association for Electronic Suppliers (Assodel) has awarded NXP Semiconductors with the 2011 Best Supplier Award for RF and Wireless.

The award was presented on June 17, at a European industry gala in San Siro, Italy, attended by more than 400 participants from the electronics industry.

Mark Murphy, director of marketing, RF Power, NXP Semiconductors, commented, "This prestigious award not only recognises the strength and success of our High Performance Mixed Signal business model, but also the quality of the people within our Regional Marketing and Sales Teams. It's a particular honour that this award was voted by a team of jurors from the electronic community, including end customers, distribution, customer supply operations and management. These are our most demanding critics and to be recognised as a best supplier means we are doing our job well and delivering on our promise to solve the most demanding RF challenges."



Assodel Award Event in San Grio Italy with Maurizio Caudera (RS Components Italia), Enrico De Salve (NXP), Domenico Caserta (Assodel president), Silvio Baronchelli (IDEA president) and Vittorio Basso Ricci (Assodel Marcom)

Promoted by the Italian Association for Electronic Suppliers and now in its ninth edition, the Assodel Award recognises manufacturers who have excelled in quality from design to distribution.

According to Assodel, NXP is recognised for driving developments in the RF and Wireless sector and setting market standards with products such as the LDMOS RF power transistor - BLF888A - used in broadcast transmitter and industrial applications. In addition, the acquisition of Jennic in mid-2010 has further strengthened NXP's ability to offer a wide range of products and RF solutions.

NXP develops high-performance solutions for the most demanding RF challenges, from satellite receivers, cellular base stations and broadcast transmitters to ISM (Industrial, Scientific, and Medical), and aerospace and defence applications.

In June, NXP announced the following enhancements to its RF portfolio including the BLF578XR, an eXtremely Rugged LDMOS Power Transistor, Gen8 LDMOS RF power transistors for wireless base stations, next-generation products based on GaN technology, and a complete line of overmolded plastic RF power devices.

Since 2003, the Assodel award has been given annually to manufacturers in the electronics industry who are honoured for their excellent quality in collaboration and distribution. The award

is presented in nine categories including active components, passive components, connectors, electromechanics, LED, visualisation, RF and wireless, power and instrumentation. There is also a lifetime achievement award.

Assodel is based on nominations, votes and feedback from a jury composed of participants from the Electronic Community. Jury votes are based on the following parameters: Sales Support, Logistical Support, Design Support, Communication Support, Relationship Quality, Product Quality and Distribution Policies.

New mini signal generators perform up to 20 GHz

Vaunix has expanded its Lab Brick LMS series of USB-compatible synthesised signal generators with two new models which can test the 8 GHz to 20 GHz X-band. They have low phase noise, fast 100 microsecond switching time, and 100 Hz frequency resolution.

Vaunix Technology Corporation, a designer and manufacturer of RF and microwave test equipment and communications products, has introduced two new models to its Lab Brick product line that together cover frequency ranges from 8 to 20 GHz.



The LMS-203 operates from 10 to 20 GHz, while the LMS-163 operates from 8 to 16 GHz. Both boast low phase noise, fast 100 microsecond switching time, and fine 100 Hz frequency resolution. The LMS series also offers advanced operating features such as phase-continuous linear frequency sweeping, optional internal/external pulse modulation, and a selectable internal/external 10 MHz reference.

Typical spurious for the two models is at -80 dBc, with typical harmonics of -40 dBc and subharmonics at -25 dBc. They deliver at least +10 dBm output power, and can be adjusted over a 40 dB dynamic range, with 0.5 dB resolution. The pulse modulation feature offers internal or external triggering with pulse widths as low as 100 ns and pulse repetition intervals of 200 ns.

Other previously released models in the LMS family include the LMS-802 covering 4 to 8 GHz, the LMS-103 covering 5 to 10 GHz, and the LMS-123 covering 8 to 12 GHz. Lab Brick signal generators are known for their compact size, low power consumption, and USB compatibility. Lab Brick signal generators measure 4.90 x 3.14 x 1.59 in. (124 x 80 x 40 mm) and weigh less than 1 lb. (0.45 kg).

They connect to a host computer by means of a standard USB cable and are controlled via the Graphical User Interface (GUI) software supplied with each unit. The simple GUI features large display windows to quickly view and adjust the signal generator's operating parameters. They are powered and controlled by means of any USB equipped PC or laptop. They can also be run from battery power or from a remote power supply for non-USB embedded or automated applications.

They are available for purchase at www.vaunix.com.

Based in Haverhill, Massachusetts, Vaunix Technology Corporation designs, manufactures, and services RF and microwave test equipment and communications products. It says its Lab Brick product family sets a new standard for cost, size, and simplicity for microwave test equipment.

M/A-COM Tech to broaden horizons in Asia Pacific

The firm has taken on Vincent Pelliccia, who has 25 years of experience in the industry, as Senior Director Asia Pacific Sales.

M/A-COM Technology Solutions (M/A-COM Tech) has appointed Vincent Pelliccia's appointment as Senior Director of Asia Pacific Sales, reporting to Jack Kennedy, Vice President of Sales for M/A-

COM Tech. Pelliccia is now responsible for leading the company's Asia Pacific Sales initiatives.



Vincent Pelliccia, Senior Director Asia Pacific Sales

Pelliccia most recently served as M/A-COM Tech's Director of Sales Operations and Business Development. In this role he helped implement an SAP Customer Relationship Management solution for M/A-COM Tech, while concurrently playing a lead role in simplifying the company's order management system. Prior to that, he served as Vice President of Sales at Mimix Broadband, which was acquired by M/A-COM Tech in May 2010. Pelliccia worked at M/A-COM for 11 years as a Product Group Manager prior to joining Mimix Broadband.

Pelliccia boasts 25 years in the industry with a strong background in engineering, finance, and sales. He received a B.S. and M.S. in Electrical Engineering from the University of South Florida.

"I am very proud to have Vince leading our Asia Pacific sales efforts. His industry experience and strong leadership will greatly benefit the company," said. "I am confident he will fulfil his new role exceptionally well."

BeRex unveils GaAs PHEMT FET chips for RF apps

The BCP-Series gallium arsenide based devices up to 26 GHz, are immediately available. The series also includes devices for wideband (6-18 GHz) or narrowband RF applications.

BeRex high performance BCP-series of GaAs PHEMT FET chips featuring a nominal gate length of 0.25µm, are now available in gate widths of 200, 300, 600, 800, 1200, 1600 or 2400µm.

These chips are available in bare-die form and provide low noise, high gain, and excellent power added efficiency making them ideal for low noise amplifiers, satellite communications, high reliability and other demanding applications. They are especially well suited for either wideband (6-18 GHz) or narrowband applications. The BCP-series chips are produced using state of the art metallisation and Si3N4 passivation to assure the highest reliability.

“BeRex, Inc. is committed to being a dominate player in providing high performance PHEMT devices. Our company’s Silicon Valley location has allowed us to assemble a “dream team” of highly experienced PHEMT designers, quality and applications engineers, all of whom are focussed on providing our clients with the highest quality parts, consistently and reliably”, commented Alex Yoo, Vice President of Research and Development.

TriQuint welcomes James L. Klein to Defence and Aerospace Division

Now Vice President and General Manager at TriQuint, Klein has over 20 years in the RF industry and has held previous positions in Raytheon and Texas Instruments.

RF solutions supplier and technology innovator TriQuint Semiconductor, has appointed James L. Klein as Vice President and General Manager of its Defence and Aerospace business.

Klein will be based in TriQuint's Texas facility and

report to President and CEO, Ralph Quinsey. Klein will work closely with Tom Cordner, TriQuint's current Vice President and General Manager of Defence and Aerospace as Cordner supports the transition and prepares to retire after a successful career.



“Tom has done a wonderful job building our business and we wish him well on his forthcoming retirement. We are fortunate to have found James. His experience and deep industry knowledge will be invaluable in helping us take our defence and aerospace business into the next decade,” said Ralph Quinsey, TriQuint President and CEO.

Klein brings more than 20 years of industry experience in RF to TriQuint. He was most recently with Raytheon in the Space and Airborne Systems division and responsible for design and manufacturing of advanced RF and microwave subsystems and components. Prior to Raytheon, Klein held various positions with Texas Instruments where he focused on MMIC and Transmit / Receive module engineering. He holds both Bachelor and Master of Science in Electrical Engineering degrees from Texas A&M University.

“I’m excited to join TriQuint Semiconductor and look forward to utilizing my industry experience, relationships and engineering background to help drive TriQuint's growth. TriQuint's commitment to technology innovation and customer service make it an ideal place to define the next generation of RF solutions. I look forward to being a member of the team during this exciting time of expansion,” said Klein.

TriQuint honours Richardson RFPD as best distributor

The award recognises Richardson RFPD's overall contribution to TriQuint's growth, including high level of responsiveness to customers, increasing design wins, and technical support.

Richardson RFPD has announced that for the second consecutive year, it has received the "Top Distributor of the Year" award from TriQuint Semiconductor, a leading RF solutions supplier and technology innovator.

"It is very gratifying to win this award two years in a row from one of our top suppliers," said Greg Peloquin, President of Richardson RFPD. "TriQuint's broad portfolio of leading-edge technology products, combined with our global strategy of engineer-focused distribution continues to drive numerous design wins."

Award winners were chosen based on nominations by members of TriQuint's executive sales team and announced at TriQuint's 2011 sales conference.

Lasers

Avago debuts first 16 Gigabit fibre channel transceiver

The new module, which incorporates an 850 nm gallium arsenide based VCSEL, is claimed to increase port density and deliver twice the data bandwidth of the current generation of fibre channel devices at nearly the same power level.

Avago Technologies has announced production availability of a 16 Gigabit Fibre Channel transceiver with industry-standard signalling rates up to 14.025 GBd.



The new AFBR-57F5PZ SFP+ transceivers support high-speed serial links over multimode optical fibre with double the data throughput of existing 8 Gigabit Fibre Channel modules. The modules address 16 Gigabit Fibre Channel switches, routers, host bus adapters, RAID controllers, tape drives and video switching, as well as inter-switch and inter-chassis aggregated links.

The AFBR-57F5PZ SFP+ transceiver reduces the number of ports required for inter-switch connectivity by a factor of two compared to existing 8 Gigabit Fibre Channel solutions and operates at essentially the same power level. The SFP+ module's transmitter and receiver can operate at different data rates, as is often required during Fibre Channel speed negotiation. The module maintains compatibility with legacy 8 Gigabit and 4 Gigabit Fibre Channel devices, simplifying design migration.

"Our new 16 Gigabit Fibre Channel SFP+ module continues the Avago tradition of setting new performance standards and bringing innovative form-factors to market first," said Victor Krutul, director of marketing for the Fiber Optics Products Division at Avago. "Avago has worked closely with our top customers to develop solutions with the bandwidth and port-density they require, which has helped us to establish a position as the market's leading Fibre Channel optical supplier in the storage networking segment."

The AFBR-57F5PZ transceiver incorporates Avago's 850 nm Vertical-Cavity Surface Emitting

Laser (VCSEL) technology and PIN detector technology. This combination ensures that the multi-rate SFP+ module is compliant with FC-PI-5 and 16G/8G/4G Fibre Channel specifications. The module will respond to both rate select pin and control bit inputs, which simplifies Fibre Channel host auto-negotiation algorithms, layout and software.

The lead-free and RoHS-compliant device has a temperature operation of 0° to 70° C and supply voltage of 3.3V ± 5% and digital diagnostic features of the SFF-8472 module. The LC Duplex optical connector interface also conforms to ANSI TIA/EIA604-10 (FOCIS 10A) and has enhanced EMI performance for high port density applications.

U.S. Pricing and Availability

The AFBR-57F5PZ 16 Gigabit Fibre Channel transceiver is priced at \$215.35 each in 100 piece quantities. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

Oclaro appoints Marissa Peterson to Board of Directors

The former Sun Microsystems executive brings extensive global customer advocacy expertise to Oclaro.

Oclaro, a provider of optical communications and laser solutions, has appointed industry veteran Marissa Peterson to its board of directors.

Peterson brings to Oclaro substantial management and operational experience, including 17 years at Sun Microsystems where she was Executive Vice President, Worldwide Operations, Services & Customer Advocacy.

“Marissa’s experience with global customer advocacy programs and expertise in supply chain and logistics management will enable Oclaro to better serve its global customer base,” said Alain Couder, chairman and CEO of Oclaro. “She is a tremendous addition to our board and we look forward to her valuable contributions.”

“This is an exciting time to join Oclaro,” said Marissa Peterson, board member for Oclaro. “Oclaro has achieved a tremendous transformation to become a tier one supplier of innovative optical communications and laser solutions. I look forward to working with the company’s management team and board of directors to expand its market position, and further strengthen its reputation as a customer-focused, highly efficient industry leader.”

Peterson was Executive Vice President, Worldwide Operations, Services & Customer Advocacy for Sun Microsystems in Santa Clara, California, until her retirement in 2005. She currently serves on the board of directors for Ansell Limited, Humana, Quantros and the Lucile Packard Children’s Hospital at Stanford, and previously served on the board of directors of Supervalu Inc. and the board of trustees of Kettering University. She also runs an executive coaching practice focused on helping grow and develop leaders in the high-technology space.

Oclaro Announces 19% Growth in Annual Revenues

Oclaro, a tier-one provider of optical communications and laser solutions, have announced the financial results for its fourth quarter of fiscal year 2011, and for its 2011 fiscal year, which both ended July 2, 2011.

“In fiscal 2010 we transformed Oclaro into a tier-one supplier of optical components and subsystems through a series of strategic initiatives,” said Alain Couder, Chairman and CEO of Oclaro. “In fiscal 2011 we began structuring the integrated company to scale, while accelerating our investment in new product innovation. As a result, we believe we are well positioned for growth as the telecom optical market recovers.” Highlights for Fourth Quarter Fiscal 2011: Revenues were \$109.2 million for the fourth quarter of fiscal 2011, compared to \$115.7 million in the third quarter of fiscal 2011. Revenues in the quarter ended July 2, 2011 included initial shipments of new products including 40G coherent transponders, tunable XFP transceivers, 40G lithium niobate external modulators and an integrated ROADM line card. GAAP gross margin was 23% for the fourth quarter of fiscal 2011,

compared to 25% in the third quarter of fiscal 2011. GAAP gross margin for the fourth quarter of fiscal 2011 included approximately 3% points of impact from excess and obsolete reserves and related inventory valuation charges. Non-GAAP gross margin was 23% for the fourth quarter of fiscal 2011, compared to 25% in the third quarter of fiscal 2011.

GAAP operating loss was \$33.6 million for the fourth quarter of fiscal 2011, including \$20 million of impairment charges following the company's annual review of goodwill, compared to a GAAP operating loss of \$6.8 million in the third quarter of fiscal 2011.

Non-GAAP operating loss was \$9.4 million, or 9% of revenues, for the fourth quarter of fiscal 2011, compared to a non-GAAP operating loss of \$3.3 million, or 3% of revenues, in the third quarter of fiscal 2011.

The Company is now investing \$18.9 million a quarter in research and development, as of the fourth fiscal quarter of 2011, which is \$7.4 million, or 64%, more than in the same quarter of the 2010 fiscal year.

Adjusted EBITDA was negative \$4.7 million for the fourth quarter of fiscal 2011, compared to a positive \$0.7 million in the third quarter of fiscal 2011.

GAAP net loss for the fourth quarter of fiscal 2011 was \$36.7 million, including \$20 million of impairment charges following the company's annual review of goodwill, compared to a GAAP net loss of \$9.8 million in the third quarter of fiscal 2011.

Non-GAAP net loss for the fourth quarter of fiscal 2011 was \$10.0 million, compared to a non-GAAP net loss of \$4.5 million in the third quarter of fiscal 2011.

Cash, cash equivalents and restricted cash were \$83.4 million as of July 2, 2011.

On July 26, 2011 the company closed an increase in its line of credit from \$25 million to \$45 million and extended its term through August 1, 2014. No amounts were drawn under this line as of July 2, 2011.

Highlights for Fiscal Year 2011:

-Revenues were \$466.5 million for fiscal 2011, compared to \$392.5 million in fiscal 2010.

-GAAP gross margin was 27% for fiscal 2011, compared to 29% in fiscal 2010.

-Non-GAAP gross margin was 27% for fiscal 2011, compared to 28% in fiscal 2010.

GAAP operating loss was \$33.6 million for fiscal 2011, including \$20 million of impairment charges following the company's annual review of goodwill, compared to GAAP operating income of \$4.8 million in fiscal 2010.

Non-GAAP operating income was \$1.6 million for fiscal 2011, compared to \$15.7 million in fiscal 2010.

During fiscal 2011, the company increased its investment in research and development expenses by \$24 million, compared to fiscal 2010. The company also had \$4.5 million more depreciation expense in fiscal 2011 compared to fiscal 2010, associated with capital investments in scaling the company for long-term growth and new product introductions.

-Adjusted EBITDA was \$17.0 million for fiscal 2011, compared to \$26.5 million in fiscal 2010.

GAAP net loss for fiscal 2011 was \$46.4 million, including \$20 million of impairment charges following the company's annual review of goodwill, compared to GAAP net income of \$12.4 million in fiscal 2010.

Non-GAAP net loss for fiscal 2011 was \$2.0 million, compared to non-GAAP net income of \$14.1 million in fiscal 2010.

First Quarter Fiscal 2012 Outlook The results of Oclaro, Inc. for the first quarter of fiscal 2012, which ends October 1, 2011, are expected to be:

-Revenues in the range of \$103 million to \$113 million.

-Non-GAAP gross margin in the range of 18% to 24%.

-Adjusted EBITDA in the range of negative \$8.5 million to negative \$2.5 million.

Nanotubes could help measuring THz laser power a piece of cake

NIST researchers have found that dense arrays of extra-long carbon nanotubes absorb nearly all light of long wavelengths, and are promising coatings for prototype detectors intended to measure terahertz laser power.

Terahertz radiation can penetrate numerous materials—plastic, clothing, paper and some biological tissues—making it an attractive candidate for applications such as concealed weapons detection, package inspection and imaging skin tumours.

However, to date there is no standard method for measuring the absolute output power of terahertz lasers, one source of this type of radiation. Now, researchers at the National Institute of Standards and Technology (NIST) have found that dense arrays of extra-long carbon nanotubes absorb nearly all light of long wavelengths, and thus are promising coatings for prototype detectors intended to measure terahertz laser power.



“Cupcakes” of vertically aligned carbon nanotube arrays (VANTAs) grown on silicon, which appear violet in the photo. A chunk of VANTA can be sliced from the silicon with a razor blade and, using the blade as a spatula, easily moved to the top of a laser power detector. The very dark nanotube coating absorbs terahertz laser light. (Credit: Lehman/NIST)

The research is part of NIST’s effort to develop the first U.S. reference standards for calibrating lasers

that operate in the terahertz range, from the far infrared at wavelengths of 100 microns to the edge of the microwave band at 1 millimetre.

“There is no measurement traceability for absolute power for terahertz laser sources,” NIST project leader John Lehman says. “We have customers asking for the calibrations. This coating looks viable for terahertz laser power detectors.”

The coating, called a VANTA (vertically aligned carbon nanotube array), has several desirable properties ; it is easy to handle. The nanotubes are tens of microns to over a millimetre long, so a dense layer is visible without a microscope. A chunk of VANTA can be cut, lifted, and carried like a piece of cake, making it easy to transfer from a silicon surface where the tubes are grown to a laser power detector.

Most importantly, the coating is very dark. The NIST team evaluated three VANTA samples with average lengths of 40 and 150 microns and 1.5 mm and found that longer tubes reflect less light. The 1.5 mm version reflects almost no light—just 1 percent at a wavelength of 394 microns. This result, the first-ever evaluation of a VANTA’s reflectance at that terahertz wavelength, indicates that virtually all arriving laser light is absorbed, which would enable highly accurate measurements of laser power.

The 1.5 mm VANTA absorbs more light than comparable coatings such as gold black, but more work is needed to calculate uncertainties and determine effects of factors such as light angle. The project extends NIST’s long history in laser power measurements and Lehman’s recent advances in ultradark nanotube coatings.

VANTAs also have desirable thermal properties. NIST researchers found that the material absorbs and releases heat quickly compared to other black coatings, which will make the detectors more responsive and quicker to produce signals. Otherwise, a coating thick enough to absorb long wavelengths of light would not efficiently transmit heat to the detector.

In developing the capability for terahertz laser radiometry, NIST is building a terahertz laser designed for routine measurements and a detector called a thermopile to measure the laser’s power. This simple detector design produces a voltage

when heat is applied to a junction of two dissimilar metals. NIST researchers used the VANTA to coat a prototype thermopile. Further research is planned to design detectors that might be used as reference standards.

The researchers aim to extend the available spectral range for detector calibration to 1 THz to 5 THz in the future.

Further details of this work are described in the paper “Far infrared thermal detectors for radiometry using a carbon nanotube array” by J.H. Lehman *et al*, in *Applied Optics*, and can be accessed via the following link: <http://www.opticsinfobase.org/ao/abstract.cfm?URI=ao-50-21-4099>

Soraa propels green lasers beyond 100 mW

The Californian pioneer of semi-polar and non-polar light emitters drives green and blue laser performance to new levels

Soraa has improved the performance of its semi-polar and non-polar green and blue lasers that it is developing for displays and medical markets.

James Raring revealed to delegates at the ninth International Conference on Nitride Semiconductors that the continuous-wave output of the company’s 516 nm green lasers now exceeds 100 mW. Other characteristics of these packaged diodes included threshold currents and voltages of 125 mA and 5.9 V, a slope efficiency of 0.4 W/A and a wall-plug efficiency that peaks at 4.1 percent.

Soraa has recently focused on improving the beam-quality of its single-mode green lasers. Divergence along the fast axis is 14-22 degrees, and in the slow axis it is 10-14 degrees.

Improvements have also been made to Soraa’s blue lasers, which have similar levels of beam divergence. Packaged single-mode variants have a slope efficiency of more than 1.6 W/A, and the threshold current and voltage are 30 mA and 3.9V. When emitting 500 mW, wall plug efficiency is more than 20 percent and it hits 22 percent at 200 mW.

The West-coast outfit has also made more powerful,

multi-mode variants that can produce 1.4 W and have a wall-plug efficiency of more than 23 percent.

Raring believes that the excellent performance produced by these lasers stems from the use of non-polar and semi-polar planes.

Turning to these orientations improves the radiative recombination rate of these devices through increased overlap of the electrons and holes in the quantum wells. What's more, it aids hole injection, thanks to a reduction in the effective mass of this carrier. However, Raring believes that the most exciting aspect of these novel planes is the far greater design freedom that they enable.



The most promising market for Soraa's lasers is projection displays, which employ a combination of red, green and blue lasers to form colour images. In this market lasers are competing with lamps and LEDs, but the latter two deliver an inferior optical throughput, typically by a factor of three.

Most commercial green lasers on the market today employ some form of frequency doubling of an infra-red source. Replacing such devices with a single, green-emitting chip will lead to improvements in efficiency, compactness, ruggedness and speckle, according to Raring.

He estimates that the pico-projector market could consume 200 million units per year, and a similar number may be needed to supply desktop and high-end projectors.

Osram improves green laser performance

Refinements to the epitaxial structure of green laser diodes have led to an increase in output power and longer lifetimes.

At the ninth International Conference on Nitride Semiconductors, Uwe Strauss from Osram Opto Semiconductors described the company's efforts to improve the performance of its green laser diodes that are fabricated on the conventional plane of GaN.

Strauss explained that these lasers will target pico-projectors, where they can combine with red and blue equivalents to provide a lighting source with a small footprint that is free from a focusing element.



According to him, the green source in a pico-projector producing a 100 lumen brightness must have: an emission wavelength of 515 nm; an output power of at least 50 mW; a wall plug efficiency of 5 percent or more; and, in both the lateral and vertical directions, a single mode output. If a shorter wavelength source is used – for example, a 505 nm laser – the power output requirements are higher.

In the lab, Osram has exceeded these requirements. Its best lasers produce 70 mW at 522 nm with a wall plug efficiency of 5-6 percent, and have a spectral width of 1.8 nm. What's more, reliability – defined as the time taken for the operating current to increase by 30 percent – is more than 1000 hours.

Strauss offered some insights into how the German outfit has improved the performance of its laser diodes. He explained that when green laser development began, the wafers were plagued by V-shaped defects associated with strain.

To minimise this strain and prevent the formation of V-defects and other imperfections in the crystal lattice, engineers began by fabricating two test structures to understand the extent of this issue. One contained just blue quantum wells - the other had blue wells grown on top of green-emitting ones. The photoluminescence from the latter structure was far weaker, due to defects that were subsequently exposed by transmission electron microscopy. Managing this strain enabled the high output powers realised in the lab.

Engineers have also studied the change in the threshold of the lasers, which is proportional to the square root of the operating time.

One potential culprit behind the higher currents is the diffusion of magnesium atoms from the p-type region to the quantum wells. However, this has been ruled out by secondary ion mass spectrometry. According to Strauss, the most likely reason for the increase in threshold current is the generation of charge defects in the quantum wells.

Daylight Solutions closes \$15 M Series C equity financing

The strategic financing round is focussed on expanding Daylight's core compound semiconductor QCL technology and manufacturing infrastructure for defence and commercial applications.

Daylight Solutions has announced the closing of a \$15M Series C equity financing with Northrop Grumman Corporation as the lead investor, together with several of the company's existing investors.

The Series C financing will enable the company to continue its high rate of growth, while further maturing and advancing its technology, and expanding its product offering and manufacturing infrastructure. Manufacturing capacity, quality processes, reliability, and field support will be significantly enhanced as a result of the financing

transaction.

Daylight Solutions has developed a wide range of products for scientific research, defence, and commercial markets based on its III-V semiconductor Quantum Cascade Laser (QCL) technology. The company's QCL-based products are ideally suited for addressing molecular detection and imaging applications that benefit from mid wave infrared and long wave infrared illumination. One example is the company's JammIR family of laser products for Infrared Countermeasures (IRCM).

Multiple configurations and capabilities of the JammIR product line have been successfully tested under environmentally demanding conditions for military rotary and fixed wing applications, and have undergone multiple flight tests. The JammIR product family has been verified as a highly effective infrared countermeasure against a variety of missile threats. The company remains the world leader in QCL-based products with several hundred commercial laser systems already manufactured and delivered into a wide range of markets.

"We are pleased to receive this additional endorsement of our technology and capability from a market leader such as Northrop Grumman," said company Chairman and CEO Timothy Day. "The Series C financing will allow us to serve all of our customers with a family of QCL-based products based on a modular, open source, core technology platform meeting the requirements of the most demanding environments in defence as well as commercial markets. Our manufacturing infrastructure, capacity and reliability programs will be expanded as a result of the financing transaction."

"Our investment in Daylight Solutions serves as an acknowledgement of their leadership position in QCL-based products, and reflects our commitment to deliver best-in-class solutions to our customers in support of our warfighters," commented Jeff Palombo, Sector Vice President and General Manager of Northrop Grumman's Land and Self Protection System Division.

Daylight Solutions and its wholly owned subsidiary Daylight Defense, LLC, have leveraged their core technology in QCL modules to create multiple versions of its JammIR™ line of products. The company's modular approach allows for high

flexibility, reducing the cycle-time from design to deployment, while providing significant improvements in reliability and lifetime over existing technologies.

Multifaceted laser technology could kill viruses and Improve DVDs

Scientists are claiming that zinc oxide nanowire waveguide lasers can offer smaller sizes, lower costs, higher powers and shorter wavelengths than conventional gallium nitride UV lasers.

A team led by Jianlin Liu from the University of California, Riverside Bourns College of Engineering has made a discovery in semiconductor nanowire laser technology that could potentially do everything from kill viruses to increase storage capacity of DVDs.

Ultraviolet semiconductor diode lasers are widely used in data processing, information storage and biology. Their applications have been limited, however, by size, cost and power. The current generation of ultraviolet lasers is based on GaN, but Jianlin Liu and his colleagues have made a breakthrough in zinc oxide (ZnO) nanowire waveguide lasers, which can offer smaller sizes, lower costs, higher powers and shorter wavelengths.



Until now, ZnO nanowires couldn't be used in light emission applications because of the lack

of p-type material needed by all semiconductors. This problem was overcome by doping the ZnO oxide nanowires with antimony to create the p-type material.

The p-type ZnO nanowires were connected to the n-type ZnO material, which was grown on a c-sapphire substrate, to form the p-n junction diode. Powered by a battery, highly directional laser light emits only from the ends of the nanowires.

"People in the zinc oxide research community throughout the world have been trying hard to achieve this for the past decade," Liu said. "This discovery is likely to stimulate the whole field to push the technology further."

The discovery could have a wide-range of impacts.

For information storage, the zinc oxide nanowire lasers could be used to read and process much denser data on storage media such as DVDs because the ultraviolet has shorter wavelength than other lights, such as red. For example, a DVD that would normally store two hours of music could store four or six hours using the new type of laser.

For biology and medical therapeutics, the ultra-small laser light beam from a nanowire laser can penetrate a living cell, or excite or change its function from a bad cell to a good cell. The light could also be used to purify drinking water.

For photonics, the ultraviolet light could provide superfast data processing and transmission. Reliable small ultraviolet semiconductor diode lasers may help develop ultraviolet wireless communication technology, which is potentially better than state-of-the-art infrared communication technologies used in various electronic information systems.

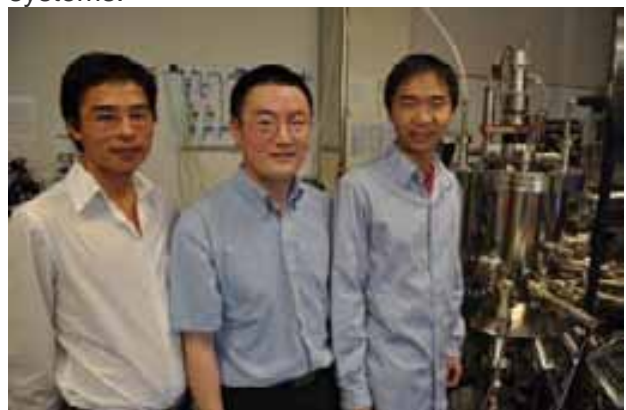


Figure: From left, Guoping Wang, Jianlin Liu and Sheng Chu

While Liu and the students in his laboratory have demonstrated the p-type doping of zinc oxide and electrically powered nanowire waveguide lasing in the ultraviolet range, he said more work still needs to be done with the stability and reliability of the p-type material.

Further details of this work can be found in the paper "Electrically pumped waveguide lasing from ZnO nanowires" by Sheng Chu *et al* published in *Nature Nanotechnology* (2011). DOI: [doi:10.1038/nnano.2011.97](https://doi.org/10.1038/nnano.2011.97)

The work was carried out in conjunction with researchers at Fudan University in China, the University of Central Florida and the Dalian University of Technology in China.

The work on the ZnO device was in part supported by Army Research Office Young Investigator Program and the National Science Foundation. The work on p-type ZnO was supported by the US Department of Energy.

Finisar acquires 100% of Ignis

The firm has completed the purchase of the manufacturer of optical chips, splitters, multiplexers, tunable lasers and modulators.

Finisar Corporation has successfully completed its acquisition of the entire equity interest in Ignis ASA, a Norwegian company whose shares are currently listed on the Oslo Stock Exchange.

As a result of its previously-announced recommended voluntary public offer and subsequent mandatory public offer to acquire all outstanding Ignis shares at a cash NOK 8 per share, Finisar acquired approximately 97.25% of the outstanding Ignis shares and subsequently acquired the remaining shares through the compulsory transfer provisions of Norwegian law.

Ignis is applying to the Oslo Stock Exchange for the delisting of its shares. The Exchange has suspended trading in the Ignis shares pending

delisting.

SEB Enkilda has acted as Finisar's financial advisor, and DLA Piper has acted as Finisar's legal advisor, in connection with Finisar's acquisition of Ignis.

Ignis ASA is an innovative provider of optical components and network solutions for fibre optic communications. The company operates globally through four subsidiaries: Fi-ra Photonics in Korea (71.8% owned) and wholly-owned subsidiaries Syntune in Sweden, Ignis Photonix in Denmark, and SmartOptics in Norway.

Tiger Optics' new gas analyser pounces on contaminants

In order for customers to meet targets for the 15-year International Technology Roadmap for Semiconductors, they need to monitor their process gases at ever increasing levels of purity.

Expanding the capabilities of its patented CW-CRDS technology, Tiger Optics has plans to introduce the LaserTrace 3 trace gas analyser at the Semicon West trade show in San Francisco.

The LaserTrace 3 can detect moisture, oxygen, methane, and other analyte contaminants at limits that are more than two times lower than previous generations of the product line.



Tiger, in the industry vanguard, sells laser-based trace gas analysers to semiconductor

manufacturers, tool manufacturers, purifier manufacturers and the gas companies that supply bulk and specialty gases to the industry.

In semiconductor manufacturing, contamination in process gases has a destabilising effect and negatively impacts deposition processes. As a result of as little as single-digit parts-per billion impurities in process gases, product yields are reduced. To remedy this problem, the LaserTrace 3 allows users to monitor for intrusions at levels that were never previously available.

“The leading semiconductor manufacturers have adopted our patented CW-CRDS technology due to the superior detection range, ease of use, the lowest total cost of ownership in the industry, and the fact that this is an absolute technology. No calibration gases are required,” said Lisa Bergson, Tiger’s founder and chief executive. “In order for our customers to meet targets for the 15-year International Technology Roadmap for Semiconductors, they need to monitor their process gases at ever increasing levels of purity.”

“The technological advancements of the LaserTrace 3 are a result of Tiger Optics’ on-going investment in research and development. We’re thrilled that our customers will now be able to realise a two-fold improvement in their detection limits.”

Since its debut in 2003, the LaserTrace platform has been widely accepted for semiconductor applications, based on its versatility, ease-of-use, and low cost-of-ownership. The multi-species, multi-point, multi-gas product line accommodates up to four sensor modules in a standard 19-inch rack, or permits placement of individual sensor models as far as 200 feet from the computerized control unit. In 2005, the company introduced its LaserTrace O2 as the world’s first laser-based, trace oxygen analyzer to detect parts-per-trillion levels in ultra-high-purity gases.

In 2008, the LaserTrace+ made possible the lower detection limit of 200 parts-per-trillion, which the company says at the time had the widest dynamic range of any dedicated analyser currently in the market.

Solar

Five First Solar executives purchase company stock

The cadmium telluride solar cell manufacturer says that its leadership team has confidence in the company’s long-term growth prospects and its ability to develop new markets.

First Solar has sold 5,500 shares of company stock this week to five of its senior executives, to add to their current holdings.

The purchases were made during one of four annual open trading windows for First Solar’s Directors and Section 16 officers and have been reported to the Securities and Exchange Commission in Form 4 filings where applicable.

Each of the First Solar executives purchased shares on the open market using personal funds.

Tymen DeJong, Senior Vice President of Global Operations, purchased 1,000 shares.

Frank DeRosa, Senior Vice President of Business Development for the Americas, purchased 500 shares.

TK Kallenbach, President of the Components Business Group, purchased 1,000 shares.

Jim Lamon, Senior Vice President of Engineering, Procurement and Construction (EPC) purchased 2,000 shares.

Mark Widmar, Chief Financial Officer of First Solar, purchased 1,000 shares.

“First Solar’s leadership team has confidence in the company’s long-term growth prospects and our ability to develop new markets and execute our cost, technology and project road maps,” said Rob Gillette, CEO of First Solar.

IQE supports Asia Pacific region with new sales manager

Based at the Group's Singapore facility, Norio Hayafuji will provide customers with a technical focus for IQE's wireless, optoelectronic and photovoltaic products across the APAC area.

IQE, a global supplier of advanced semiconductor wafer products and services to the semiconductor industry, has appointed Norio Hayafuji as Head of Sales and Marketing for the Asia Pacific region.

Norio has more than 27 years' experience in manufacturing, business development, sales and marketing and general management within compound semiconductor technology companies including Mitsubishi Electric, Procomp and Century Epitech.

Norio will be based at the Group's Singapore facility. He will coordinate sales and marketing activities and provide a technical focus for wireless, optoelectronic and photovoltaic products across the Group's Asia Pacific customer base.

CEO and President, Drew Nelson, said, "We confidently expect China, Taiwan, Korea and Japan to become major global powers in emerging technologies over the next decade. We already have a considerable presence in the Far East with a solid customer base and state-of-the-art manufacturing facility. The appointment of an acknowledged industry expert with extensive knowledge and experience of our industry in the region will help ensure that IQE is well positioned to exploit this growth potential."

IQE's comprehensive wireless portfolio includes III-V PHEMT, HBT, and BiFET epi-wafers grown by MBE and MOCVD at IQE's manufacturing sites in the US, UK, and Singapore.

First Solar honours progress at Mesa site

The cadmium telluride solar cell manufacturer has also announced the promotion of Todd Spangler to Site Director and General Manager.

At a ceremony held last week, CdTe solar cell manufacturer First Solar celebrated the construction advancement of its factory site in Mesa, Arizona.

The company also announced that Todd Spangler has been appointed Site Director and General Manager of the new Mesa factory, having previously served as General Manager of First Solar's factory in Perrysburg, Ohio.

Mike Koralewski will succeed Spangler as manager of the Perrysburg facility, and was appointed Vice President of Site Operations and Plant Manager.



First Solar CEO Rob Gillette and Mesa, Arizona, Vice Mayor Scott Somers unveil a ceremonial marker commemorating construction progress for the company's new factory, while Barry Broome, President and CEO of the Greater Phoenix Economic Council, looks on.

Representatives from the city of Mesa and First Solar officials hosted a reception at Chandler-Gilbert Community College in Mesa to celebrate construction progress. Vice Mayor Scott Somers, Greater Phoenix Economic Council President and CEO Barry Broome, and Tom Alston, Solar Outreach and Policy Coordinator for U.S. Representative Gabrielle Giffords, also took part in the celebration.

"First Solar coming to Mesa is an important step to establish Arizona as a major player in the solar

and clean energy industry. This cutting-edge facility brings hundreds of new high-tech jobs to the East Valley and adds to the ongoing development of the Gateway area," Mayor Scott Smith said.

"Projects like this don't happen without the cooperation between the private and public sectors, region and state. I'd like to thank those partners, especially First Solar and DMB, for working together to bring this facility to the Mesa Proving Grounds."

"Our Mesa factory has progressed from an idea to advanced construction in just a few short months, which would not have been possible without the support and hard work of countless state and local officials. Today we dedicate this site to the many people and agencies that helped make it happen, both public and private," said Rob Gillette, CEO of First Solar. "The U.S. is our fastest-growing market, and the additional production capacity from this factory will help us meet growing demand for clean, locally produced solar electricity."

First Solar's Mesa factory is expected to begin producing modules by the third quarter of 2012 and will employ approximately 600 full-time associates. First Solar is investing just over \$300 million in the four-line factory, which will produce approximately 250 MW of thin-film modules per year.

Output from the new factory is expected to be used in the construction of First Solar's 2,600MW North American project pipeline, which includes the 290MW Agua Caliente project, located in Yuma County, Arizona.

When fully operational in 2014, Agua Caliente could generate enough clean solar energy to serve the needs of about 100,000 average homes per year, displacing approximately 220,000 metric tons of carbon dioxide—the equivalent of taking about 40,000 cars off the road. Output from the Mesa factory is also expected to be used in First Solar's California projects, including the 550MW Topaz project, 230MW Antelope Valley Solar Ranch One and the 550MW Desert Sunlight project.

Todd Spangler joined First Solar in February 2007 as the company's Director of Manufacturing. In December 2008, he was promoted to Plant Manager of the Perrysburg, Ohio, campus. Prior to joining First Solar, he managed multiple plants and distribution centres for Lutron Electronics, the

world's leader in lighting controls.

Mike Koralewski has been with First Solar since August of 2006, leading the company's global quality and product reliability initiatives. Prior to First Solar, he was employed by Dana Corporation for 10 years in a variety of quality functions throughout different business units.

SoloPower awarded \$197 million by DOE

High-volume manufacturing CIGS solar module facilities in Oregon and California will increase availability of innovative thin film solar modules and provide more than 700 jobs.

SoloPower, a San Jose, California-based manufacturer of flexible CIGS thin film solar cells and modules has received a \$197 million loan guarantee from the U.S. Department of Energy's (DOE) Loan Programs Office.

The guarantee will support the construction and operation of three facilities that are expected to produce up to 400MW of state-of-the art thin film photovoltaic modules annually.

In addition to expanding its existing operation in San Jose, California, SoloPower will construct and operate two new facilities in Portland, Oregon. Together, these facilities will provide 450 permanent jobs, 270 construction jobs and several hundred additional supply chain jobs.

"SoloPower is bringing exactly the kind of new jobs Oregon needs," said Governor John Kitzhaber. "Working with SoloPower to bring their manufacturing headquarters to Portland, we are continuing on the path of supporting a strong clean technology manufacturing base in Oregon."

SoloPower uses innovative manufacturing technology to produce low-cost, high efficiency CIGS based photovoltaic cells. The CIGS cells are then packaged into unique, flexible, lightweight solar modules. The modules require less balance-of-system hardware and are easier to install than traditional solar panels.

"This loan guarantee from the DOE is the kind of

job creating investment this country needs,” said Senator Ron Wyden. “Companies that push the boundaries of known technology will reinvigorate America’s economy and provide much-needed family wage jobs for Oregonians now, and in the future.”

“Solar manufacturing represents one of the best ways to reduce dependence on fossil fuels, and with SoloPower poised to make a massive investment in Oregon’s already impressive alternative energy technology industry, it is clearer than ever that Oregon continues to be a ‘go-to’ state for innovation,” the Senator added.

SoloPower recently began making improvements to its existing facility in San Jose, California to accommodate the capacity expansion. Construction on the first high-volume facility in Portland, Oregon is anticipated to start next month.

Isofoton participates in 2011 EU PVSEC

The firm will present its III-V compound semiconductor based products at the solar power and environment fair in Hamburg, Germany from 5 to 9 September.

Isofoton will be presenting its new products, adapted to the demand for solar power generation solutions, at the 26th EU PVSEC.

The firm will present its complete range of ISF panels, including the ISF-250 and ISF-280 models, with 60 and 70 cells respectively. The range of ISF panels is comprised of units with white, black or transparent back coat, which can be customised according to the client’s requirements and the desired aesthetic of the installation.

In addition, as a new product, the ISF-480-Black 120 cell unit will be on display. These products offer technical solutions suitable for architectural integration projects, and provide high energy performance through the inclusion of micro-structured glass and a strict control process for the manufacture of high-efficiency cells, which optimises performance at low levels of radiation.

Isofoton will also present its latest development in

High Concentration technology, the GEN 2 unit.

Isofoton will also be exhibiting the ISOTRACKER range, which offers fully formed solutions for double or single axis monitors, and conventional or High Concentration photovoltaic panels. The main advantage of double axis ISOTRACKER products is their superior energy performance. Existing facilities have seen an increase of up to 42 percent compared to static installations (depending on the environmental conditions and solar radiation).

The Nessuno photovoltaic boat, covered with Isofoton cells and capable of reaching a speed of nine knots, will also be displayed on the stand.

The Isofoton stand is located in pavilion B6, stand B23.

Jens Meyerhoff to leave CdTe innovator First Solar

Jim Brown has replaced Meyerhoff as President of the Utility Systems Business Group of the cadmium telluride solar cell manufacturer.

First Solar has announced that Jens Meyerhoff, President of the Utility Systems Business Group (USBG) and former Chief Financial Officer (CFO), will be leaving the company effective Sept. 30, 2011.

James Brown, currently Senior Vice President of Utility Systems Business Sales, will succeed Meyerhoff, reporting to Rob Gillette, CEO of First Solar. In addition, Frank DeRosa will assume an expanded role in USBG as Senior Vice President of Business Development for the Americas, reporting to Brown.

“Jens has been an instrumental part of our growth, both as CFO and leading the Utility Systems business. He has always been equally passionate about both our business success and our long-term vision to build sustainable solar markets. We thank Jens for his dedication and wish him the best,” said Gillette. “Jim is an experienced leader with a proven track record who has been deeply involved in the creation and execution of our USBG strategy, so we are confident the transition will be seamless.”

“Over the past five and a half years I had the privilege to be part of building the leading franchise in the PV solar industry. I am very proud of what we have achieved, not only financially, but also in building the foundation for a sustainable global market for solar power,” said Meyerhoff. “With the full integration of our past acquisitions, the formation of a world-class Utility Systems team with a strong leader like Jim stepping up, as well as the completion of major project milestones such as the sale of Agua Caliente and the construction start of Desert Sunlight, First Solar is well-positioned for the future. The company has now reached a size and scale that allows me to step back and self-reflect before deciding my next step in life.”

Meyerhoff joined First Solar in May 2006 as CFO and led First Solar through the transformation from private to publicly traded company through its initial public stock offering in November 2006. Meyerhoff led the creation of First Solar’s Utility Systems business and was appointed President of the Utility Systems Business Group in July 2010.

James Brown joined First Solar in 2008 as Vice President, Project Finance, and has been involved in project finance and business development during his tenure. He currently is responsible for leading the wholesale systems sales business in the Americas and Asia-Pacific and has been instrumental in financing and selling First Solar’s self-developed portfolio of projects aggregating over 1.8 GW.

Prior to joining First Solar, Brown worked for approximately 20 years in banking covering project and structured finance for the energy and industrial sectors. He earned a B.S. degree from the United States Military Academy at West Point and was a Captain in the U.S. Army where he was a helicopter pilot and commanded an Air Cavalry troop.

In his new role, Frank DeRosa will add Business Development and Sales to his Project Development responsibilities in USBG for the Americas. DeRosa joined First Solar in 2010 as Senior Vice President of Project Development when First Solar acquired NextLight Renewable Power, where he was founder and CEO.

Prior to that, DeRosa worked for 23 years at Pacific Gas & Electric Company in both the regulated and unregulated business units, including

running PG&E’s RPS procurement program and the independent power plant subsidiary’s development activities. He earned a B.S. degree from Boston University and a Masters in Public Policy from Harvard University’s Kennedy School of Government.

Miasolé to rejuvenate sales with two new appointments

The additions of Rob DeLine and Paul Apen should enhance the growth and industry advancement of MiaSolé’s strategic approach to growth in CIGS commercialisation.

MiaSolé, a manufacturer of CIGS thin-film photovoltaic solar panels, has appointed Rob DeLine as Vice President of Marketing, and Paul Apen as Vice President of Business Development.

MiaSolé believes these latest appointments will expand the prowess of its core team by adding expertise and experience in marketing and business development.

Rob DeLine, a Fortune 500 veteran, brings 20 years of experience in brand and product management in the high-tech and energy sector to MiaSolé. He most recently served as Chief Marketing Officer for the Energy and Environmental Division of Applied Materials, where he was responsible for market strategy, business development and outbound communication initiatives to grow the company’s solar and lighting business. Prior to this, DeLine spent 15 years at Intel where he served in various roles including Marketing Director for the Asia-Pacific region.

Paul Apen has over 20 years experience in business development, product management and technology development in global high tech industries. He comes to MiaSolé from E-Ink Holdings where he was the Chief Business Development officer with primary responsibility for alliance and partner development and intellectual property strategy. Apen also held leadership positions in global business management, product management and technology development at Honeywell International.

“This is an extraordinarily exciting time in the solar

industry and MiaSolé is uniquely positioned to cement its role as one of the leading innovators and CIGS manufacturers,” said Joseph Laia, President and Chief Executive Officer, MiaSolé. “The collective experience and expertise that Rob and Paul bring to the table will be instrumental in our current and future plans to expand our business and more effectively articulate our value proposition to the marketplace.”

Singulus advances CIGS technology on glass

The firm has unveiled the TENUIS GEN 2 process system for CIS and CIGS modules which is claimed to offer significant cost advantages in the application of buffer layers on thin film solar cells.

Singulus Technologies has presented a promising new development on the way to the efficient wet-chemical coating of thin film solar modules made of CIGS on glass.

The second generation of the TENUIS production line has a modular cluster build basis and is said to enable both significant savings in terms of required floor space and the simultaneous one-side coating of two substrates. Due to new and unique concepts in terms of dosing and temperature control, the developers at the subsidiary Singulus STANGL SOLAR (Singulus STANGL) were successful in reducing the process time by up to 20 %, which has a positive effect and a considerably higher output in production.

The new TENUIS generation offers substantial cost advantages in the production of high performance CIS/CIGS thin film solar cells. Furthermore, the costs are significantly reduced by temperature profiles adjusted to the process and by very efficient use of process chemicals, so that the new system consistently exploits the savings potential in the manufacturing of thin film solar cells.

Compared with its predecessor the TENUIS GEN 2 version not only reduces the production time but also the required floor space by 30 % and saves footprint and maintenance costs accordingly. Due to the space-saving design the new system is easily integrated into existing production lines. For a

higher throughput several production machines can be combined to a large production complex.

The TENUIS GEN 2 also provides advantages upon commissioning and in the ramp-up stage. Because of the new cluster design the commissioning can commence modularly after a short installation time and the first substrates can be coated. The following cluster can be assembled simultaneously or consecutively. Correspondingly, the TENUIS GEN 2 meets the ever increasing demands of the market with respect to the reduction of the commissioning and ramp-up times.

It is extremely important for cell manufacturers to continuously advance processes and throughput to gain an advantage over the competitors. Here the TENUIS GEN 2 also offers ideal prerequisites since a module for alternative processes can be run independently in the production line. As a consequence, know-how is gained on a production scale and under real conditions.

Singulus STANGL's TENUIS GEN 2 provides the possibility of using alternative coating materials such as ZnS. The extensive process know-how of the developers in Fürstfeldbruck, Germany, which is combined in Singulus STANGL's systems, results in optimised operating costs and total costs of ownership.

Singulus says the new coating system is offers extremely stable and reproducible process results and very high up time. The re-launch of the TENUIS system is completed by a new software user interface.

Ultrasonic installs CIGS thin film module production in France

The PV-480 tool, which uses nozzle-less ultrasonic spray head technology for a more uniform and repeatable coating deposition, will be used to improve overall cell efficiency.

Ultrasonic Systems, a manufacturer of high-performance ultrasonic spray coating equipment, has successfully installed and commissioned a PV-480 coating system at Nexcis Photovoltaic

Technology, a CIGS solar panel developer, based in Rousset, France.



The system will be used for the application of sodium fluoride solution, a process claimed to improve the overall efficiency of the cell. Ultrasonic Systems says the PV-480 leverages USI's proprietary, nozzle-less ultrasonic spray head technology for a more uniform and repeatable coating deposition vs. conventional air atomizing spray nozzle, conventional ultrasonic nozzle, and roll coating technologies.

Designed for high-volume in-line manufacturing, the PV-480 processes glass plates up to 48 inches wide at line speeds of up to six feet per minute. The PV-480 delivers liquid coating with transfer efficiencies in excess of 90%, utilising a traversing Ultra-Spray blade head. This versatile system is ideal for the application of a variety of low viscosity liquids used in the manufacture of thin film photovoltaic cells.

"The PV-480 complies perfectly with our expectations and provides excellent coating performance," said Herve Rivoal, Chemistry Section Head of Nexcis Photovoltaic Technology. "We are pleased with our growing success with thin-film solar manufacturers requiring the latest manufacturing equipment technology to create reliable, efficient thin-film modules," said Stuart Erickson, President of Ultrasonic Systems. "The latest PV-480 installation reflects the success of our unique nozzle-less spray head technology for spray coating applications critical to CIGS thin-film solar production."

First Solar CdTe cells to shine in Arizona

At full capacity, the electricity generated by Agua Caliente, which uses cadmium telluride First Solar modules is enough to serve more than 225,000 homes.

NRG Energy has completed its acquisition of the 290 MW Agua Caliente solar project from First Solar,

The acquisition was contingent upon the financial closing of the project's loan guarantee from the U.S. Department of Energy's Loan Programs Office.

Agua Caliente is one of the world's largest solar photovoltaic project currently under construction. The Yuma County, Arizona project has obtained all permits and approvals from both federal and state agencies, and is expected to create up to 400 construction jobs through its completion date in 2014. Financial terms of the sale of the project were not disclosed.

"Agua Caliente demonstrates the extraordinary progress the U.S. has made to achieving energy independence through public-private collaboration and technological innovation," said Tom Doyle, CEO of NRG Solar.

"Construction of the Agua Caliente system will create hundreds of new jobs in local communities, supporting economic growth alongside environmental sustainability. The sheer scale of the project will also help drive developments needed to deploy even larger and more efficient clean-energy resources in the future."

"Agua Caliente is a major milestone for utility-scale solar," said Frank De Rosa, First Solar senior vice president of North American project development. "We are pleased to continue working with NRG in adding significant renewable generation resources to the U.S. electrical grid, delivering both economic and environmental benefits."

Electricity from Agua Caliente will be sold under a 25-year power purchase agreement with Pacific Gas and Electric, helping California to meet its ambitious renewable energy goals. At full capacity, the electricity generated by Agua Caliente is enough

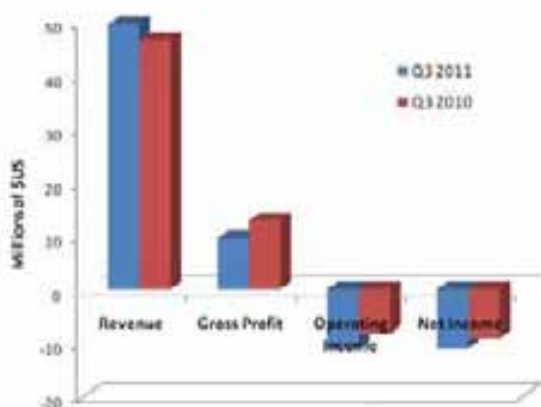
to serve more than 225,000 homes. The project is expected to offset approximately 5.5 million metric tons of CO₂ over 25 years, the equivalent of taking over 40,000 cars off the road annually.

Emcore's Q3 revenue in line with guidance

The company has reported revenue of \$49.5 million for the latest quarter and says it projects Q4 revenue to be in the range of \$51 to \$55 million.

Emcore Corporation, a provider of compound semiconductor-based components, subsystems, and systems for the fibre optics and solar power markets, has announced its financial results for its third quarter ended June 30, 2011.

GAAP Financial Results for Q3 2011 & 2010



Revenue:

Consolidated revenue for the third quarter ended June 30, 2011 was \$49.5 million, which represents a 6% increase compared to the prior year.

On a segment basis, revenue for the Fibre Optics segment was \$33.3 million, which represents a 6% increase compared to the prior year. Revenue for the Photovoltaics segment was \$16.2 million, which represents a 7% increase compared to the same quarter last year.

Gross Profit:

Consolidated gross profit was \$9.5 million, a 26% decrease compared to the prior year, while consolidated gross margin was 19.1%, a decrease from the 27.5% gross margin reported the same

time last year.

On a segment basis, Fibre Optics gross margin was 19.4%, a decrease from the 25.9% gross margin reported in the prior year. Photovoltaics gross margin was 18.6%, which represents a decrease from both the 30.7% gross margin reported in the prior year.

Operating loss:

The consolidated operating loss was \$11.2 million, which represents a \$2.9 million increase in operating loss when compared to the same quarter last year.

Emcore says the quarter-over-quarter variance was primarily due to the change in litigation settlements totalling \$4.1 million, an increase in non-cash stock-based compensation expense of \$1.4 million, and an increase in research and development expense associated with the March 2011 Soliant Energy asset acquisition and our Fibre Optics segment.

Net loss:

The consolidated net loss was \$11.1 million, which represents a \$1.9 million increase in net loss when compared to the prior year. The consolidated net loss per share was \$0.12, which represents a \$0.01 increase in net loss per share when compared to the prior year. During the third quarter ended June 30, 2011, Emcore recorded \$0.3 million of non-operating expense related to its Suncore joint venture.

Order Backlog

As of June 30, 2011, Emcore has a consolidated order backlog of approximately \$66.2 million, a 31% increase from the \$50.5 million order backlog reported as of March 31, 2011. On a segment basis, the Photovoltaics order backlog totalled \$39.6 million, a 50% increase from \$26.4 million reported as of March 31, 2011. The Fibre Optics order backlog totalled \$26.6 million, a 10% increase from \$24.1 million reported as of March 31, 2011. The order backlog is defined as purchase orders or supply agreements accepted by the firm with expected product delivery and/or services to be performed within the next twelve months.

Balance Sheet Update

As of June 30, 2011, cash, cash equivalents, and restricted cash totalled approximately \$21.1 million. In May 2011, Emcore completed a common stock

private placement of \$9.7 million. In June 2011, the company paid its remaining capital contribution obligation to its Suncore joint venture. Emcore says it is not required to contribute additional funds in excess of the initial \$12 million investment, and at this time, it does not anticipate contributing any additional funds to Suncore.

Business Outlook

For the fourth quarter ending September 30, 2011, Emcore expects consolidated revenue to be \$51 to \$55 million.

Manz given €3.8 million to develop CIGS technology in Germany

The firm has joined a government-sponsored project as part of the Photovoltaics Innovation Alliance. Würth Solar and the Centre for Solar Energy and Hydrogen Research (ZSW) in Stuttgart are part of the team.

Efficient solar technology “made in Germany” with decreased manufacturing costs – that is the goal of two development partnerships Manz AG is participating in with various industry and research partners.

Manz has entered the first cooperative research project with the CIGS module manufacturer Würth Solar and the Centre for Solar Energy and Hydrogen Research (ZSW) in Stuttgart. The goal of this project is to make more rapid advancements in CIGS thin-film technology licensed to the company as part of the exclusive expertise and cooperation agreement with Würth Solar.

CIGS modules are one of the most efficient of all thin-film solar technologies available today. Photovoltaic cells in ZSW’s laboratory, which have an impressive efficiency of 20.3%, demonstrate that there is still enormous potential for increasing the efficiency of mass-produced cells.

The primary goals of the project are to both rapidly increase efficiency while simultaneously reducing investment and manufacturing costs. The project has a total budget of €12.5 million. Manz will receive €3.8 million in subsidies over the next four years from Germany’s Federal Ministry for the Environment.

The second project involving crystalline silicon solar

cells has a budget totalling €7.7 million, with €1.85 million coming from government subsidies.

“The issue here is Germany’s ability to compete in our industry on an international scale,” says Dieter Manz, founder and CEO of Manz AG, “and we are up against strong research initiatives in many countries, not only in China. For Manz, the support is important as we move down the path toward our strategic goal of becoming the leading supplier of fully integrated production systems.”

As part of the Photovoltaics Innovation Alliance launched in August of 2010, Germany’s federal government is funding select industry projects in order to reach grid parity for solar power as quickly as possible. This refers to the point at which the cost of generating solar power is competitive with other sources of energy.

Q-Cells CIGS technology shoots and scores in Germany

The firm is installing roof-top solar systems at the Hallesche FC and Borussia Dortmund football stadiums.

Q-Cells SE will install a 526 kilowatts-peak (kWp) photovoltaic plant on the roof of ERDGAS Sportpark, the new stadium of the Hallesche FC (HFC) using its CIGS technology.

The football team from the city of Halle (Saale) will play their home games in the ERDGAS Sportpark.

Project developer Q-Cells has already completed preparing for construction in coordination with HFC and Stadion Halle Betriebs GmbH, and is negotiating with potential investors in the solar project. Once these negotiations are successfully concluded, Q-Cells will install the photovoltaic plant on the roof of the ERDGAS Sportpark stadium as the general contractor. The company will also assume responsibility for operating and maintaining the system.

Installing the photovoltaic roof-top plant, HFC and Q-Cells want to contribute to expanding solar power in the Halle region. “We are setting an example for the transformation of the regional energy market by installing the solar system on the roof of the

new stadium, showing that solar power is a future-oriented source of energy,” said Nedim Cen, CEO of Q-Cells. “Q-Cells is also proving our expertise as a supplier of complex commercial photovoltaic plants.”

The system will produce approximately 455,000 kilowatt-hours (kWh), equal to the amount of power consumed by 150 households annually. The solar plant will also save around 403 tons of CO₂ emissions annually, making a significant contribution to sustainability on site. The roof-top system will consist of XXX Q.SMART thin-film modules produced by Q-Cells.



Rooftop array using Q.SMART modules on industrial building in North Rhine Westphalia, Germany

The attractive black Q.SMART modules stand out with their high performance under rather unfavourable conditions. “Due to the complex structures and static requirements, installing solar plants on football stadiums requires in-depth technical expertise and suitable technical products,” said Stefan Läufer, Senior Vice President Commercial & Industrial Systems at Q-Cells. “We have long-standing experience in the field of solar applications and an ideal, high-quality product:

our Q.SMART modules. Q.SMART is perfectly suited for installations on flat roofs or facades. The modules produce maximum yields, guaranteed for at least 25 years.”

Q-Cells has already gained experience in installing roof-top systems on sports arenas. The company is currently working to build a PV system on the roof and facade of the biggest German football stadium, SIGNAL IDUNA PARK (Dortmund), in cooperation with the German football champion, Borussia Dortmund.

This plant will also consist of Q.SMART modules produced by Q-Cells in Bitterfeld-Wolfen. Crystalline Q-Cells cells were also installed in the solar system at Weserstadion in Bremen. PV plants in football stadiums introduce the benefits of solar power to the public, and as a leading photovoltaics company Q-Cells is successfully establishing itself in this market.

Isoton inaugurates PV system for Conad Sicilia

The firm’s III-V compound semiconductor based modules have been used at a Conad Sicilia distribution centre in Modica, Sicily.

Isoton recently completed its first photovoltaic facility for Conad Sicilia.

The installation, which covers 2,000 square metres or the equivalent of nearly two Olympic-size pools, is located on top of the warehouse at the Cooperative’s headquarters in Modica (RG). Supplies are transported from this distribution centre to 159 supermarkets throughout eastern Sicily and Malta.



Inauguration of facility at the Cooperative's headquarters in Modica, Sicily

The facility, with 200kWp of total power, was installed by Cerberus S.A. on the roof of the loading platform for this distribution centre, taking advantage of an area that was not being used by the warehouse.

The solar panels it uses are highly-efficient, Isofoton ISF-230 III-V modules, manufactured in the Research & Development Centre of Málaga. Conad Sicilia invested €1 million in these solar panels, in order to reduce its emissions by 30% compared to 2010 and to generate a yearly electrical energy production of 326,700 kWh.

Giorgio Ragusa, General Manager for Conad Sicilia declared: "This facility is the first step in an ambitious project that aims to protect the environment and to promote clean energy production using photovoltaic energy. We anticipate an overall reduction in carbon dioxide emissions of 103 tonnes, which translates into an environmental benefit equivalent to forest plantation covering 11 hectares."

"This investment is closely aligned with our environmental sustainability policy. In fact, for quite a few years now we have been firmly committed to reducing our energy consumption by designing and building new, environmentally-friendly points of sale that take advantage of innovative technical solutions in energy savings and ecological processes. Ours is the first industrial area to have invested in clean energy production," continued Ragusa.

Juan Manuel Antelo, Country Manager for Isofoton Italia, highlighted how important it was for Isofoton to be chosen by a strategic partner like Conad, not only for the prestige of the project and the possibility of continuing to develop photovoltaic systems for the cooperative's supermarket chain, but also in stipulating public awareness of solar energy through "ad hoc" informational campaigns conducted within the actual supermarkets. Conad Sicilia will be soon launching its international campaign "Your Sun Your Energy," dedicated to informing consumers on the benefits of solar photovoltaic energy.

Phoenix Solar stretches its wings in India

The Asia Pacific subsidiary of Germany-based Phoenix Solar AG will install two 1 MWp facilities in the states of Tamil Nadu and Gujarat. The systems will use MiaSolé CIGS modules and First Solar cadmium telluride modules.

Phoenix Solar Pte in Singapore has signed two contracts in the Asia Pacific region totalling 2 megawatts peak power (MWp).

India's PV market grew by 57 percent to reach approximately 69 MWp in 2010 and the government plans 20 GW of installed photovoltaic capacity by 2022. "India is poised for expansion and offers immense market potential. The country's high insolation (1,500 – 2,000 kWh/m²), combined with plentiful available land, strong demand and power purchase agreements (PPA) makes it an ideal location for solar PV", said Christophe Inglin, Managing Director of Phoenix Solar Pte.



Phoenix Solar Singapore and local company Alectrona Energy Private have contracts to jointly supply and install a 1 MWp system in Tamil Nadu for Great Shine Holdings Pvt, a subsidiary of Zynergy Projects and Services Pvt.

The system uses CIGS modules from MiaSolé, and SMA inverters. Approximately 9,000 modules will cover an area of 1.8 hectares of flat land and feed over 1,600 MW hours a year into the National Thermal Power Corp (NTPC) grid. This project is funded under the Jawaharlal Nehru National Solar Mission (JNNSM), with a PPA of INR 18.45/kWh (approx. EUR 0.29/kWh) for 25 years.

Rohit Rabindernath, Zynergy's CEO, commented, "We have big plans for India's solar sector, and we are very pleased to partner with Phoenix Solar for this pilot project – the first of many to come".

Phoenix Solar Singapore has also signed a 1 MWp

contract with Chemtrols Solar Pvt for a project in the state of Gujarat, India, using First Solar CdTe modules and SMA inverters. This system will use over 13,000 modules to cover 2.2 hectares. The plant will feed 1,600 MW hours per year into the Gujarat Energy Transmission Corporation Limited grid, with a PPA of INR 15/kWh (approx. €0.24/kWh) for years 1-12, and INR 5 (approx. €0.08/kWh) for years 13-25.

“We value the close collaboration with Phoenix Solar especially in the early phases of India’s PV market development. We appreciate the experience that Phoenix Solar brings to the table”, said Sharad Saxena, CEO of Chemtrols Solar Pvt.

For Andreas Hänel, CEO of Phoenix Solar AG, this is further proof of the growth in Asia. “Internationalisation is a critical aspect of our business and we are pleased that our Singapore subsidiary – after the market entry in Malaysia last year – now successful entered both Thailand and the Indian solar market. These first two projects in India mark a significant first step towards an important market in our portfolio.”

Both projects are scheduled to be connected to the grid by 31 December 2011.

Chris Grasset quits OPEL Solar

The company, which manufactures gallium arsenide based devices using its patented POET technology, which is focused on increasing the speed and decreasing the energy usage in computers, has announced a change to its Board of Directors.

OPEL Solar International has announced that due to unanticipated personal circumstances, Chris Grasset has withdrawn from serving on the Board of Directors.

Grasset wanted to reiterate that his optimism remains undiminished and that the Company’s efforts will result in strong growth in both its solar and semiconductor lines of business. The Board does not intend to fill the vacancy at this time, and wishes Grasset the best in his future endeavours.

The Company’s management and the Board

continue to be committed to the goal of increasing long-term shareholder value, and underlines its confidence in the current strategy for the Company’s solar business - including greater vertical integration, development of a brownfields initiative and its burgeoning systems rollout in North America and China – and for its Planar Optoelectronic Technology (POET) device development program. OPEL is looking forward to shortly providing updates of its growing activities in both the solar and semiconductor sectors towards these goals.

OPEL Solar and Limen announce agreement to supply two HCPV solar power plants in Italy

OPEL Solar, a global supplier of high concentration photovoltaic (“HCPV”) solar panels and other solar products including ground based and rooftop tracker systems, have announced the signing of an Agreement to supply two HCPV solar power plants in Italy.

Each solar utility plant will be approximately 1 MW HCPV power installations that will be built in Sicily, Italy. The orders combined revenue to OPEL approach five million dollars. Beginning delivery in late 2011, these orders for OPEL’s HCPV solar modules spotlight HCPV solar in Italy.

The solar plants will be eligible for receiving the CPV Feed-In Tariff of the Italian Government, which is €0.31/kWh currently for systems of this size, in addition to the market value for the sale of the electricity produced.

According to a July feature article in Renewable Energy Focus.com, the installed base for CPV in Italy is targeted to attain 320 MWs by 2015. Going forward, OPEL Solar and LIMEN shall have a close collaboration for the preparation, the construction and the commissioning of CPV solar power plants. To date, LIMEN has developed a multi-megawatt pipeline of CPV projects in Sicily and Sardinia.

“The collaboration between OPEL and LIMEN in the Italian CPV market represents significant value growth for OPEL Solar’s stakeholders because of

the HCPV potential in the Italian market,” said Leon M. Pierhal, CEO of OPEL Solar International.

“The Italian climate is ripe for CPV; it is one of the best areas in the world for our solar technology to be deployed.” “We are very pleased to partner with OPEL Solar in building CPV solar utility plants,” said Roberto Petti, Ph.D., head of the renewable energy division of LIMEN SA. “We believe OPEL Solar has the proven HCPV solar technology to be a market leader in Italy. Bringing an advanced solar energy technology to customers allows them to maximize their return on investments in green technology.”

The OPEL Solar HCPV module is called the Mk-I, and it is a high performance, reliable, cost effective product designed for utility grade grid-connected solar systems in medium to high solar irradiance climates. The high efficiency of the OPEL HCPV panel results in significantly higher power generation per unit of area when compared with both silicon flat panel and thin film installations.

Major Asia Pacific Photovoltaic Markets to Reach 26% of Global Demand by 2015

Asia Pacific photovoltaic markets are set to grow rapidly and are projected to account for approximately one-quarter of global demand by 2015, up from 11% in 2010, according to the latest Asia Pacific Major PV Markets report from Solarbuzz.

The top five markets in this region—China, Japan, India, Australia, and South Korea—are projected to account for 3.3 GW of demand in 2011, with China and Japan leading the region. Each major Asia Pacific country market is currently undergoing significant alternations to its policy structure. While China, India and Australia are building on-grid markets for the first time, Japan and South Korea face policy transitions that are re-stimulating their domestic demand over the next two years. Following the establishment of a manufacturing base that now accounts for approximately 50% of global production, China is stimulating its domestic demand through both national and provincial

programs. This will cause China's market to expand in 2011 by up to 174% over its 2010 level. “Market growth expectations are high for the region, China and India in particular, as they each have multi-gigawatt project pipelines. However, the largest challenge facing many of these projects is the need to secure financing amidst a still evolving policy and regulatory environment,” said Craig Stevens, President of Solarbuzz. “If these policies are successful in delivering the projected growth for the Asia Pacific region, it will help offset the impact of incentive cuts across Europe.” In terms of customer segments, growth will be led by utilities, forecast to become the largest customer segment as the markets move away from the current dominance of residential installations. With the implementation of a nationwide net feed-in tariff, the Japanese solar PV market is expected to install at least 1.29 GW of new PV capacity in 2011. This represents growth of approximately 35%, a sharp contrast to established European markets which are displaying low growth or even contraction during 2011. Non-residential installations, while not representing the majority of total capacity, are growing at more than twice the rate of residential system installations. Japan was the fourth largest PV market in the world in 2010, doubling for a second year in a row and installing 960 MW, thanks to re-launch of the nationwide residential incentive program and the net feed-in tariff. The Fukushima nuclear disaster has led to calls from domestic cell manufacturers to push for enhanced renewable energy policies. Meanwhile, the share of imported modules has grown more than 138% Y/Y, accounting for 13% of module shipments in Japan last year. On-grid installations in China are projected to double in 2011 as Chinese incentive policies increase the pace of large and utility-scale PV installations. In 2010, 85% of demand in China was from projects larger than 1 MW and the latest temporary on-grid tariff announcement in Qinghai province will further boost shares of ground-mount utility projects in 2011. Programs such as the Golden Sun and Solar Rooftop programs maintain prominence going forward as developers continue to advance projects towards completion. Provincial FIT policies in Jiangsu and Shandong also made significant contributions to overall demand. With improving policy environments at both central and local government levels, as well as a near 10 GW project pipeline, the PV market in China is ready to deliver strong growth through 2015. The on-grid ground-mount segment is expected to lead

the way in building India's installed capacity, with installations expected to at least double in 2011. The National Solar Mission, as well as state level policies in Gujarat, Rajasthan, and Maharashtra are leading to strong growth, with these three states accounting for as much as 70% of the total Indian market in 2011. Armed with the goal of installing 22 GW of new solar capacity by 2022, the National Solar Mission has sanctioned 300 MW of on-grid PV capacity to be installed through 2011 and 2012, with an additional 300 MW to be allocated in 2H'11. Though the first round of projects has experienced setbacks due to high capital costs, low returns, and regulatory hurdles, a potential restructuring of project guidelines is likely to stimulate higher success rates of future projects. As of June 2011, the on-grid pipeline of projects targeted for completion by 2013 stood at 1.5 GW. Although projected to contract in 2011 due to the phase-out of the country's FIT program, longer-term growth potential in South Korea remains stable as new Renewable Portfolio Standards are implemented. The new RPS is expected to install 1.2 GW of new PV capacity over the next five years, although at a much slower pace than in past years. Decreased incentives under the FIT and RPS significantly slowed large ground-mount installations in 2010, paving the way for strong growth in the building-mount segments. This trend is expected to continue over the next few years, as the Korean government seeks to incentivize small and building-mount applications. The Australian government's latest energy policy takes the form of a carbon tax, which will transition to a cap-and-trade system in 2015. The introduction of this policy comes on the heels of several dramatic policy changes, including an increase in the rate of decline for Australia's main PV incentive program, Solar Credits, and the implosion of several state-based feed-in tariff programs. The 431% market growth in 2010 came despite an attempt by the government to reign in demand for PV installations. The economics of PV systems have been enhanced by decreasing installed system costs, due to falling global module prices, an increasing number of accredited installers, and expectations of increasing retail electricity prices. New South Wales accounted for 44% of the national market, but now faces market disruption following cessation of the Solar Bonus Scheme in April. Fragmented and stop-start solar policies remain the largest stumbling block to long-term sustainable growth for the PV industry in Australia.

Global CPV Cumulative Installations to Reach 12.5 GW by 2020

CPV is an upcoming renewable market which promises to provide cost-effective power generation at high levels of efficiency

Presently, the global CPV cumulative installed capacity is 23 MW. The technology is still developing and so most CPV projects are in the pilot or prototype stage. Guascor Foton's Navarre power plant and Murcia power plant are the largest CPV plants with installed capacities of 7.8 MW and 2 MW respectively. Globally, Spain has the largest market for CPV installations. In the US, the major emerging companies are SolFocus, Amonix, EMCORE and Skyline Solar. European companies such as Concentrix, Abengoa Solar and ArimaEco have also started making progress in the CPV market.

The CPV market is expected to grow dramatically over the next three years. Companies that have successfully operated CPV prototype systems in pilot locations are progressing towards multi-megawatt CPV projects. With an increased understanding of CPV in terms of technology and investment, most of the players have plans for large-scale CPV projects. Companies such as SolFocus, Amonix and ArimaEco are planning to expand their production capacities in order to meet the upcoming demand. Countries such as Italy, China, Australia, India and South Korea are proving to be important emerging markets in the CPV industry. Italy's CPV FIT program and China's low-cost production and high DNI in western region are attracting CPV investors in these countries.

In 2010 Spain dominated the global CPV market with around 16 MW of cumulative installed capacity. Spain accounts for 70% of the global CPV installed base. Most parts of the country experience high DNI which attracts CPV installers for investments in Spain. The US follows Spain with a cumulative installed capacity of around 4.5 MW; thereby accounting for 20% of the global CPV installed capacity. Greece and Australia have also attracted CPV system installers due to a high DNI concentration. These countries account for approximately 5% and 3% of the global CPV

cumulative installed capacity respectively.

During 2006–2010 more than \$11.6 billion deals have been completed in the global CPV market globally. As CPV is still an emerging technology there were approximately 46 private equity and venture financing deals during the period. Centure financing increased from \$81m in 2006 to \$189.2m in 2010. The major venture financing deals were \$101m by HelioVolt Corporation, \$130m by eSolar, \$57m by Infinia, \$77.6m by SolFocus and \$129.4m by Amonix.

The research provides an understanding of the global CPV market and also provides market analysis of the US, Spain, China, Italy and Australia CPV markets. The research provides historical and forecast data to 2020 for installed capacity, power generation and cost trends. The report also details the installed capacity split by concentration (HCPV and LCPV), major countries and major players in the global CPV market. The report analyses renewable energy initiatives with policy framework in countries such as the US, Spain, China, Italy and Australia.

First Solar Receive New IEC Certification

First Solar, today announced that its advanced thin-film solar modules have received a new international certification confirming that the company's technology can be used in a variety of operating conditions, including coastal environments.

First Solar's photovoltaic (PV) modules have passed the International Electrotechnical Commission's (IEC) 61701 salt mist corrosion test, which studies module performance in coastal environments characterized by corrosive salt mist. "This certification further demonstrates the robustness and versatility of First Solar's PV technology," said John Kufner, First Solar director of global module product management. "The data shows that our modules can be expected to produce clean electricity in coastal marine environments without any performance concerns." The IEC 61701 accreditation applies to First Solar's Series 3 modules. All First Solar modules

are backed by a 25-year performance warranty and covered by an industry-leading, prefunded collection and recycling program.

First Solar Sets World Record for CdTe Solar PV Efficiency

First Solar has announced it set a new world record for cadmium-telluride photovoltaic solar cell efficiency, reaching 17.3 percent with a test cell constructed using commercial-scale manufacturing equipment and materials

The test cell's performance, confirmed by the U.S. Department of Energy's National Renewable Energy Lab (NREL), far surpassed the previous record of 16.7 percent set in 2001.

First Solar's research and development group studies a PV test cell constructed using commercial-scale manufacturing equipment and materials. (Photo: Business Wire)

"This is a significant milestone that demonstrates the ongoing potential of our advanced thin-film technology," said Dave Eaglesham, Chief Technology Officer at First Solar. "This leap forward in R&D supports our efficiency roadmap for our production modules and will recalibrate industry expectations for the long-term efficiency potential of CdTe technology."

"This achievement is a direct result of our industry-leading investment in research and development and our commitment to continuous improvement," said Rob Gillette, CEO of First Solar. "First Solar's innovation in both module technology and balance of systems engineering continues to drive us closer to grid parity."

The average efficiency of First Solar modules produced in the first quarter of 2011 was 11.7 percent, up from 11.1 percent a year earlier, and the company has recorded full-module efficiencies over 13.5 percent, with a 13.4 percent module confirmed by NREL. First Solar's module efficiency roadmap sets a goal for production-module efficiencies of 13.5-14.5 percent by the end of 2014.

First Solar utilizes a continuous manufacturing process which transforms a sheet of glass into a complete solar module in less than 2.5 hours, which contributes to the company's industry-leading energy payback time and the low carbon footprint of systems using First Solar PV modules. First Solar also implemented the industry's first comprehensive, prefunded solar module collection and recycling program. Anyone wishing to dispose of First Solar modules can request collection at any time, at no additional cost, and First Solar will pick up the modules and recycle up to 90% (by mass) of the material for use in new products, including new solar modules and new glass products.

First Solar Sells 10MW Solar Power Plant near Zamora, Spain to KGAL

First Solar and KGAL on Thursday announced the purchase of a 9.9 megawatt (MW) (DC) solar power plant near Zamora, Spain by European Solar Power Fund — a renewable energy-focused fund for institutional investors managed by KGAL — from First Solar.

Currently under construction by Gehrlicher Solar España with an expected completion in December, the 37.6 hectare solar farm will produce an estimated 15,000 megawatt hours (MWh) of clean, green electricity a year — equivalent to the annual needs of around 3,400 Spanish households and CO₂ savings of approximately 5,600 metric tons/year.

"We are very glad about the successful acquisition of this exceptional solar farm in Spain and the opportunity to collaborate with highly professional partners like First Solar and Gehrlicher," said Dr. Klaus Wolf, managing director of KGAL. "The total capacity of solar farms owned and operated by KGAL's investment funds now exceeds 200 MW."

The solar farm is located in Pereruela in the province of Zamora, Spain, about 250 kilometers northwest of Madrid. The Zamora area is one of the sunniest in Europe, with around 1,700 kWh/m² of sunlight a year. Guillermo Barea Herranz, CEO of Gehrlicher Solar España, said: "We are happy about the successful realization of this project

together with our business partners. Based on our long-term experience and the high potential of the Spanish PV market, we look forward to installing many more PV systems in this region as well as in the rest of the world." As with other large, ground-mounted solar farms such as the 53MW Lieberose solar farm in Germany and 26.3MW Badajoz solar farm in Spain, First Solar helped to organize third-party financing in addition to supplying solar modules—in this case some 122,000 FS Series 3 thin-film solar modules. "Large-scale projects are essential to greenhouse gas reductions and driving economies of scale that make us more competitive with fossil fuels," said Peer Guenzel, Managing Director of First Solar's Utility Systems Business Group in Europe, the Middle East and Africa. "We are pleased to be able to continue to enable a market for large-scale solar power plants in Spain," he said. The long-term financing for the Zamora project was structured by HSH Nordbank AG. Jürgen H. Lange, head of energy at HSH Nordbank, said: "We have been active in the renewable energy sector for several years now. Knowing the international network, the financial and technical developments, and specific regional requirements for solar projects, we were able to structure the Zamora transaction in a way that satisfied the needs of all parties."

Financial terms of the agreement weren't disclosed.

\$1.4 Billion in transactions in India supports 10,000 American jobs

Export-Import Bank in Washington is providing a \$16 million, 16.5-year loan to Azure Power Rajasthan Pvt to purchase thin-film solar cadmium telluride based First Solar modules for the construction of a 5 MW solar PV plant in Rajasthan.

Fred P. Hochberg, chairman and president of the Export-Import Bank of the United States (Ex-Im Bank), is leading a business-development mission this week in India.

He announced \$25 million in Ex-Im Bank loans for two new solar-energy projects and is promoting the Bank's financing products to support the purchase of U.S. goods and services by Indian buyers.

Hochberg is in New Delhi today for the U.S. - India Strategic Dialogue headed by Secretary of State Hillary Rodham Clinton.

“India is a key country for U.S. exports and an increasingly important market for Ex-Im Bank. In the first nine months of fiscal year 2011, the Bank has approved \$1.4 billion in transactions on behalf of American exporters and their Indian buyers. This financing has increased our overall exposure in India to \$5.5 billion and supported over 10,000 American jobs,” said Chairman Hochberg. “With this kind of growth in demand, we anticipate that next year India may very well become Ex-Im Bank’s biggest single market.”

Hochberg added, “As the world’s two largest democracies, the United States and India have a solid and unique partnership. There are tremendous opportunities for investments in projects that create jobs and help address India’s growing energy and infrastructure needs.”

Renewable-energy projects are a top priority for Ex-Im Bank. In FY2011 until June 30, the bank has approved \$75 million in solar transactions in India, which will produce approximately 35 MW of solar power. The Bank also has approximately \$500 million in upcoming Indian solar transactions, which will generate 315 MW of solar power.

In New Delhi, Hochberg announced authorisations totalling more than \$25 million for two separate solar transactions. Ex-Im Bank is providing a \$16 million, 16.5-year loan to Azure Power Rajasthan Pvt to purchase thin-film solar modules from First Solar based in Tempe, Arizona, for the construction of a five-MW solar photovoltaic plant in the state of Rajasthan.

Additionally, Ex-Im Bank authorised a \$9.2 million, 18-year loan for thin-film solar modules from Abound Solar in Loveland, Colorado, to Punj Lloyd Solar Power for the construction of a 5 MW photovoltaic solar power plant in Rajasthan.

Later in the week, Hochberg will travel to Mumbai to meet with Anil Ambani, chairman of Reliance Power. As part of President Obama’s trip to India last November, Ex-Im signed a \$5 billion Memorandum of Understanding (MOU) with Reliance for the purchase of U.S.-manufactured equipment for a power project that will produce 8,000 MW. The

MOU also covers the purchase of renewable-energy (solar and wind) equipment from U.S. manufacturers and service providers for projects that will produce 900 MW of clean energy.

In New Delhi, Hochberg met with officials from the General Electric Co. to discuss rail and energy projects. And in Mumbai, Hochberg will meet with officials from the Infrastructure Development Finance Corporation (IDFC) to discuss collaborative efforts on a number of infrastructure projects throughout India. This relationship dates back to IDFC’s selection by Ex-Im Bank as one of nine Indian financial institutions to participate in its \$2.45 billion India Infrastructure Facility.

Hochberg will also meet with officials in Mumbai from the Indian Merchant Chamber, the State Bank of India, Tata Capital, CitiBank India and ICICI Bank to discuss Ex-Im’s role in financing renewable energy and infrastructure projects.

Ex-Im Bank is an independent federal agency that helps create and maintain U.S. jobs by filling gaps in private export financing at no cost to American taxpayers. The Bank provides a variety of financing mechanisms, including working capital guarantees, export-credit insurance and financing to help foreign buyers purchase U.S. goods and services.

In the first nine months of FY 2011 through June, Ex-Im Bank authorized over \$215 million to finance U.S. environmentally beneficial exports, including approximately \$100 million for renewable-energy products and services.

Through June 30, 2011, Ex-Im Bank has approved 173 India related transactions totalling \$1.4 billion and supporting over 10,000 U.S. jobs,

Overall, in FY 2011 through June, Ex-Im Bank has approved nearly \$22 billion in total authorisations – a historic year-to-date record – to support \$28.1 billion in U.S. export sales. These sales will support approximately 189,700 American jobs in communities across the country.

Former First Solar CEO launches Venture Capital company

The fledgling firm is focussed on identifying exceptionally talented entrepreneurs to significantly improve the world and help them realise their ambitions

True North Venture Partners has announced its launch of its \$300 million venture capital company founded by Mike Ahearn, the co-founder and former CEO of First Solar.

True North will invest primarily in early stage companies in the energy, water, agriculture and waste sectors. Investment amounts will generally range from \$100,000 to \$25 million.

“We are focussed on sectors where the global problems are pressing, the need for disruptive innovation is great and the challenges faced by early stage entrepreneurs and investors are particularly daunting,” said Ahearn. “Our goal is to identify exceptionally talented entrepreneurs with the vision, drive and business potential to significantly improve the world and help them realise their ambitions.”

Ahearn co-founded, and until 2009 served as the CEO of First Solar. During this period First Solar grew from a start-up to a leader in the solar industry and an S&P 500 company. Before investing in First Solar, Ahearn helped to build a number of other successful companies as an early stage investor.

“We are assembling a team of partners and advisors who combine successful investment experience with proven track records in developing start-up businesses into significant enterprises,” said Ahearn. “We can help entrepreneurs navigate the obstacles that they will inevitably face in fundamentally transforming global industries.”

True North has commenced operations and expects to be fully staffed by the end of 2011.

Semprius awarded \$7.88 M for III-V solar plant

The gallium arsenide based solar cell pilot production plant will provide jobs for 256 people within five years in North Carolina.

The North Carolina Department of Commerce has announced that Semprius, an innovator of high III-V based concentration photovoltaic (HCPV) solar modules, has received an incentives package to build a pilot production plant in Henderson.

The incentives package includes a State of North Carolina Job Development Investment Grant, and grants from the Golden LEAF Foundation, Vance County, the One North Carolina Fund, and the North Carolina Community College System, and totals more than \$7.88 million.

The incentives package comes on the heels of Semprius securing \$20 million in its first tranche of Series C venture fundraising led by Siemens Venture Capital earlier this month. Semprius will use the incentives package and venture funding to construct the pilot HCPV module production plant beginning later this month.

The first phase of the pilot plant will be 50,000 square feet and employ 60 people. Semprius plans to expand within the next several years to 150,000 square feet and will eventually employ 256 people at the pilot production plant. Semprius will make an \$89.7 million capital investment in the pilot plant, and the plant is estimated to draw \$120 million in investment to the region.

“Semprius chose to bring their business to North Carolina because our investments in education and job training ensure they can find the work-ready employees they need,” said Governor Bev Perdue. “This company is on the cutting edge in the solar energy field and we welcome them to North Carolina, the smart grid capital of the world.”

Semprius builds its HCPV modules using novel processes that combine extremely tiny GaAs based solar cells with low-cost, efficient optics, and improve long-term reliability and performance. The firm also utilises an automated manufacturing process, leveraging standard manufacturing equipment and commodity materials, to dramatically

reduce capital and labour costs.

“Demand for CPV is expected to grow exponentially over the next several years to greater than 6 GW by 2020,” said Joe Carr, President and CEO of Semprius. “We’ve designed our modules to be efficient, low-cost and reliable, gathering energy from the sun that is converted into electricity in a clean, efficient manner.”

The Semprius pilot production plant, expected to be operational in August 2012, will have an initial capacity of 5 MW and is expandable to 35 MW as needed.

“Semprius HCPV modules can concentrate the sun more 1,000 times for highly efficient conversion into electricity,” said Carr. “We believe HCPV solar technology is leading us toward achieving grid parity with fossil-based fuels, and we’re proud that the state of North Carolina and Vance County find our technology as important to the future of clean energy as we do.”

Ohio poised as global leader in thin film solar industry

The state provides an ideal location for solar companies such as CdTe panel makers First Solar and WK Solar. Last week, Isofoton, the Spanish III-V high concentration PV manufacturer announced it has chosen Napoleon, Ohio, as the new home for its North American CPV manufacturing facility.

Business owners striving to launch and grow in the solar industry are easily drawn to locations that boast their desire and willingness to nurture invention. However, in order to successfully grow a business in a developing industry like the solar industry, businesses require more than a promise of funding.

They need a perfect location where innovation is backed by generations of hands-on manufacturing expertise combined with extensive resources that also support profitable commercial success. Resources such as R&D, academic institutions, a skilled workforce, strong industry partnerships and a supply chain efficiently and cost-effectively bring a product to market.

Ohio has built its world-class manufacturing base in glass and plastic films to support the automotive industry. This existing infrastructure is now being repurposed to create truly innovative materials and products for solar photovoltaic technologies. This is key to new solar power technology development and the rapidly growing commercial success of Ohio’s advanced energy community. In support, the state’s academic institutions are solving some of the industry’s most challenging innovation needs and preparing the next generation of advanced energy engineers for business success.

“Ohio is becoming a national and international leader in the solar industry,” said Rick Stansley, co-director of the Wright Centre for Photovoltaics Innovation and Commercialisation, a world-class science and technology platform dedicated to research, development and commercialisation of new photovoltaic solutions.

“The state’s long history as a manufacturing leader shows that we have the workforce and expertise to succeed in the evolving manufacturing sector and provide a world-class supply chain for the solar industry,” continued Stansley.

Ohio offers a complete advanced energy supply chain infrastructure for businesses in the solar energy industry. The state’s manufacturing strengths, skilled workforce and central location make Ohio a preferred location for advanced energy manufacturing businesses.

Northwest Ohio’s historic strengths in the glass industry along with the world-class supply chain of manufacturers and systems integrators found throughout the state are a driving force supporting the state’s solar industry growth. Leading solar manufacturing companies, such as First Solar and WK Solar Group, which both use CdTe solar technology, and Xunlight Corporation, which develops thin-film silicon solar cells, have operations in Ohio.

Last week, Isofoton, a leading solar energy technology company, chose Napoleon, Ohio as the new home for its North American manufacturing facility. Angel Luis Serrano, CEO of Isofoton said, “Our intention is to advance to all corners of the North American marketplace from our Ohio base, including advanced research and development.”

Isofoton has worked with many Ohio partners to produce an “all-Ohio” supply chain. After extensive research, Ohio was determined the best location choice because it is a top five electricity generator and consumer, a top 10 in population, top five in strength of state solar carve-out, as well as home to several top-5 utilities and has a strong solar energy cluster.

American Municipal Power (AMP) has agreed to purchase up to 200 MW of “made in Ohio” solar panels over five years from Isofoton’s Napoleon factory, which also has been selected by the Turning Point Solar project and American Electric Power (AEP) to supply Napoleon, Ohio-produced photovoltaic panels for 49.9 MW of solar energy to be erected on reclaimed mine lands in rural Appalachia. Isofoton is also working closely with the Toledo Port Authority on “made in Ohio” PV panels for solar energy projects.

“The state’s long-standing heritage of developing manufacturing facilities and associated jobs shows companies like Isofoton that Ohio is the place where emerging technologies can thrive,” said Joseph Hamrock, president of AEP Ohio. “At AEP Ohio, we are proud to play an instrumental role in bringing new jobs to Ohio, while advancing renewable energy technologies in the Midwest.”

Ohio’s universities and colleges are ready to meet the need for new technologies and skilled advanced energy workers through new research, degrees and training specific to the advanced energy industry through programs such as The University Clean Energy Alliance of Ohio (UCEAO) and investments through Ohio Third Frontier.

Converting research into commercial success is another key to Ohio’s success. Programs such as the state’s Edison Technology Centres and Photovoltaics Innovation and Commercialisation initiative (PVIC), a collaboration between The University of Toledo, The Ohio State University (OSU) and Bowling Green State University, have been instrumental in advancing solar technology innovation.

In addition, companies that locate in Ohio can reduce operating costs with the state’s favourable business climate, because there is no tax on inventory or corporate income - and boost the return on investment with no tax on purchases of

machinery and equipment. A recent report by the Quantitative Economics and Statistics Practices (QUEST) of Ernst & Young in conjunction with the Council On State Taxation (COST) ranks Ohio as third in the nation for friendliest tax environment.

“Ohio’s success is not solely dependent on the strength of its business advantages. It’s about Ohio’s promise of work-life balance,” said Ed Burghard, executive director of the Ohio Business Development Coalition, the non-profit organisation that markets the state for capital investment. “Low-cost, low-stress communities and short commutes create the State of Perfect Balance, where you can achieve both professional and personal success without sacrificing one for the other.”

ARC Energy countersues GT Solar for anticompetitive conduct

The firm is defending its proprietary sapphire technology which it says is superior to that of GT Solar.

Advanced RenewableEnergy (ARC Energy), a provider of innovative c-axis sapphire growth technologies and turnkey solutions for the LED industry, last week filed an Answer and Counterclaim in Hillsborough County, New Hampshire Superior Court against GT Solar International.

In its filing, ARC vigorously denies that any of ARC’s products or technologies use any proprietary GT Solar technology and has countersued GT Solar for anticompetitive conduct. ARC Energy’s Counterclaim asserts that GT Solar has made knowingly false and defamatory statements about ARC Energy’s business and products for the unlawful purpose of inhibiting sales of ARC Energy’s sapphire crystal growth system into the fast growing LED market.

Additionally, ARC states that GT Solar’s allegations are baseless and that ARC’s proprietary c-axis CHES sapphire technology is different from, and superior to, other sapphire growth technologies, including GT’s. ARC Energy says its technology for growing sapphire crystals on the c-axis affords

several advantages over a-axis technologies. C-axis wafers are the optimum orientation for LED applications and c-axis growth leads to higher material utilization and lower overall costs compared with conventional technologies.

Daniel Lyman, ARC Energy's secretary and general counsel said, "We must defend our right to continue to develop and deliver new and innovative technologies that have very real potential to help solve important energy problems worldwide. We must also defend the rights of our customers to choose the technologies and products best suited to give them an advantage in the marketplace."

Emcore's CPV module all set to target U.S. and Europe

The G3-1090X compound semiconductor multijunction solar cell module was found to meet or exceed internationally accepted safety and performance requirements.

Emcore Corporation has announced the successful completion of third party testing, certification, and listing to IEC-62108 and UL-SUB-8703 for its G3-1090X CPV module.

The test results confirm that the G3-1090X fully satisfies the product safety, performance, and reliability criteria for entry into the US and European markets. Emcore worked with Intertek Testing Services to obtain OSHA NRTL (Nationally Recognised Test Laboratory) and CEC (California Energy Commission) listings for the G3-1090X module.



Emcore's multi-junction high-efficiency CPV module

Emcore's G3-1090X module, which operates with a geometric optical concentration ratio of 1090X, was found to meet or exceed the safety and performance requirements of the internationally accepted IEC-62108 standard, and the United States product safety requirement UL-SUB-8703.

Demonstrating compliance with these standards through testing and evaluations by Intertek make the G3-1090X module eligible to bear the ETLUS mark recognised in the US and the ETLEU mark recognised in the EU. CEC listing of the module qualifies it for performance-based incentives in the California Solar Initiative rebate program. In addition, the G3-1090X module will bear the CE Mark to indicate compliance with all applicable EU directives, regulations and standards.

Successful third party evaluation of Emcore's G3-1090X module to the applicable standards and requirements is a significant achievement. The G3-1090X CPV module is among the first to fully comply with all sections of both IEC-62108 and UL-SUB-8703. Working with Intertek for independent certified product testing and construction evaluation is an example of Emcore's commitment to producing CPV products that meet the most up-to-date industry standards and requirements.

"The successful certification and listing of our latest CPV module demonstrates our product will meet the rigors and performance requirements of utility-scale solar deployments," said Christopher Larocca, Chief Operating Officer of Emcore. "This achievement, combined with the establishment of our low-cost manufacturing joint venture, Suncore, positions Emcore to supply the most competitive high-performance, CPV systems in the industry."

The IEC-62108 standard specifies safety and performance requirements for CPV modules and assemblies suitable for long-term operation in outdoor environments. The objective of this test standard is to determine the electrical, mechanical, and thermal characteristics of CPV modules and assemblies with regard to the product's ability to withstand prolonged exposure in climates where the product is expected to be deployed. UL-SUB-8703 incorporates all of the tests in the IEC-62108 standard, plus evaluations of grounding schemes, fire resistance, robustness to corrosion,

electrical ratings of select parts and materials, and other safety related aspects of product design and construction not covered by IEC-62108.

XsunX CIGS devices hit 16.3% efficiency

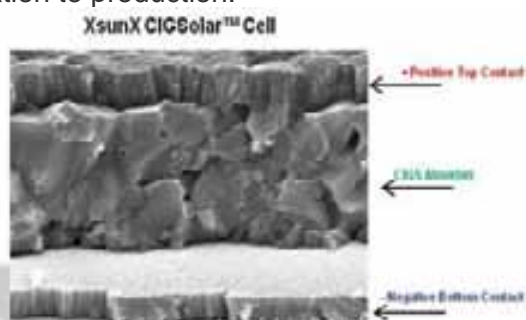
NREL's official efficiency measurement supports XsunX's manufacturing approach and the viability of single cell processing to compete with silicon.

CIGS solar cell manufacturer, XsunX, has announced that the National Renewable Energy Laboratory (NREL) has certified a peak efficiency conversion of 16.36% for its CIGS photovoltaic devices.

XsunX is the developer of CIGSolar, a hybrid, thin-film photovoltaic (TFPV) solar cell technology process.

Overall efficiency of the tested samples ranged from 15.3% to 16.36% producing an average efficiency of 15.91%. The sample provided to NREL was part of a 125mm substrate which after deposition was sub-divided into quadrants to produce NREL device test structures and analytical equipment test structures. The purpose was to provide a statistically significant body of data in support of XsunX's continuous process improvement efforts.

Robert Wendt, CTO at XsunX, commented, "NREL's official measurement of 16.36% supports our manufacturing approach and the viability of single cell processing. We believe the efficiency levels that we achieved will provide an economically viable process that we can offer the market." Wendt continued, "We are pleased with the results, but they are what we had planned for and expected. We believe that our approach lends itself to direct translation to production."



The Company's technology utilises co-evaporation for rapid deposition of final-sized cells to better control the complex management of the CIGS layer deposition process. The Company's method, unlike other CIGS manufacturing technology, begins and ends using individual substrates sized to match silicon cells. In addition to providing for a smaller and more precise deposition environment, this also helps to avoid performance losses experienced when cells are either cut from rolls of CIGS material or mismatched electrically in monolithic assemblies.

"We focussed our efforts on the belief that high performance CIGS solar cells could offer an alternative to the use of more costly silicon technology – a \$13 billion dollar market opportunity in 2010," said Tom Djokovich, CEO, XsunX. "The official measurements conducted by NREL help to show that small area co-evaporation offers the necessary conversion efficiencies to compete with silicon. We are very excited about these results, the work we have accomplished, and the opportunities for our CIGSolar technology."

PVMC showcases solar collaborative model

The pioneering partnership between the University of Albany NanoCollege and SEMATECH will lead a national push to accelerate solar energy research, development and manufacturing in CIGS technology.

A collaborative initiative for research, development, and commercialisation is the key to producing more efficient, less costly PV technologies and accelerating their use in both residential and commercial markets.

So say leaders of the U.S. Photovoltaic Manufacturing Consortium (PVMC) speaking at Intersolar North America 2011 in San Francisco. The syndicate is made up of the U.S. Department of Energy (DOE), photovoltaic (PV) equipment suppliers, materials providers, and solar cell manufacturers.

PVMC, headquartered in New York State, represents a more than \$300 million partnership between the College of Nanoscale Science and Engineering (CNSE) of the University at Albany and

SEMATECH, created as part of DOE's SunShot initiative which is designed to reduce the cost of photovoltaic solar energy systems by about 75 % over the next decade. The consortium has already enlisted over 40 corporate partners throughout the solar community, and continues to expand.

Through PVMC, CNSE and SEMATECH are spearheading a unique research, development, and commercialisation partnership in which industry, academia and government are working together to drive new advances in next-generation solar cell technologies, beginning with CIGS thin film PV manufacturing solutions – increasing performance while driving down the cost and risk of bringing them to the marketplace.

Dan Armbrust, President and CEO, SEMATECH and PVMC, said, "By engaging the entire supply chain, from equipment and materials suppliers to manufacturers, SEMATECH and CNSE are establishing a new model for the solar industry that will enable more efficient PV technologies while driving down the costs of production. In the same way the semiconductor industry has benefitted from this collaborative approach to research, development and manufacturing, PVMC will fuel exciting opportunities, reducing costs to consumers and creating new jobs and investment in the high-tech sector."

Pradeep Haldar, CNSE Vice President for Clean Energy Programs, Head of Nanoeconomics and Chief Technology Officer of PVMC, said, "The U.S. Photovoltaic Manufacturing Consortium brings together, for the first time, the critical partners that are necessary to jump-start the development and integration of the innovative solar energy technologies of the 21st century. Through this groundbreaking collaboration, CNSE and SEMATECH are poised to lead the national effort to develop more efficient solar cells that are less costly to manufacture, increasing their use in homes and businesses across the country."

Armbrust delivered a keynote presentation at the Second North American PV Fab Managers Forum on July 11 entitled, "Introduction to the PVMC in Support of the DOE Manufacturing Initiative." Haldar is a featured speaker at two forums, presenting "Department of Energy PV Manufacturing Initiative – A Path Toward Supply Chain Collaboration in the U.S." on July 12 and "Economic Development

Opportunities – Working with Federal, State and Local Government" on July 13.

Established in 2008, the Intersolar North America exhibition and conference have developed into the premier platform for the solar industry in North America, focussing on photovoltaics and solar thermal technology. The public presentations provided PVMC leaders an opportunity to address solar suppliers, researchers, scientists, policy makers and key industry stakeholders on the importance of a collaborative supply chain in the U.S.

Fully automatic backside contacting for thin film photovoltaics

IMA's 'modu*contec' system combines all production steps and tools needed for CIGS and CdTe thin film photovoltaics in one versatile system whilst ensuring super fast processing.

IMA Automation Berlin (IMA) is delivering its first 'modu*contec' systems to a large, well-known vendor of high-performance production tools for thin film solar modules.

The newly developed 'modu*contec' fully automates the backside contacting process of CIGS and CdTe thin film solar modules, up to the junction box connection. With this innovative product line, the Berlin-based manufacturer of advanced industrial automation solutions extends its product range aimed at thin film photovoltaics.



For more than 20 years, IMA has built up its profile as a well-known vendor of assembly automation

systems for the automotive and electronics industries. In terms of its product development strategy, IMA is an integral part of the Swiss Feintool Group, a provider of fineblanking systems, fineblanked and formed components and assembly automation technology.

For the last four years IMA has successfully branched out and specialised in developing user-specific automation solutions for PV manufacturing, whilst reducing costs and increasing reliability. In this highly competitive market segment, IMA claims to hold a significant lead in advanced manufacturing know-how.

The new 'modu*contec' system is based on IMA's proven and user-friendly system concept of modular production tools. Depending on the product's complexity, or customers' requirements, IMA can configure flexible and scalable manufacturing automation solutions with optimised transport flow characteristics or individual process control.

IMA's best known product is the 'modustringer', which fully automates the interconnect of silicon-based PV modules, realising highest productivity levels. The 'modustringer' processes up to 1,200 cells per hour, based on single-lane operation. This includes loading, check of incoming cells by electroluminescence, ribbon preparation, fluxing, testing/sorting, lay-up, soldering and unloading.

Other system components offered by IMA Automation Berlin for turnkey automation systems, suited for small-lot up to high-volume manufacturing of photovoltaic modules, are testers/sorters, systems for lay-up, and loading/unloading for thin film technology.

IMA says the new 'modu*contec' system is the first to combine all production steps and tools needed for thin film photovoltaics in one versatile system. Additionally it ensures high processing speed. At a throughput rate of up to 130 modules per hour, 'modu*contec' will produce thin film modules at a total capacity of 160 MW per year.

Parts per trillion particle contamination detected in solar substrates

Material handling solutions and products designed to achieve target cell efficiencies and productivity in CIGS and CdTe thin film processes have been developed by Entegris.

Entegris' expertise in the handling and control of wet chemistries, gas processes, and critical substrates offer photovoltaic manufacturers the optimal material handling and contamination control needed to achieve target cell efficiencies. The company's solutions help increase efficiency and productivity in both thin film process and silicon-based photovoltaic manufacturing.

Italy's largest photovoltaic panel plant opens its doors

The 3Sun factory, which manufactures solar panels based on triple junction compound semiconductor technology, will initially have the capacity to produce PV modules to provide 160 MW per year.

An innovative photovoltaic panel factory run by 3Sun, the equal share joint venture between Enel Green Power, Sharp and STMicroelectronics, was inaugurated last Friday in Catania.

The ceremony was attended by President of Sicily Region Raffaele Lombardo, President of Catania Province Giuseppe Castiglione, and Mayor of Catania Raffaele Stancanelli. In addition to Government representatives, the plant's opening ceremony was attended by senior executives from 3Sun, Enel, Sharp Corporation and STMicroelectronics.

The plant will manufacture integrated compound semiconductor multi-junction, thin-film PV cells and modules.



The Catania plant will supply the most promising markets of Europe, the Middle East and Africa

The plant currently has a work force of 280 qualified staff and a solar panel production capacity of 160 MW per year, which could be increased to an annual 480 MW over the next few years. It is already the largest solar panel factory in Italy and one of the largest in Europe.

It was financed through a mixture of capital from the partners, funding from CIPE - which earmarked € 49 million for the project - and project financing with three major lending institutions: Banca IMI, Centrobanca and Unicredit. Following the agreement signed in August 2010, each of the three partners subscribed to a third of the capital - committing € 70 million each in cash or in tangible and intangible assets.

The partners have also contributed their specific expertise: Enel Green Power, with the development and operation of plants generating power from renewable resources at the international level and the retail marketing of photovoltaic panels on a national scale through its subsidiary Enel.si; Sharp, with its unique compound semiconductor multi-junction thin-film technology already being manufactured at its factory in Sakai, Japan and the marketing of photovoltaic panels through Sharp's subsidiaries in Europe; STMicroelectronics, with its manufacturing capabilities, a staff highly trained in advanced technology sectors such as microelectronics as well as its competence in innovative energy-saving power-management systems.

The factory output is intended to meet the demand of solar power markets in Europe, the Middle East and Africa (EMEA), using both projects under development and the sales networks of Enel Green Power and Sharp.

In this regard, Enel Green Power and Sharp have formed a second joint venture, ESSE (Enel Green Power & Sharp Solar Energy), to develop, build and operate photovoltaic systems in the EMEA area with an output target of over 500MW by 2016. This project will use panels manufactured by the factory, which will also be employed on the 1 MW photovoltaic plant that ESSE will build on the rooftop of the new factory.

Enel.si, the Enel Green Power subsidiary which specialises in the installation of photovoltaic systems for the retail market, will also participate in the marketing effort, offering panels through its franchise network of over 570 qualified installers throughout Italy.

JDSU acquires critical assets from QuantaSol for CPV solar development

QuantaSol's combination of compound semiconductor triple junction solar cell and MQW technology will be used to accelerate JDSU's CPV product roadmap.

JDSU has acquired critical product design, patented intellectual property and other assets from QuantaSol, a concentrated photovoltaic (CPV) provider based in the United Kingdom.

The materials used in today's leading triple-junction cells (InGaP, InGaAs, and Ge) have been adopted from previous industrial processes and are not the optimum combination of materials to maximise the potential efficiency of a triple-junction solar cell. By tuning the sub-cells of a triple junction cell, QuantaSol's Multiple Quantum Well (MQW) technology allows more light to be converted to electrical power (i.e. it further enhances its efficiency).

JDSU will leverage QuantaSol's MQW technology for its CPV cell product platform.

JDSU plans to transfer key assets from QuantaSol to the JDSU headquarters in Milpitas, California over the next 6 months.

"The CPV market is gaining momentum with major installations happening worldwide," said Alan Lowe, president of the CCOP unit at JDSU. "Incorporating key QuantaSol technology will allow us to further differentiate our products and expand our position in the CPV solar market as popularity for CPV continues to grow."

According to GreenTech Media, more than 1 GW of CPV installations are expected by 2015, a hundred-fold increase from 10 MW of installations in 2010.

JDSU CPV cells are optimised to capture different parts of the sun's spectrum using multiple junctions, and are expected to result in conversion efficiencies exceeding 40 % in the next few years. This is an ideal range for solar system integrators. The CPV cells are specifically designed to capture concentrated sunlight at 500 to 1,000 times its

original power. JDSU claims additional benefits include a small footprint, improved temperature performance, less use of semiconductor materials, and lower cost per kW compared to other photovoltaic technologies.

In addition to its new CPV technology for land installations, JDSU has been providing solar power products to the satellite industry for several decades. JDSU also provides photovoltaic solutions for the digital monitoring of smart grid power plants.

Tellurium to find new applications in thermal energy

Vertically integrated refiner and producer of high purity tellurium, tellurium-based compounds and other metals, Apollo Solar has developed a new tellurium based material for use in thermal exchange technology at oil transportation stations.

Apollo Solar Energy has launched a project to utilise tellurium in the production of thermal energy.

The Company has formed a subsidiary in Anhui province to develop a tellurium based thermal energy system at Shengli Oil Field, a major oil field in China.

The Shengli Oil Field, owned by Sinopec is the second-largest oil field in The People's Republic of China, with daily production of approximately 650,000 barrels. The field contains more than one hundred transportation stations, which are powered, in part, through thermal exchange systems.

Apollo's R&D team, in collaboration with Chinese thermal control experts, has developed a new tellurium based material that is ideal for use in thermal exchange technology at oil transportation stations. The firm believes that the new thermal exchange systems, combined with a small solar power station that will be used in each station, will reduce total annual energy costs at the Shengli Oil Field by approximately 40%. The first demonstration station will be started in July of 2011 and the entire project is expected to be completed within 3 years.

Jingong Pan, CEO of the Company, commented, "Included in our strategy for Apollo's growth is to increase revenue and profit margins of the Company by developing new materials and entering new markets. The use of our materials and technology to reduce energy costs at the thousands of oil transportation stations in major oil fields in China represents an untapped market that provides us the opportunity to substantially increase revenue."

DOE to loan nearly \$4.5 billion for First Solar CdTe PV solar power plants

The three projects based on cadmium telluride technology are expected to create 1,400 jobs and generate approximately 1330 MWs of installed solar power in California.

U.S. Energy Secretary Steven Chu has announced offers of conditional commitments for loan guarantees, of approximately \$4.5 billion, to support three alternating current CdTe thin film photovoltaic (PV) solar generation facilities.

The Department is offering a conditional commitment for a \$680 million loan guarantee to support the Antelope Valley Solar Ranch 1 project, conditional commitments for partial loan guarantees of \$1.88 billion in loans to support the Desert Sunlight project, and conditional commitments for partial loan guarantees of \$1.93 billion in loans to support the Topaz Solar project.

First Solar is sponsoring all three projects and will provide Cd-Te thin film solar PV modules for the projects from a new manufacturing plant that has begun construction in Mesa, Arizona, as well as from its recently expanded manufacturing plant in Perrysburg, Ohio, which serves as its primary hub for engineering, research and development. The company expects that the projects will create a combined 1,400 jobs in California during peak construction.

"These projects will bring immediate jobs to California in addition to hundreds more across the supply chain," said Chu. "Together the projects will power hundreds of thousands of homes with

clean, renewable power and increase our global competitiveness in the clean energy economy.”

DOE is offering a conditional commitment for a loan guarantee to AV Solar Ranch 1, LLC to support the Antelope Valley Solar Ranch 1 project. The 230 MW project will be located in the Antelope Valley area of the Western Mojave Desert, approximately 80 miles north of Los Angeles, California. The project is expected to generate 350 construction jobs and will feature a utility-scale deployment of innovative inverters with voltage regulation and monitoring technologies that are new to the U.S. market.

The inverters enable the project to provide more stable and continuous power, increasing the efficiency and reliability of large-scale solar power plants greater than 100 MW. The facility is expected to generate over 622,000 MW hours of electricity per year, equivalent to powering over 54,000 homes, and will avoid over 350,000 metric tons of carbon dioxide emissions annually. Power from the Antelope Valley Solar Ranch 1 project will be sold to Pacific Gas & Electric Company.

DOE is offering conditional commitments for partial loan guarantees to Desert Sunlight 250, LLC and Desert Sunlight 300, LLC to support the Desert Sunlight project. The 550 MW project is expected to generate 550 jobs during construction and will be located on land managed by the Bureau of Land Management in eastern Riverside County, California.

The Desert Sunlight project is expected to use 8.8 million CdTe thin film solar PV modules, which are commercially proven and have been deployed since 2001. The facility is expected to generate enough electricity to power over 110,000 homes and will avoid over 735,000 metric tons of carbon dioxide annually.

Project construction will take place in two phases; Phase I will generate 300MW of power, which will be sold to Pacific Gas & Electric Company, while Phase II will generate 250 MW of power, which will be sold to Southern California Edison. The \$1.88 billion in loans that are partially guaranteed by DOE will be funded by a syndicate of institutional investors and commercial banks led by lead lender and lender-applicant, Goldman Sachs Lending Partners LLC, which submitted the project under the Financial Institution Partnership Program (FIPP),

and Citibank N.A. as co-lead arranger.

DOE is offering conditional commitments for partial loan guarantees to Topaz Solar Farms, LLC to support the Topaz Solar project. The 550 MW project is expected to generate 500 jobs during construction and will be located in eastern San Luis Obispo County, California. The Topaz Solar project will use over 8.5 million CdTe thin film solar PV modules and is anticipated to generate enough electricity to power approximately 110,000 homes and avoid nearly 725,000 metric tons of carbon dioxide emissions annually. The project's power will be sold to Pacific Gas & Electric Company.

The \$1.93 billion in loans that are partially guaranteed by DOE will be funded by a syndicate of institutional investors and commercial banks led by lead lender and lender-applicant, The Royal Bank of Scotland plc, which submitted the project under the Financial Institution Partnership Program (FIPP).

Putting sunshine in the tank

Changing the size of indium phosphide quantum dots alters the colour of light they absorb or give out and so can be customised to match required parts of the solar spectrum.

Scientists from the University of Manchester are working on how to use the sun's energy into making fuels, which could help to solve the world's escalating energy crisis.

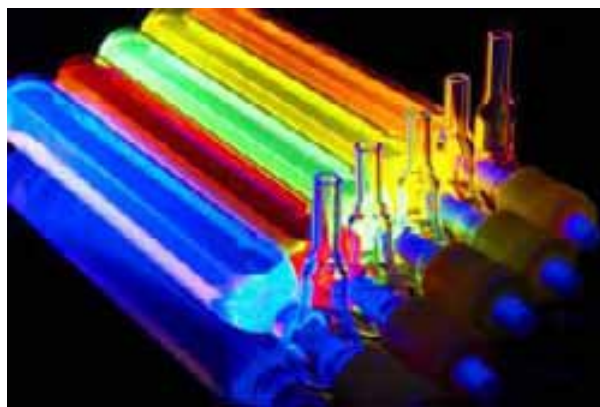


Figure: Luminescence from solutions of small InP quantum dots of different sizes. Changing the size of the dots changes the colour of light they

absorb or give out so the dots can match the part of the solar spectrum required. (credit: Nanoco Technologies Ltd).

Working with the Universities of East Anglia, York and Nottingham and using nanotechnology 100,000 times smaller than the thickness of a human hair, the researchers are working on harnessing the vast energy of the Sun to produce clean fuel.

The scientists are presenting their research at the Royal Society's annual Summer Science Exhibition which opens today.

Members of the consortium at UEA have already found a way to produce hydrogen from water. A revolutionary future use of this technology could be to make the fuel for hydrogen-powered cars, rather than making it from fossil fuel.

Now the scientists are aiming to use the same technology to create alternatives for other fuels and feedstock chemicals, including turning methane into liquid methanol and carbon dioxide into carbon monoxide.

The sun's potential is vast – just one hour of sunlight is equivalent to the amount of energy used over the world in an entire year – yet no one has yet tapped into its immense power to make fuels.

Wendy Flavell, from The University of Manchester's Photon Science Institute, and her colleagues are working to create a solar-nano device using InP 'quantum dots' which are tiny clusters of semiconducting material which absorb sunlight.

When sunlight is absorbed, carriers of electric current are created. Together with catalyst molecules grafted to the surfaces of the dots, these create the new fuel – for example hydrogen can be produced from water. Flavell said: "Our sun provides far more energy than we will ever need, but we use it really inefficiently.

"To make better use of the fantastic resource we have in our Sun, we need to find out how to create solar fuel that can be stored and shipped to where it is needed and used on demand.

"Most hydrogen so far is obtained from fossil fuels, which are of course not going to last forever, so it is important to get energy from renewable

sources." "One of the key questions is: 'what do we do when the sun goes down, what happens at night?' If we can store the energy harnessed from the sun during the day then we will have supplies ready to use when the sun is not shining.

"This is a first step in taking the vast power of the sun and using it to provide the world's fuel needs."

At the exhibition, Flavell and her team will be displaying an interactive world map which will show children and other visitors just how much energy the sun provides.

There will also be a chance to see the InP quantum dots at work, and show how, simply by changing the size of the dots, the colour of light they absorb or give out can be changed.

A solar cell that produces hydrogen directly from the electricity generated will also be on display and there will be a chance to race solar-powered and hydrogen-powered model racing cars.

Chris Pickett of the University of East Anglia said "Creating catalytic devices which harvest light energy using quantum dots, or photovoltaic materials to drive the formation of synthetic fuels from water or carbon dioxide can be viewed as artificial photosynthesis.

"Globally, chemists, physicists and materials scientists are coming together to work on artificial photosynthesis to get to a stage where we can viably make clean, green fuels"

Robin Perutz of the University of York said: "This is the most challenging scientific project I have ever been involved in, but it will be the most rewarding if we can bring it off. It's no use sitting back and hoping that someone else will work out how to harness the Sun's energy. This technology could revolutionise our energy usage in the coming decades."

Spire expands its solar representation to South Korea

JEIS is now the CdTe solar module manufacturer's local solar representative.

Spire Corporation, a global solar company providing CdTe solar production lines to manufacture photovoltaic (PV) modules has announced that JEIS Holdings (JEIS) of Ansan-City, Gyeonggi-do, South Korea will represent Spire Corporation's solar products and services throughout the country.

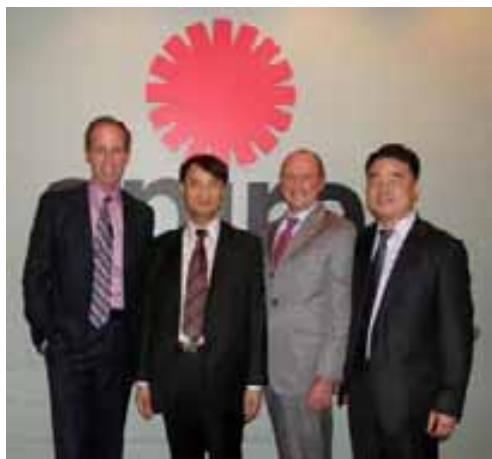


Figure: JEIS at Spire Corp's Headquarters in Bedford, MA. In Photo, From Left to Right: Mark C. Little, CEO of Spire Biomedical, Dong-Ho Roh, Executive Director of JEIS, Roger G. Little, Chairman & CEO of Spire Corporation, and Jae-Seung Jo, CEO of JEIS.

"The Korean Government has implemented one of the largest stimulus programs to encourage the use of green energies. It has also created substantial Solar Feed-in Tariff programs. With JEIS located in Korea, Spire can better address these opportunities and provide direct service to its customers throughout the nation."

"The Korean solar industry has been on the rise for many years," said Roger G. Little, Chairman and CEO of Spire Corporation. "Our Vice President of Business Development in Asia, Jae-Bok Young, has worked very hard to identify the company that best fits Spire's needs in Korea and has successfully secured the representation of JEIS."

Little continued, "The Korean Government has implemented one of the largest stimulus programs to encourage the use of green energies. It has also created substantial Solar Feed-in Tariff programs. With JEIS located in Korea, Spire can better address these opportunities and provide direct service to its customers throughout the nation."

Individual GaAs nanowires can function as low cost solar cells

Industrifonden is banking on solar cell company Sol Voltaic's gallium arsenide based nanowire solar cells to bring in the money.

Swedish cleantech investor Industrifonden is providing over £1.8 million to Sol Voltaics, which is developing what it says is a new type of material that can significantly reduce the cost of producing electricity from solar cells. The new share issue total over £3.97 million and the money will be used to further develop the company's products.

Sol Voltaics is developing a new material and production method to manufacture solar cells which involves quickly fabricating nanowire from GaAs, where every wire functions as a solar cell.

GaAs has long been considered the best material for producing solar cells, but to date has been too expensive to use. Sol Voltaics says it has now developed a method that radically reduces the cost.

"Sol Voltaics has an opportunity to offer the market the world's most inexpensive solar cells, providing solar cell manufacturers and users with greater value, higher efficiency and increased production at a lower cost," says Stefan Jakélius, Investment Manager at Industrifonden.

"The market for solar cells is large and global and is practically bursting at the seams, especially in Germany, where the decision to phase out nuclear power could give solar cells an additional boost."

Founded in 2008, Sol Voltaics originated from nanotechnology research at Lund University. The company is still in the development stage, but will now intensify its development work and win its first

customers.

“We are very pleased to have Industrifonden as an investor,” says Sol Voltaic CEO Bo Pedersen. “They are Sweden’s leading cleantech investor and have extensive experience in our area. With Industrifonden we now have a financially strong, knowledgeable investor that can help us to shift our expansion into higher gear.”

Power Electronics

EPC adds another eGaN FET to its family

The second generation 40 Volt, 16 milliohm EPC2014 gallium nitride transistor delivers high frequency switching with enhanced performance in lead-free, RoHS compliant package.

Efficient Power Conversion Corporation is introducing the EPC2014 as the newest member of EPC’s second-generation enhanced performance eGaN FET family.



The EPC2014 is environmentally friendly, being lead free, RoHS-compliant, and halogen free.

The EPC2014 FET is a 1.87 mm², 40 VDS, 10 A device with a maximum RDS(ON) of 16 milliohms with 5 V applied to the gate. This eGaN FET provides significant performance advantages over the first-generation EPC1014 eGaN device. The EPC2014 has an increase in maximum junction temperature rating to 150 degrees C and is fully enhanced at a lower gate voltage than the predecessor EPC1014.

Compared to a state-of-the-art silicon power MOSFET with similar on-resistance, the EPC2014

is much smaller and has many times superior switching performance. Applications that benefit from eGaN FET performance include high-speed DC-DC power supplies, point-of-load converters, class D audio amplifiers, hard-switched and high frequency circuits.

“In addition to increases in performance, this new generation enhancement mode gallium nitride FET is offered as lead-free, halogen-free and RoHS-compliant,” noted Alex Lidow, co-founder and CEO.

In 1k piece quantities, the EPC2014 is priced at \$1.12 and is immediately available through Digi-Key Corporation.

SemiSouth SiC transistors and JFETS go global

The firm’s products, which include silicon carbide transistors, are suited to solar inverters, hybrid electric vehicles, industrial motors, computing and defence are now available globally through Premier Farnell.

In line with the company’s focus on Electronic Design Engineers, driving business to the web and growth in emerging markets, Premier Farnell, has signed a worldwide stocking distribution agreement with SemiSouth Labs.

SemiSouth is a leading manufacturer of SiC diodes and transistor technology for high-power, high-efficiency, harsh-environment power management and conversion applications.

Under the terms of the deal, SemiSouth’s SiC JFETs and diodes will be made available via the Farnell, Newark and element14 operations of Premier Farnell and will be stocked at all of Premier Farnell’s warehouses worldwide. Further product information documents are also made available via the element14, online community and the new agreement will also be supported via the element14 knode, Premier Farnell’s online design platform that is exclusively focused on the needs of electronic design engineers.

Dieter Liesabeths, SemiSouth’s Director of Sales said: “We are thrilled to be working with the a leading multi-channel distributor like Premier

Farnell. This is our first major catalogue outlet and we are excited about the new project opportunities it will drive.”

David Shen, Group Senior Vice President and Global Head of EDE and Technical Marketing of Premier Farnell said: “We are sure that our vast customer base will benefit from the leading performance of the SemiSouth parts. Their diodes and JFETs are a perfect fit for applications such as solar inverters, hybrid electric vehicles, industrial motors, computing and defence, and we will be able to introduce them to designers working in these areas.”

EPC expands its eGaN FET family

The firm’s second generation gallium nitride based power transistor delivers high frequency switching with enhanced performance at 200 V and 100 milliohms.

Efficient Power Conversion Corporation (EPC) is introducing the EPC2012 as the newest member of its second-generation enhanced performance eGaN FET family. The EPC2012 is environmentally friendly, being lead free, RoHS-compliant, and halogen free.



The EPC2012 FET is a 1.6 mm² 200 VDS device with a maximum RDS(ON) of 100 milliohms with 5 V applied to the gate. This eGaN FET provides significant performance advantages over the first-generation EPC1012 eGaN device. The EPC2012 has an increased pulsed current rating of 15 A (compared with 12 A for the EPC1012), is fully enhanced at a lower gate voltage, and has superior dv/dt immunity due to an improved ratio of QGD/QGS.

Compared to a state-of-the-art silicon power MOSFET with similar on-resistance, the EPC2012 is much smaller and claimed to have many times

superior switching performance. Applications that benefit from eGaN FET performance include high-speed DC-DC power supplies, point-of-load converters, class D audio amplifiers, hard-switched and high frequency circuits.

“With the expansion of our family of eGaN FETs, we continue to raise the bar for the performance of gallium nitride FETs. In addition, this new generation of eGaN products are the industry’s first gallium nitride FETs to be offered as lead-free and RoHS-compliant,” said Alex Lidow, co-founder and CEO.

In 1k piece quantities, the EPC2012 is priced at \$2.10 and is immediately available through Digi-Key Corporation.

Mouser to distribute Cree products worldwide

For design engineers and manufacturers, this means faster access to Cree’s LED lighting solutions and silicon carbide power products on a global basis.

Mouser Electronics, a design engineering resource and global distributor for semiconductors and electronic components, has signed a global distribution agreement with giant Cree, a provider of LED lighting and SiC power products.

The global agreement enables lighting designers worldwide to quickly find, compare, select, and order Cree’s latest products, including their innovative line of lighting-class XLamp LEDs, high brightness LEDs, LED modules, and power products.

Cree LED components and solutions are driving improvements worldwide in applications such as general lighting, electronic signs and signals. Cree also is among the world’s leading manufacturers of SiC-based diodes for power control and management, providing increased efficiency in a variety of applications from solar inverters to industrial motor drivers to wireless technologies.

Cree gains access to Mouser’s highly-successful design engineering marketing programs and to Mouser’s state-of-the-art fulfilment operations.

The award-winning distributor offers 17 customer support locations across multiple continents with 42 country websites. Mouser's Product Knowledge Centres and application guidance tools will give lighting designers easy access to view Cree's product advantages, technical specifications and data sheets.

"Cree is a progressive company known for top-of-the-line innovations in the LED industry and we are pleased to align with them," says Russell Rasor, Mouser's vice-president of advanced technology. "For design engineers and manufacturers, this means faster access to Cree's LED lighting solutions and SiC power products on a global basis."

"With the distribution might of Mouser behind our products, our customers will not only have worldwide access to our products, but will also have the search and comparison resources available through Mouser's award-winning online catalogues and websites," says Mark Desportes, Cree vice president of global channels. "The service and support Mouser offers as an authorised worldwide distributor is invaluable to us and to our customers."

The agreement reinforces Mouser's commitment to support new solid-state lighting designs by offering a comprehensive line-up of Cree LED components. In support of Cree's products, Mouser says it will provide engineers with the most innovative optical and mechanical products along with IC-based LED drivers from key suppliers such as Texas Instruments, On Semiconductor, STMicroelectronics and Maxim Integrated Products. This strategically positions Mouser, the design-fulfilment distributor, to deliver advanced lighting technology components to enable a successful new design project.

Kyma adds $n+$ bulk GaN substrates to its portfolio

The new gallium nitride substrates come in form factors of 10 mm x 10mm squares and 18 mm x 18 mm squares. The firm is also developing 2" diameter and larger $n+$ bulk GaN substrates for volume production.

Kyma's new $n+$ GaN substrate product line will boast a bulk resistivity specification of $< 0.02 \Omega$

-cm, which is two orders of magnitude lower in resistivity than Kyma's previously offered n -type GaN.



What's more, Kyma has successfully produced $n+$ bulk GaN wafers with measured carrier concentrations of up to $6 \times 10^{18} \text{cm}^{-3}$ and corresponding bulk resistivities of $< 0.005 \Omega \text{-cm}$. The firm's n -type GaN product is still being offered and, for distinction, is being relabelled as n - GaN (" n minus" GaN).

Kyma says that although its n - GaN remains an excellent starting material for a variety of materials and device studies, its $n+$ GaN offers benefits for vertical devices as well as reduced contact resistance for all devices. Key advantages for vertical power devices include ultra-low on-resistance as well as decreased parasitic resistance. Key advantages for LEDs include low vertical resistance and the mitigation of current crowding effects.

"We are pleased to respond to our customers' requests for more conductive substrates," said Jacob Leach, Kyma Characterisation and Device Engineer. "The high electron concentrations in this new product line directly support higher performance and reliability for a number of device applications of great commercial interest."

Tamara Stephenson, Kyma's Technical Sales Engineer, added, "We are happy to offer these new substrates in form factors of 10 mm x 10mm squares and 18 mm x 18 mm squares. Additionally, the development of commercially available 2" diameter and larger $n+$ bulk GaN substrates is underway."

Kyma is a supplier of crystalline GaN and AlN materials for a broad range of high performance nitride semiconductor device applications.

The market for nitride semiconductor devices is expected to surpass \$90B over the long term,

including over \$60B in visible lighting applications and over \$30B in power electronics applications.

Industry and academia power on to develop nanoscale technology

Southampton University and Oxford Instruments have worked together to develop a range of processes which will be used to make nanoscale transistors.

The UK based organisations recently demonstrated the success of an industrial collaboration which is creating the cutting-edge nanotechnology needed for smaller, low power devices.

The 'Knowledge Creation Partnership – From Funding to Results' workshop at the University of Southampton, attracted a high level of interest, with talks by University researchers in nanotechnology and industrialists from Oxford Instruments Plasma Technology.

They described how the two organisations have partnered during a two year collaboration to develop nanotechnology tools. Combining the University's knowledge and research with Oxford Instruments' tools has already produced results, and these were presented by Peter Ashburn from the University, Mike Cooke, CTO at Oxford Instruments, and their colleagues.



The University of Southampton Cleanroom (Image courtesy of University of Southampton)

“We recognise the importance of partnerships between the commercial and the academic sectors, in today's highly competitive, fast moving and demanding global markets, and at Oxford Instruments we see businesses forming the bridge

between science and the consumer.” Frazer Anderson, Oxford Instruments Plasma Technology's Business Development Director comments, “Through collaborations with some of the world's leading scientists and institutions, companies like ours turn smart science into commercially successful products.”

Peter Ashburn, of the University's Nano Research Group within ECS-Electronics and Computer Science is very positive about the collaboration, “Our University and Oxford Instruments have worked together to develop a range of processes for the company's tools which will be used to make nanoscale transistors. These new plasma-based technologies provide etching and deposition functions on nanoscale materials and are being used in the Southampton Nanofabrication Centre, one of Europe's leading multidisciplinary state-of-the-art cleanroom complexes.”

New SiC JFETs propel SemiSouth into high-end audio market

SemiSouth says its latest silicon carbide devices are 15% cheaper than conventional SiC JFETs and are particularly suited for high end audio amplifier designs demanding the best linearity performance and lowest distortion.

SemiSouth Laboratories has launched a new family of low cost SiC JFETS with very good linearity targeted at high-end audio applications.

The SJEP120R100A and SJEP120R063A are claimed to offer best-in-class distortion. Compatible with standard gate driver ICs, both versions feature a positive temperature coefficient for ease of paralleling; extremely fast switching with no 'tail' current at up to a maximum operating temperature of 150 °C and a low RDS(on)max of 0.100Ω and 0.063Ω respectively. Devices are available in TO-247 packages; the 100mΩ part is also available in die form for integration into modules.



Nelson Pass, founder of audio amplifier manufacturer Nelson Pass, comments, “Over the last forty years I have greatly appreciated the qualities of low power JFETs in audio circuits, and experimenting with the few examples of ‘unobtainable’ power JFETs has convinced me of their great potential. With the new SiC power JFETs from SemiSouth, this potential has been realised in reliable linear power amplifiers. In push-pull topologies, they exhibit a 50% to 70% improvement in distortion, and in single-ended circuits the improvement has been nearly ten-fold. Currently we profitably produce a small high-end audio amplifier using the SJEP120R100A devices and are engaged in developing other higher power amplifiers using this and the SJDP120R085 depletion mode devices.”

SemiSouth’s Director of Sales, Dieter Liesabeths, adds, “These parts are especially suitable for high end audio amplifier designs which demand the best linearity performance and lowest distortion. Compared to conventional SiC JFET for power applications, the prices for these audio parts has been reduced by about 15% in order to meet the demand of customers.”

GaN energy efficient technology is driving demand for PMICs

Gallium nitride is overtaking silicon carbide for use in power semiconductors (which use PMICs), as it enhances power density, breakdown voltage, switching frequency, resistance and system efficiency.

Power Management Integrated Circuits (PMICs) accounted for 3.5% of the global semiconductor market in 2010, according to a new report available on companiesandmarkets.com.

PMIC market growth is driven by consumer interest in portable devices such as smartphones, and their need for energy efficient technologies.

PMICs have applications in the communication, IT, industrial, automotive, medical, defence and electronics sectors. A factor encouraging growth in the PMIC market is the interest in energy efficient technologies, to combat rising energy prices and consumer adoption of portable electronic devices.

Alternative energy technologies used to harness solar and wind power are driving demand, as power semiconductors use power management integrated circuits to minimise energy wastage and ensure efficient power distribution. The PMIC research report, “Power Management Integrated Circuits (IC) Market to 2020 - Alternative Energy Markets and Energy Efficient Portable Gadgets to Drive Sales Growth,” indicates that energy efficient technologies could reduce global electricity use by up to 30%, by 2025.

Manufacturing companies are seeking improvement opportunities for their power devices, and substrate technology is of interest. The power management integrated circuit research report highlights a trend for the use of GaN instead of SiC in power semiconductors (which use PMICs), as it enhances power density, breakdown voltage, switching frequency, resistance and system efficiency.

Thermal management is another opportunity to minimise cost and improve efficiencies of power management semiconductor PMICs. Improvements to packaging systems will equip PMICs to cope with fluctuations in current, and subsequently enhance energy management.

Key companies profiled within the PMIC research report include: Infineon Technologies AG, Linear Technology Corporation, National Semiconductor, STMicroelectronics N.V and Texas Instruments.

GeneSiC wins R&D100 award for SiC devices

The firm has been recognised for its silicon carbide products used in grid-connected solar and wind energy applications.

R&D Magazine has selected GeneSiC Semiconductor of Dulles, Virginia as a recipient of the prestigious 2011 R&D 100 Award for the commercialisation of SiC devices with high voltage ratings.

The innovator of SiC based power devices was honoured last week with the prestigious 2011 R&D 100 Award. This award recognises GeneSiC for introducing one of the most significant, newly introduced research and development advances among multiple disciplines during 2010.

R&D Magazine recognised GeneSiC's Ultra-High Voltage SiC thyristor for its ability to achieve blocking voltages and frequencies never utilised before towards power electronics demonstrations.



Figure. GeneSiC silicon carbide thyristor

GeneSiC says the voltage ratings of $> 6.5\text{kV}$, on-state current rating of 80 A and operating frequencies of $> 5\text{ kHz}$ are much higher than those previously introduced in the marketplace. These capabilities achieved by GeneSiC's thyristors critically enable power electronics researchers to develop grid-tied inverters, Flexible AC Transmission Systems and High Voltage DC Systems.

This will allow new inventions and product developments within renewable energy, solar inverters, wind power inverters, and energy storage industries. Ranbir Singh, President of GeneSiC Semiconductor commented, "It is anticipated that large-scale markets in solid-state electrical substations and wind turbine generators will open up after researchers in the power conversion arena will fully realise the benefits of SiC thyristors. These first generation SiC thyristors utilise the lowest demonstrated on-state voltage drop and differential on-resistances ever achieved in SiC thyristors."

Singh continued, "We intend to release future generations of SiC thyristors optimised for Gate-controlled Turn Off capability and pulsed power capability and $>10\text{kV}$ ratings. As we continue to develop high temperature ultra-high voltage packaging solutions, the present 6.5kV thyristors are packaged in modules with fully soldered contacts, limited to 150°C junction temperatures." Since this product was launched in October 2010, GeneSiC has booked orders from multiple customers towards demonstration of advanced power electronics hardware using these SiC thyristors.

GeneSiC continues to develop its family of SiC thyristor products. The R&D on early version for power conversion applications were developed through SBIR funding support from US DOE. More advanced, pulsed power optimised SiC thyristors are being developed under another SBIR contract with ARDEC, US Army. Using these technical developments, internal investment from GeneSiC and commercial orders from multiple customers, GeneSiC was able to offer these UHV thyristors as commercial products.

The 49th annual technology competition run by R&D Magazine evaluated entries from various companies and industry players, research organizations and universities around the world. The magazine's editors and a panel of outside experts served as judges, evaluating each entry in terms of its importance to the world of science and research.

According to R&D Magazine, winning an R&D 100 Award provides a mark of excellence known to industry, government, and academia as proof that the product is one of the most innovative ideas of the year. This award recognises GeneSiC as a

global leader in the creation of technology-based products that make a difference in how we work and live.

Toyota gears up HEMTs for hybrid electric vehicles

To improve the efficiency of power switching in hybrid electric vehicles, Toyota is developing a pair of gallium nitride transistors.

Toyota is developing vertical HEMTs for high power switching in hybrid electric vehicles (HEVs), and lateral equivalents for lower power applications in cars.

That was the main message of the talk given by Tetsu Kachi from Toyota Central R&D Labs, Japan, to delegates at the ninth International Conference on Nitride Semiconductors (ICNS) in Glasgow, UK.

Kachi began by pointing out that the silicon electronics used today to convert DC power from the battery to an AC form to power the motor has an efficiency of 90-95 percent. The energy that's wasted is dissipated as heat, and managing this requires a water-cooling system.



The amount of energy lost could increase because the trend is towards higher and higher powers in HEVs. The first generation of Prius used a 30 kW motor, but second and third generations have increased this figure to 50 kW and 70 kW. Even higher figures are being used by Lexus, which has a motor with a power of more than 150 kW in its model LS600h.

Losses in the DC-to-AC conversion process occur because the switching is imperfect. Ideally, no current would be drawn in the off-state, in the on-state there would be no resistance and switching speeds would be instantaneous.

Kachi explained that switching losses promise to fall by a factor of about six by replacing silicon switches with those made from GaN. What's more, the electronics would no longer need its own dedicated water cooling system. Instead, it could tap into the one used for the engine, and one day it might just require air cooling.

The representative of Toyota also explained that smaller power modules, operating at a few kilowatts, are also needed in HEVs for air-conditioning, and emergency and outdoor applications.

"Each loss is low, but the total loss is not low," added Kachi, who pointed out that every efficiency saving boosts the mileage of the HEV.

Toyota are developing two types of GaN HEMT for the HEV: vertical devices for high-powers, which have the merits of high current density, high breakdown voltage and a high on-resistance; and lateral transistors for lower powers, which combine high frequencies with a low resistance, and high breakdown voltage and low cost.

The vertical devices feature a novel U-shaped trench that is formed by dry etching with an inductively coupled plasma, followed by wet etching for 60 minutes at 85 degrees C. The sidewall forms a MOS channel that works well up to 300 degrees C. Normally-off operation is realised with this device, which has a breakdown of 180V. The goal is to increase this to 600V.

Efforts on the lateral devices have created devices that are normally off above 3V, and have issues related to current collapse and reliability of the gate insulator. Engineers at Toyota will work to improve this device and its vertical cousin.

Switching faces improves high-speed HEMTs

Conventional GaN HEMTs are excellent devices over a wide frequency range. However, for great performance at really high speeds, it's best to switch from the standard gallium face to a nitrogen one, according to UCSB's Umesh Mishra.

Researcher Umesh Mishra from the University of California, Santa Barbara, opened the International Conference on Nitride Semiconductors by highlighting the performance of GaN HEMTs and detailing approaches to take these transistors to a new level.

He kicked off his talk at the Scottish Exhibition and Conference Centre in Glasgow, UK, by saying that LEDs had made great progress in recent times, and now it was the turn of the electronics sector to make significant commercial headway.

Mishra then provided a brief overview of where the RF performance of HEMTs stands today: 13.7 W/mm at 30 GHz, 10.5 W/mm at 40 GHz, and 2.4 W/mm at 60 GHz. He also reminded the audience of the records for the fastest devices – a cut-off frequency of 220 GHz and a maximum oscillation frequency of 400 GHz.

"I'm convinced that you will see 500 GHz in the next five years. It will happen," added Mishra, who explained that only a few years ago such frequencies were unthinkable.

However, he pointed out that these devices have a major weakness – the gain falls fast as frequency rises. This stems from parasitic capacitances and resistances.

According to Mishra, the best way to address these issues is to switch from a conventional HEMT, which is produced using the gallium face, to a variant based on the nitrogen face. Making contacts to this novel device is easier, and drastically reduces the contact resistance.

One downside of HEMTs with a nitrogen face is that they have traps at the interface between AlGaN and GaN. However, by doping this region, it is possible to lift these trap levels out of harms way.

Mishra's team have built MBE-grown nitrogen-face

devices with optically defined gates that produce 5.7 W/mm at 10 GHz. And MOCVD-grown variants on off-cut SiC deliver 20.7 W/mm at 4 GHz, and 16.7 W/mm at 10 GHz.

The team has started to move to higher speeds, which is where the benefits of the nitrogen-face really come into play. Initial results include a cut-off frequency of 163 GHz.

The West-coast academic also spoke about the promise of GaN transistors for digital applications – his team has produced a device with an InAlN back barrier and a 60 nm gate length that produces 2.77 mA/mm.

Activities at Transphorm, the company that Mishra co-founded in 2007, were briefly covered towards the end of the presentation. Normally-off HEMTs produced by this start-up are converted into a normally-on mode with an additional circuit, and can be used to make products for power switching. This includes three-phase inverters for photovoltaics that can operate at efficiencies of more than 98 percent.

Billion pixel Gaia camera starts to take shape

The European Space Agency (ESA) camera to be used for the mission to map one thousand million stars, uses high temperature resistant silicon carbide as the CCD support structure.

Another milestone in the development of Gaia, the ESA's ultra-sensitive space astrometry mission, was passed on 1 June when the 106 electronic detectors of its billion pixel camera were assembled like a large mosaic for the first time.

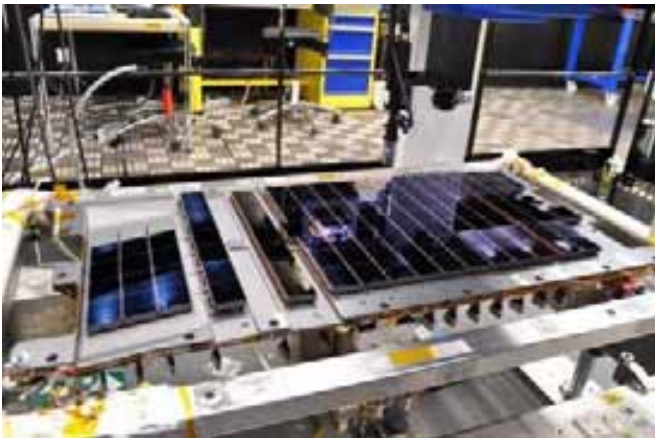


Technicians carefully bolting and aligning each

of the CCDs onto the support structure. (Credit: Astrium)

These rectangular detectors, each measuring 6 × 4.7 cm, with a thickness of only a few tens of microns, are precisely fitted together on the CCD support structure (CSS). The gap between each CCD package is about 1 millimetre.

Made of SiC which provides remarkable thermal and mechanical stability, the CSS weighs about 20 kg. The overall CCD mosaic, a key part of the complete focal plane assembly, measures 1 × 0.5 metres.



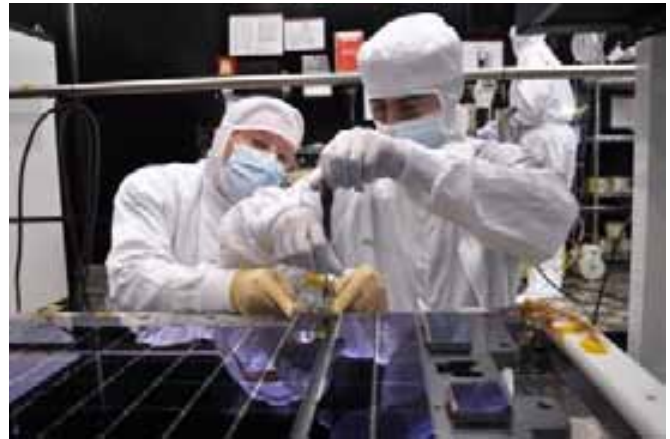
The complete Gaia CCD mosaic (Credit: Astrium)

During its ambitious mission to map one thousand million stars, the spinning Gaia spacecraft will monitor each of these pinpoints of light up to 70 times over a five year period. In order to detect distant stars about one million times fainter than the eye can see, Gaia will carry 106 CCDs, each of which is, effectively, a miniature camera.

The contract to provide the Gaia CCDs was awarded to e2v Technologies of Chelmsford, UK, in summer 2005, and their production kept the company busy for more than 5 years. Each CCD converts incoming light into electrical charge and stores it as a tiny data package, or pixel, until it can be read by the onboard computer.

The Gaia CCDs feature 4500 pixels in the along scan direction and 1966 pixels for across scan. With an overall total of about a thousand million pixels, Gaia's focal plane is the largest digital camera ever built for a space mission.

Over the past few weeks, technicians from the mission's prime contractor, Astrium France, have been carefully bolting and aligning each of the CCDs onto the support structure at the company's facility in Toulouse. Working in double shifts inside a Class 100 clean room, the rectangular focal plane mosaic has grown at a rate of about four CCDs per day.



Gaia CCDs integration onto the CCD support structure (Credit: Astrium)

The completed focal plane is arranged in seven rows of CCDs. The main array, which comprises 102 detectors grouped into four fields, is dedicated to star detection. A further four CCDs are used for monitoring the stability of the 'basic angle' of 106.5 degrees between the two telescopes and the quality of the optical performances.

"The mounting and precise alignment of the 106 CCDs is a key step in the assembly of the flight model focal plane assembly," said Philippe Garé, ESA's Gaia Payload Manager.

As the two telescopes of the spinning Gaia spacecraft sweep across the sky, the images of stars in each field of view will move across the focal plane array. They will be detected first by the star mapper CCDs. Each of the two strips of seven CCDs detects star images only from its assigned telescope.

The confirmed star images will then move across a block of 62 astrometric field CCDs, where they are assigned tracking 'windows' and given a precise time stamp by a rubidium atomic clock.

Next, the star images enter the photometric field

where two rows of CCDs produce low-resolution spectra in different wavelength bands. The blue CCDs spread the light at wavelengths between 330 and 680 nm, while the spectrum created by the red CCDs goes from 640 to 1000 nm. These spectra are used for gathering colour information on the stars and for correction of the optical aberrations in the astrometric part of the instrument.

Finally, the star images enter the spectroscopic field where a spectrograph only allows light in the narrow band of 847 to 874 nm. The filtered light is then dispersed over 1100 pixels to detect characteristic spectral lines in this band. Subsequent analysis on the ground enables stellar velocities in the radial (line-of-sight) direction to be calculated, based on the red or blue shifts of the spectral lines.

Located 1.5 million km from Earth, Gaia will operate at a temperature of minus 110°C (163.15 K). This low temperature will be maintained by passive thermal control, including the cold radiator on the focal plane assembly and a giant sunshade attached to the top of the spacecraft.

“In parallel to the assembly of the CSS, Astrium is working on the cold radiator and the proximity electronics module. We are aiming to bring together all three parts of the focal plane assembly by October of this year,” added Garé.

EpiGaN raises €4 million for GaN-on-Silicon production

Capricorn Cleantech Fund, Robert Bosch Venture Capital (RBVC), and LRM jointly invested €4 million in EpiGaN, to launch volume production of gallium nitride-on-silicon wafers.

Imec spin off EpiGaN has closed its first capital round of €4 million, which will allow it to start volume production of GaN-on-silicon epitaxial material for the next-generation efficient power electronics.

Set up in 2010, EpiGaN was founded by Marianne Germain, CEO, Joff Derluyn, CTO and Stefan Degroote, COO, as a spin-off of research institute imec. For more than 10 years, the founders jointly developed state-of-the-art GaN-on-Silicon technology on 4” and 6” wafers at imec, part of

which has been licensed to EpiGaN.

They are today joined by a strong consortium of investors who share their vision on GaN-on-silicon as a key technology for enhancing power management efficiency, implementing renewable energy sources, or enabling cleaner transportation technologies with reduced environmental impact.

“EpiGaN has demonstrated the capability of its innovative material to support record device performance either in high voltage, high current or high frequency operation”, says Marianne Germain. “We are proud that investors have decided to support our initiative and will enable us to commercially provide the same high-standards material quality in large volume to our industrial customers.”

The participation of RBVC lends credibility to the strategic vision of the company: “We are impressed by the technological achievements of EpiGaN and the capabilities of the team. As a leading manufacturer of power electronics modules and systems, we believe that this technology has the potential to make significant contributions to the world of power conversion and are happy to be part of the investor syndicate supporting the company,” said Gadi Toren, venture capital investment partner at RBVC and future board member of EpiGaN.

Marc Lambrechts, who will join the board of EpiGaN on behalf of Capricorn Cleantech Fund, is convinced EpiGaN addresses a key target market: “Power conversion is an essential technology for an impressive number of cleantech applications such as energy efficient power supplies, solar inverters, wind energy, electric or hybrid vehicles and smart grids. The customers of EpiGaN will benefit from higher efficiency, improved reliability and reduced system size and weight, by using the EpiGaN state-of-the-art GaN-on-silicon technology.”

The support of the investors will allow EpiGaN to implement its own production capacity and increase its market supply: 4” and 6” GaN-on-silicon wafers for high voltage or RF applications are readily available from EpiGaN while a 200 mm wafer technology is under development in EpiGaN. EpiGaN will deploy its activities at the Research Campus Hasselt in Limburg, geographically located squarely within Leuven, Eindhoven and Aachen.

“EpiGaN has chosen Limburg as the best location to grow their business after an in depth location study. We are happy that our intertwined offer of venture capital and sector specific infrastructure played a key role in the decision process”, says Stijn Bijmens, CEO of LRM; “EpiGaN will contribute to the development of high-tech solutions for the renewable energy domain, an area where Limburg is willing to play an important role”. “Imec has pioneered the use of Si substrates for GaN technology, for its cost efficiency and its bright perspective of leveraging on the silicon-based semiconductor industry. We are proud to see that a highly-innovative, long-term research project leads to the creation of a high-potential spin-off, bringing imec technology to the market”, concludes Luc Van den hove, President and CEO of imec.

Equipment and Materials

InGaAs spectrometers from B&W Tek are cool

The company will debut its latest NIR indium gallium arsenide spectrometers at SPIE’s Optics & Spectrometers conference.

B&W Tek has recently introduced its enhanced series of TE Cooled fibre-coupled InGaAs array spectrometers – the Sol series.

The company says these spectrometers offer extended spectral range and high spectral resolution options along with deeper TE Cooling. All four spectrometers in the series have a USB standard interface for easy integration into OEM systems.



“B&W Tek strives for constant innovation and improvement,” says Jack Zhou, COO for B&W Tek, Inc. “ We not only believe in scientific advancement by way of engineering new products, but also by the improvement of existing products for superior results and exceptional customer value. The enhancements of our Sol series near-infrared spectrometers will allow users more flexibility in configuring systems specific to their application, with an increase in detection limits of nearly a factor of 10.”

The Sol 1.7’s TE Cooling has been upgraded from +5°C to -10°C for lower noise and better stability. The spectrometer includes three new grating options, allowing for 18 additional configurations between 900 nm – 1700 nm, and a resolution of 0.2nm. Redesigned electronics for the Sol 1.7 allow this unit to operate with a standard 5VDC power supply, making it even more convenient for OEM integrators and end users alike.

The Sol 2.2 and Sol 2.2A have also been upgraded with three new grating options, allowing for 8 additional configurations from previous models. These new gratings allow for an extended range of 900 nm-2200 nm and higher spectral resolution, measuring less than 2.5 nm for the Sol 2.2.

Rubicon upgrades its sapphire furnaces

The firm’s ES2-XLG3.0 tool is claimed to boast significant quality innovations that optimise yield and efficiency during the crystal growth process.

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, semiconductor, and optical industry has completed a company-wide installation of enhancements to its proprietary crystal growth furnaces bringing all furnaces up to Rubicon Furnace Version ES2-XLG3.0.

This is the latest version of the company’s proprietary furnace design for the production of high quality, large diameter sapphire material and provides even greater automation and yield consistency.

Over time, the company’s Design for High Volume

Manufacturing approach has led to numerous furnace design improvements that have created an industry-leading equipment platform for high volume sapphire crystal growth. Rubicon Furnace Version ES2-XLG3.0 provides even greater automation resulting in additional yield improvements. The ES2-XLG3.0 encompasses numerous innovations and now operates in Rubicon's United States high-efficiency crystal growth facilities in Batavia and Bensenville, Illinois.

"Compared to the production of other substrate materials, sapphire crystal growth is extremely complex," explains Raja Parvez, Rubicon President and CEO. "Variables such as stable power, growth profiles, cooling profiles and feedback control mechanisms must be optimally managed to maximize the yield of quality sapphire crystal. This is even more vital when producing sapphire for the expanding large diameter wafer market. With hundreds of years of combined experience and innovations such as those embedded in the Rubicon Furnace Version ES2-XLG3.0, Rubicon's design and equipment engineers and material scientists have achieved industry leading yields and performance."

The Rubicon furnace design is just one component of the company's efficient equipment platform that has differentiated the company in the large diameter sapphire wafer market. This effort, combined with Rubicon's robust process platforms and the company's ability to scale to high volume, creates superior performance factors for the LED industry. With the Batavia crystal growth facility qualified with more than a dozen customers and the Malaysia polishing facility now also qualified, Rubicon has successfully shipped more than 100,000 six inch sapphire wafers.

Market research firm iSuppli expects the global LED market to double to nearly \$14.3bn by 2013, driven by the penetration of LEDs into the general illumination market including light bulbs. LEDs are a popular option for backlighting screens from HDTVs, traffic lights and large displays as well as in a broad range of popular consumer devices including tablets, notebooks, laptops, mobile phones, navigation devices, digital music players, digital photo frames, digital cameras and keypads. LED use in general lighting applications is also increasing significantly, particularly in applications like street lighting, industrial lighting

and architectural 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.

5N Plus upgrades to \$250 million credit facility

The producer of purified metals including gallium, germanium, indium, selenium and tellurium used in compound semiconductor wafers will use the new credit facility to refinance existing indebtedness, capital expenditures and growth opportunities.

5N Plus is closing a new \$250 million senior secured multi-currency revolving credit facility to replace its existing \$50 million two-year senior secured revolving facility with National Bank of Canada.

The new credit facility will be used to refinance existing indebtedness and for other corporate purposes, including capital expenditures and growth opportunities. The new credit facility has a four-year term and bears interest at either prime rate, U.S. base rate, LIBOR or EURO LIBOR plus a margin based on 5N Plus' senior consolidated debt to EBITDA ratio. 5N Plus also has a US\$35 million credit facility in Asia.

At any time, 5N Plus has the option to request that the new credit facility be expanded to \$350 million through the exercise of an additional \$100 million accordion feature, subject to review and approval by the lenders.

In connection with the new credit facility, National Bank of Canada and HSBC Bank acted as co-lead arrangers and joint book runners, and five other banks as lenders.

Bridgelux takes its silicon-based LEDs to new highs

The performance gap between conventional LEDs and those built on silicon is closing fast thanks to the efforts of Bridgelux

Bridgelux, the trailblazer of white LEDs grown on

200 mm silicon, has recently made tremendous progress in improving device efficacy.

1.5 mm by 1.5 mm cool-white LEDs produced in the labs of the Californian outfit can now deliver 160 lm/W at 350 mA, a gain of 25 lm/W compared to the company's best devices reported this March. What's more, warm-white LEDs of the same size show an even bigger improvement at the same drive current – efficacy is now 125 lm/W, compared to 85 lm/W five months ago.

"The performance levels that we have announced are the highest lumen-per-Watt values yet published for GaN-on-silicon, and rival the best commercial LEDs grown on sapphire or silicon carbide," claims Steve Lester, chief technology officer for Bridgelux.

Although the company is not giving much away regarding the secrets of its recent success, vice-president of marketing, Jason Posselt, told *Compoundsemiconductor.net* that improvements in the epitaxial process have helped to deliver gains in efficacy.

"We are no longer taking a sapphire recipe and trying to figure out how to grow it on silicon," says Posselt. "We're optimising for the silicon wafer process." Some slight changes to packaging also led to efficacy improvements.

Thanks in part to these efforts, that latest blue LEDs - which are the foundation of making white emitters - have a forward voltage of just 2.85 V at 350 mA. "The bandgap to emit light is around 2.75 V," says Long Yang, Vice-President of Chip Technology, "[So we are] we are only about 0.1 V above the bandgap."

Driven at 350 mA, these blue LEDs deliver 591 mW at a wall-plug efficiency of 59 percent, and when the current is cranked up to 1 A, they produce 1.52 W at a wall plug efficiency of 47 percent. Although this indicates that the devices do suffer from LED droop, the decline in efficiency as current is increased may not be as high as it is for sapphire-based devices.

Other details of Bridgelux's white LEDs made from these blue-emitting chips include a colour temperature of 4350K for the 160 lm/W, cool-white LED, and a colour temperature of 2940K and a colour rendering index of 80 for the 125 lm/W, warm-white emitter.

In terms of where Bridgelux's technology stands today, the efficacy of these LEDs exceeds the company's next-generation of warm-white LEDs on sapphire, which will deliver 120 lm/W and be released within the next 12 months. "We are seeing equivalent to - and some cases even better performance now – on silicon compared to sapphire," says Posselt.

A substantial reduction in manufacturing cost is Bridgelux's primary motivation for developing LEDs on silicon. The company believes switching substrates could reduce costs by up to 75 percent. The benefit of silicon is not just a cheaper substrate – processing is also far less expensive, because the epiwafers can be churned into chips at under-utilised high-throughput 200 mm fabs.

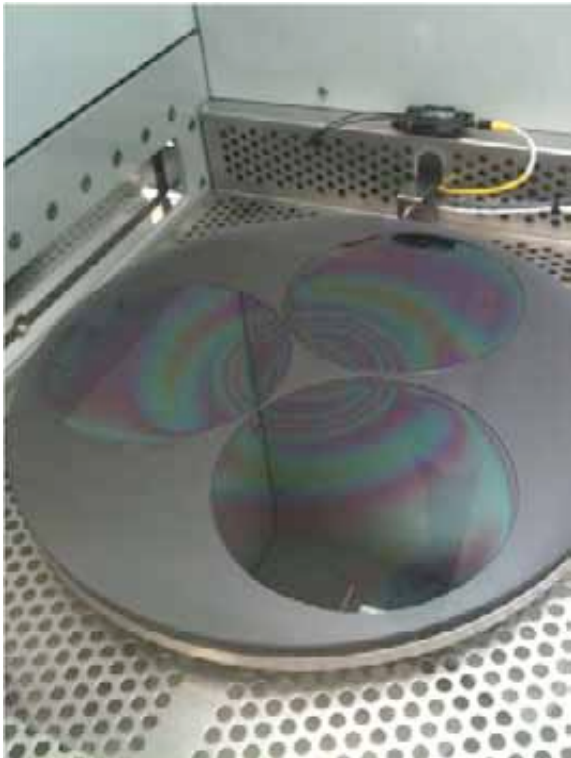
In order to tap in to this spare fab capacity, Bridgelux has to ship incredibly flat wafers to these processing partners – the bow cannot exceed 60 microns. Realising this is a challenge, because there are considerable differences in both the thermal expansion and the lattice constant of silicon and the III-Ns. To eliminate stress in the wafers, the company has developed a proprietary buffer layer.

One of the company's latest goals is to improve the peak emission wavelength uniformity of its wafers. Engineers have fabricated wafers with a wavelength uniformity, in terms of the standard deviation, of 6.8 nm. "Our target is 3 nanometers," says Yang.

The number of LEDs that the company is making in its R&D labs is rising fast. "Now we make these LEDs in thousands; a few months ago we made them in hundreds," says Yang.

Sampling of products will follow, but potential customers should not expect to get their hands on Bridgelux's silicon-based LEDs in the next month or so. "We are building prototypes of products, but this is not a tomorrow technology," says Posselt.

According to Yang, pilot production of the GaN-on-silicon LEDs should begin within a year. Once any processing issues related to this are ironed out, Bridgelux will invest in capital equipment for the growth of the wafers in high volume. According to the company, large-scale commercial production is still two years' away.



Sapphire supplier GT Solar changes name

The company says its new name GT Advanced Technologies is now more closely aligned with its strategic vision and provides a new platform for it to grow and strengthen its global brand in markets such as LEDs

GT Advanced Technologies Inc. has announced the name change from GT Solar to its new name, GT Advanced Technologies Inc., is now complete.

As part of the rebranding and new corporate identity, the company is now trading under its new GTAT stock ticker symbol on NASDAQ.

“Our transition from GT Solar to GT Advanced Technologies reflects our broader strategic market focus,” said Tom Gutierrez, GT Advanced Technologies’ president and CEO. “We are growing beyond our historic focus on the solar industry to include other growth markets such as the LED industry. We also continue to look for strategic expansion opportunities into other adjacent markets that leverage our core competencies in crystal growth technology and the commercialisation of equipment that drives the growth of new industries. Our name is now more closely aligned with our strategic vision and provides a new platform for us to grow and strengthen our global brand.”

In July 2010, the company entered the fast-growing LED market through its acquisition of Crystal Systems, a pioneer in the field of crystallising sapphire material for a wide range of industries. GT is both a producer of sapphire material as well as a supplier of Advanced Sapphire Furnaces (ASF) which it sells to companies that produce sapphire material. Since the company introduced its ASF in December of 2010, it has booked nearly \$1 billion in orders, quickly establishing itself as a leading provider of sapphire crystal growth equipment.

Azzurro opens regional office in Asia

The pioneer of gallium nitride-on-silicon technology has chosen the location in Taipei, Taiwan so that the Chinese, Japanese and Korean markets can be reached within two hours flight time.

Germany based Azzurro Semiconductor, is strengthening its customer support reach by establishing a Regional Office in Taipei, Taiwan R.O.C. for its Asian customers.

Azzurro is a manufacturer of high quality GaN epiwafers based on large area silicon substrates. These wafers are used in the power semiconductor industry to build higher performance transistors and diodes, in the LED industry it will enable the manufacturers to produce inexpensive high-brightness LEDs.

Azzurro technology provides the customers with high-quality, crack-free GaN layers on 150 mm (and soon 200 mm) standard silicon wafers with extremely low bow values, enabling the use of standard semiconductor production facilities. Azzurro says the GaN-on-Si technology, previously not available on large scale wafers, will trigger a new wave of highly efficient and cost optimized components for the LED and power semiconductor industry.

The increasing dynamic of Azzurro's customers' design-in and ramp-up activities has driven a swift decision for opening a regional support office, Azzurro's first outside of Germany and Europe. Azzurro is destined for becoming a major supplier of GaN materials to the semiconductor industry, where Taiwan is offering the right environment and excellent location in Asia.

"As customer support in the design-in phase is pivotal to make the customers' products a business success, a close contact is absolutely necessary. With the chosen location in Taipei, Taiwan also the Chinese, Japanese and Korean markets can be reached very quickly within two hours flight time.

Azzurro's aim to enable its customers a fast and smooth product introduction to quickly reap the rewards of Azzurro's GaN-on-Si technology was the key driver for the move by the company", says Erwin Ysewijn, VP Sales & Marketing of Azzurro and adds, "This enables us to better understand and resolve customer challenges in a timely fashion and offer professional solutions, in local language, local time zones and with an experienced management team on the ground."

Translucent touts commercial availability of vGaN wafer templates

The vGaN products provide a low-cost, high-quality epitaxial surface for the growth of gallium nitride devices such as LEDs or field-effect transistors (FETs).

Translucent, a provider of rare-earth-oxide (REO) engineered silicon substrates for low-cost, high-performance epitaxial semiconductor applications,

has announced the commercial availability of its vGaN family of silicon-based wafer templates.

Translucent says the vGaN product line is the world's first commercial REO-based family of 'III-N semiconductors' with scalable GaN-on-Silicon wafers. Translucent's use of crystalline REO layers provides stress relief and wafer flatness through customised lattice engineering, leading to a high quality growth surface. In addition, the wide bandgap of the REO layer is expected to lead to much higher breakdown-voltage characteristics for FETs grown on vGaN.

vGaN stands for "virtual gallium nitride." It provides a semiconductor growth surface that has the physical properties of GaN, but utilises a silicon substrate upon which is grown an epilayer of REO material that accommodates a top epilayer of Group III nitrides such as GaN. The vGaN substrate enables for the first time, industry-standard MOCVD growth processes with the low cost structures and economies of scale currently enjoyed by the silicon industry.

Michael Lebbby, Translucent's general manager, noted, "We are bringing a decade of Translucent REO epitaxial experience to bear on the challenge of enabling GaN growth to scale cost-effectively well beyond current limitations. Our vGaN platform is an 'on-silicon' technology, allowing us to harness mature silicon-substrate technologies and their low costs, and we expect this to have an extremely beneficial impact in driving down costs for GaN-based LEDs and FETs."

GaN is typically grown on sapphire substrates, which are significantly more expensive at large diameters, especially 200 mm and larger. Additionally, a major challenge facing device manufacturers today is the handling of the large, heavy, and expensive sapphire wafers. Such handling may require the purchase of special handling equipment for the fabrication plants. Conversely, the widely-used infrastructure of fabrication plants that are ready to run silicon wafers up to 200 mm already exists. This makes large-diameter silicon an ideal choice to bring economies of scale into the lighting (LED) and power electronics (FET) industries.

Translucent's vGaN wafers are already available at 100 mm diameters, with 150 and 200 mm becoming

available during the next year.

Kyma adds $n+$ bulk GaN substrates to its portfolio

The new gallium nitride substrates come in form factors of 10 mm x 10mm squares and 18 mm x 18 mm squares. The firm is also developing 2" diameter and larger $n+$ bulk GaN substrates for volume production.

Kyma's new $n+$ GaN substrate product line will boast a bulk resistivity specification of $< 0.02 \Omega\text{-cm}$, which is two orders of magnitude lower in resistivity than Kyma's previously offered n -type GaN.



What's more, Kyma has successfully produced $n+$ bulk GaN wafers with measured carrier concentrations of up to $6 \times 10^{18}\text{cm}^{-3}$ and corresponding bulk resistivities of $< 0.005 \Omega\text{-cm}$. The firm's n -type GaN product is still being offered and, for distinction, is being relabelled as n - GaN (" n minus" GaN).

Kyma says that although its n - GaN remains an excellent starting material for a variety of materials and device studies, its $n+$ GaN offers benefits for vertical devices as well as reduced contact resistance for all devices. Key advantages for vertical power devices include ultra-low on-resistance as well as decreased parasitic resistance. Key advantages for LEDs include low vertical resistance and the mitigation of current crowding effects.

"We are pleased to respond to our customers' requests for more conductive substrates," said Jacob Leach, Kyma Characterisation and Device Engineer. "The high electron concentrations in this new product line directly support higher performance and reliability for a number of device applications of great commercial interest."

Tamara Stephenson, Kyma's Technical Sales Engineer, added, "We are happy to offer these new substrates in form factors of 10 mm x 10mm squares and 18 mm x 18 mm squares. Additionally, the development of commercially available 2" diameter and larger $n+$ bulk GaN substrates is underway."

Kyma is a supplier of crystalline GaN and AlN materials for a broad range of high performance nitride semiconductor device applications.

The market for nitride semiconductor devices is expected to surpass \$90B over the long term, including over \$60B in visible lighting applications and over \$30B in power electronics applications.

SPP Process Technology Systems acquired from SPP

The manufacturer of etch, deposition, and thermal processing equipment for the compound semiconductor and related industries has been renamed SPTS Technologies.

SPTS Technologies, formerly known as SPP Process Technology Systems (SPTS), has announced the completion of the transaction by SPTS management and Bridgepoint to acquire the company from Sumitomo Precision Products Co., Ltd. (SPP).

The deal closed with an enterprise value of nearly \$200m. SPP will continue to have an association with SPTS through a minority equity stake in the company, and will cooperate with SPTS to jointly serve the Japanese market.

SPTS designs, develops and manufactures capital equipment used to produce electronic and micro-devices for a number of high growth end-markets including MEMS, power management, advanced packaging, high speed RF components, and high brightness LEDs.

With over 500 employees across 19 countries, SPTS supplies leading micro-device manufacturers from its main manufacturing facilities in Newport, Wales and San Jose, California.

On 27 June 2011, SPTS and Bridgepoint

announced the signing of a definitive purchase agreement to acquire the company from SPP, subject to certain regulatory filings, now completed.

As mentioned in the earlier announcement, there will be no change in management, product strategy, customer focus, or mission at SPTS after the ownership change, only a minor change in name in deference to the former parent company.

The all-equity, debt-free transaction sets a positive example for private equity funded management buy-outs of equipment companies, with Bridgepoint known for taking a long term view on its investment portfolio.

“We are very pleased to announce the completion of the transaction process, and are looking forward to the next phase of the company’s growth,” said William Johnson, president and CEO of SPTS. “Bridgepoint’s financial backing and merger and acquisition experience will be great assets in our growth strategy for the company.” EVP & COO Kevin Crofton agreed, “Bridgepoint provides a solid foundation as we expand our operational infrastructure and we will continue our focus on best of breed customer satisfaction.”

AXT files with SEC to offer up to \$60 million stock

The firm intends to use some of the net proceeds to expand its indium phosphide, gallium arsenide and other compound substrate manufacturing facilities in China.

AXT has filed a universal shelf registration statement on Form S-3 with the Securities and Exchange Commission (SEC).

When the shelf registration statement is declared effective by the SEC, AXT will have the option to offer and sell, from time to time in one or more offerings, up to \$60 million of common stock, preferred stock, debt securities, warrants to purchase any of these securities, depository shares, units or any combination of such securities.

AXT says the timing of any offering will be at the company’s discretion and will depend on many factors, including the prevailing market conditions.

Specific terms and share prices of any future offering under the registration statement will be established at the time of any such offering, and will be described in a prospectus supplement that AXT will file with the SEC.

AXT intends to use the net proceeds from any sale of securities under the shelf registration statement for general corporate purposes, which may include capital expenditures in connection with AXT’s planned expansion of its manufacturing facilities in China.

Kopin - Smartphones Continue to Drive III-V Business

Kopin Corporation Announces Second Quarter 2011 Financial Results

- Total revenues of \$31.4 million, up 4% from the same quarter in 2010
- Company reiterates 2011 revenue guidance of \$130 million to \$140 million

Kopin Corporation, supplier of advanced semiconductor products and micro displays for mobile applications including smartphones, tablet PCs, military thermal weapons sights and wearable computers, today announced financial results for the second quarter ended June 25, 2011.

Financial Highlights

Total revenues increased 4 percent to \$31.4 million from \$30.2 million for the same quarter of last year. III-V revenue increased to \$16.0 million, compared with \$15.9 million in the second quarter of 2010. Display revenue increased to \$15.4 million from \$14.3 million for the same quarter last year.

Gross margin increased to \$10.5 million, or 35 percent of product revenues, compared with \$7.3 million, or 25 percent of product revenues, for the comparable period of 2010.

Operating expenses were \$31.0 million in the second quarter of 2011, compared with \$30.9 million in the second quarter of 2010. R&D expenses were \$7.1 million, or 23 percent of revenues, compared with \$4.9 million, or 16

percent of revenues, in the second quarter of 2010, reflecting Kopin's investments in its Golden-i technology, III-V smartphone products and capacity expansion, military display products, and the inclusion of Forth Dimension Display's (FDD) expenses. Selling, general and administration (S,G&A) expenses were \$4.7 million in the second quarter of 2011, compared with \$4.2 million for the same period of last year. The increase in S,G&A expenses is attributable to the inclusion of FDD's expenses.

Net income was \$0.8 million, or \$0.01 per diluted share, for the second quarter of 2011 compared with \$1.9 million, or \$0.03 per diluted share, for the second quarter of 2010. Net income for the second quarter of 2010 included a \$1.9 million gain from the sale of investments and a \$0.7 million gain related to foreign currency fluctuations. Kopin's 2011 second quarter results included a net gain of \$0.4 million from the sale of investments and a net loss of \$0.3 million from foreign currency fluctuations.

Kopin's cash and marketable securities balance at the end of the second quarter was \$99.3 million and no long-term debt.

"Our second-quarter operating results reflect a continuation of the strategy we set forth at the beginning of the year – balancing short-term financial performance with a focus on long-term growth," said Kopin President and Chief Executive Officer Dr. John C.C. Fan. "We are in the enviable position of having strong growth projections for our III-V products, the opportunity to add a new military display product category, night vision systems, to our current portfolio of thermal weapon sight products and the development of a potentially game-changing, hands-free wireless industrial computing product in Golden-i. Because of the current strong growth of smart phones, the requirement for those competing for an award of the Enhanced Night Vision program in 2012 to provide qualification units in 2011 and our drive to be a leader in voice activated cloud computing, these opportunities have required significant investments this year."

"Yet with all of our development efforts, through the first half of fiscal 2011 we have maintained strong operating results," Dr. Fan said. "Overall our revenues are up 19%, with our III-V revenues up 10 percent over the same period last year as we

head into what historically has been our strongest part of the year. Although the current federal budget situation has impacted the timing of display product sales, we expect another year of strong military revenues as evidenced by our recently announced \$23.2 million in follow-on orders for the TWS Bridge (TWS-IIB) program. Our income from operations is \$2.6 million for the first half of 2011 compared with a loss of \$0.8 million through the same period last year, we have generated \$3.5 million in cash flow from operating activities and repurchased \$1.9 million of our common stock."

Smartphones Continue to Drive III-V Business

"Our III-V technology is helping to drive the rapid adoption of advanced 3G and 4G technologies across the major smartphone and tablet platforms," Dr. Fan said. "These advanced new devices not only require more III-V transistors, but structures that are more technologically complex and challenging to produce. As these phones continue to become more complex, Kopin is benefitting with higher and higher dollar content per handset. Our ability to produce these advanced products in volume and at a competitive price is simply unmatched in the industry."

Display Business Excels through System Expertise

"Just as with our III-V business, our display customers also require products that are technologically more complex to produce," Dr. Fan said. "The trend today is toward full system solutions, including displays, backlights, optics, ASIC chips, hardware and software. Once again this trend plays to our strength, as we believe that our decades of technology expertise and display system manufacturing experience differentiate us in the market."

Golden-i Program on Schedule

"Together with our business partner Motorola Solutions, we continue to make excellent progress in bringing our Golden-i® hands-free mobile computing solution to market in 2012," Dr. Fan said. "Initial response to field tests of Golden-i by select customers has been extremely positive. Golden-i was demonstrated this month at the Microsoft®-hosted Imagine Cup 2011 in New York and the World Future 2011 in Vancouver."

Business Outlook

"With revenues for the first six months of 2011

at \$66 million and the third and fourth quarters traditionally our strongest, we are on course to achieve our full-year revenue guidance of \$130 million to \$140 million," Dr. Fan said. "Robust smartphone demand should continue to fuel our III-V business, just as the TWS-IIB and a number of military R&D programs are expected to generate momentum for our display unit."

SiC Parts Fall Short of 2008 Peak

Semiconductor SiC Parts Fall Short of 2008 Peak - Techcet Forecasts \$225M-\$240M for 2011

The 2010 market for silicon carbide (SiC) fabricated parts for semiconductor applications totalled \$200M, sharply up 38% over the 2009 low, according to a new report from Techcet Group, Silicon Carbide As Used in the Semiconductor Industry 2011, A Techcet Group Critical Materials Report. This is still 5% shy of the 2008 peak, but the 2011 outlook is for continuing growth of 12% or more to between \$225M and \$240M, according to Techcet's latest forecast.

Many OEMs and fab users allowed their SiC parts inventory to run low during the recession, and are now scrambling to restock. Field experience with SiC has also matured to the point where the longer product life and superior performance over quartz for 300mm chip manufacturing have been adequately demonstrated, creating new market demand. While there is no shortage of SiC material overall, some CVD SiC suppliers have pushed lead times out to six months and are working to double their capacity. Roughly 60% of the SiC demand is for wafer carriers, boats and related fabware, with the remainder going to OEM components.

Report from Research and Markets "Silicon Carbide As Used in the Semiconductor Industry 2011"

EV Group announce expansion of manufacturing capacity at Austrian headquarters

EV Group, supplier of wafer bonding and lithography equipment for the MEMS, nanotechnology and semiconductor markets, have announced it broke ground on expanding the company's manufacturing capacity at its headquarters in Austria earlier this month.

This expansion is the latest example of the company's continued steady growth since its foundation more than 30 years ago. In addition, the company has witnessed a 40 percent increase in order intake in fiscal year 2011 compared with fiscal 2010, and is currently looking to recruit approximately 100 additional employees.



The new building will more than double the company's production floor space and is scheduled to be completed before the end of this year "The strong order intake confirms the continued confidence our customers have in EVG's innovative solutions, technology leadership and product quality," explains Dr. Werner Thallner, EV Group's executive operations and financial director. "This strong growth also validates the need for this manufacturing floor expansion at EVG headquarters."

The new building, located directly adjacent to the existing manufacturing facility, will more than double the company's production floor space and is scheduled to be completed before the end of this year. In parallel with the expansion, EVG continues to invest in additional capacity for its machining center and new manufacturing technologies, as well as plans to further modernize the existing manufacturing facility. One upgrade includes the installation of several filter fan units, which will bring a virtually particle-free environment to EV Group's entire equipment production. In addition, the entire

manufacturing area will be fully air-conditioned and additional hydraulic ramps and a large overhead crane will be installed to provide a better working environment for its employees.

EVG's customers will also have access to a new area dedicated for visitors, which houses two glass domes that provide a complete view into the manufacturing area and a sophisticated entry control system. Additional test rooms will facilitate customer-specific process development and customization, including a smooth source inspection process even at times of increased orders.

New Employment at EV Group

To support its future growth, EV Group is looking to recruit approximately 100 new employees, mainly in the area of manufacturing and technical service and support. As a recognized technology and market leader, EV Group's newly launched recruitment campaign is geared to attract educated professionals with a passion for technology. More information about current job vacancies can be found in the "careers section" on EV Group's website.

AXT achieves 22% Sequential Increase in Revenues for 2nd Quarter

AXT, manufacturer of compound semiconductor Substrates, have reported financial results for the second quarter ended June 30, 2011.

Second Quarter 2011 Results Revenue for the second quarter of 2011 was \$30.0 million, up 22 % from \$24.6 million in the first quarter of 2011, and up 29.6 % from \$23.2 million in the second quarter of 2010.

Total gallium arsenide (GaAs) substrate revenue was \$18.0 million for the second quarter of 2011, compared with \$15.9 million in the first quarter of 2011, and \$16.2 million in the second quarter of 2010. Indium phosphide (InP) substrate revenue was \$1.6 million for the second quarter of 2011, compared with \$1.3 million in the first quarter of 2011, and \$1.1 million in the second quarter of 2010. Germanium (Ge) substrate revenue was \$2.7 million for the second quarter of 2011 compared with \$3.0 million in the first quarter of 2011 and \$1.6 million in the second quarter of 2010. Raw materials sales were \$7.7 million for the second quarter of

2011, compared with \$4.4 million in the first quarter of 2011 and \$4.2 million in the second quarter of 2010.

Gross margin was 46.7 % of revenue for the second quarter of 2011. By comparison, gross margin in the first quarter of 2011 was 43.4 % of revenue.

Gross margin was 36.8 % of revenue for the second quarter of 2010.

Operating expenses were \$4.4 million in the second quarter of 2011, compared with \$4.2 million in the first quarter of 2011. Operating expenses in the second quarter of 2010 were \$3.6 million.

Income from operations for the second quarter of 2011 was \$9.5 million compared with income from operations of \$6.5 million in the first quarter of 2011, and income from operations of \$5.0 million in the second quarter of 2010.

Net interest and other income for the second quarter of 2011 was \$519,000, which included a foreign exchange gain of \$65,000. This compares with net interest and other expense of \$276,000 in the first quarter of 2011, which included a foreign exchange loss of \$196,000, and net interest and other income of \$1.6 million in the second quarter of 2010, which included \$1.2 million, net, sales tax refund and a foreign exchange gain of \$230,000. Net income in the second quarter of 2011 was \$7.1 million or \$0.21 per diluted share compared with net income of \$4.2 million or \$0.13 per diluted share in the first quarter of 2011, and with a net income of \$5.5 million or \$0.17 per diluted share in the second quarter of 2010. Excluding the \$1.2 million, net, sales tax refund or \$0.04 per diluted share, our net income in the second quarter of 2010 was \$4.3 million or \$0.13 per diluted share.

Management Qualitative Comments "This was another strong quarter for AXT," said Morris Young, chief executive officer. "Revenues exceeded our expectations, driven by double-digit growth in our substrate business and record revenues from third party raw material sales. We are experiencing healthy demand across all of our product categories and are pleased to see our competitive positioning continue to strengthen. Further, our strong business model and solid operational execution are resulting in healthy growth to our bottom line. We believe that the trends fuelling our growth are substantial, and we are well-positioned to benefit with the capacity, raw material access and attractive cost-structure that are unique in our industry."

Outlook for Third Quarter, Ending September 30, 2011 AXT estimates revenue for the third quarter for 2011 will be between \$30.5 million and \$31.5

million. The company estimates that net income per share will be between \$0.18 and \$0.20, which takes into account our weighted average share count of approximately 33.4 million shares.

Austriamicrosystems announces completion of transaction to acquire Texas Advanced Optoelectronic Solutions, Inc.

austriamicrosystems AG today announced the completion of the transaction to acquire 100% of the shares in Texas Advanced Optoelectronic Solutions, Inc.

austriamicrosystems AG, a designer and manufacturer of high performance analog ICs for the consumer, communications, industrial, medical and automotive markets, today announced the completion of the transaction to acquire 100% of the shares in Texas Advanced Optoelectronic Solutions, Inc.

As part of the total consideration of approx. USD 320 million for the acquisition of TAOS, 2,706,840 new austriamicrosystems no-par value bearer shares were issued by way of a capital increase out of existing authorized capital at an issue price of EUR 37.9843 per share, and were privately placed with Twilight S, LLC, a limited liability company owned by certain shareholders of TAOS. After the capital increase, the company's statutory ordinary share capital is divided into 13,753,092 ordinary no par value bearer shares with a calculated nominal value of EUR 2.4224 per share.

The application for the newly issued austriamicrosystems shares to be listed and admitted to trading on the SIX Swiss Exchange according to the Main Standard was approved by the SIX Swiss Exchange. The listing on the SIX Swiss Exchange will become effective and trading will commence on July 15, 2011.

Following the successful completion of the transaction, austriamicrosystems plans to hold an extraordinary shareholders meeting in the near future where the shareholders shall in particular

decide on the election of two representatives of former TAOS shareholders to the supervisory board.

“The acquisition of TAOS is a major step bringing the company to the next level of growth and profitability and creating a strong platform to expand our position in the high performance analog market. We welcome all TAOS employees and look forward to working with the talented team at TAOS on innovative sensor technologies for mobile devices leveraging both companies' world-class sensor expertise.

Together, we are in an excellent position to pursue the significant opportunities for advanced sensor solutions in growth markets such as smartphones and tablet PCs”, commented John Heugle, CEO of austriamicrosystems.

Rudolph proposes an offering of \$50 million

The manufacturer of defect inspection, process control metrology, and data analysis systems and software used by compound semiconductor device manufacturers is offering convertible senior notes due 2016.

Rudolph Technologies' notes will be sold only to qualified institutional buyers pursuant to Rule 144A under the Securities Act of 1933, as amended. The Company also intends to grant to the initial purchaser of the notes an option to purchase up to an additional \$10 million aggregate principal amount of the notes.

The Company will use a portion of the proceeds of the offering to pay the cost of a convertible note hedge transaction in connection with the offering as described below. The Company intends to use the remaining net proceeds from the offering for general corporate purposes, which may include financing potential acquisitions and strategic transactions, growth initiatives and working capital.

The notes will be general unsecured and unsubordinated obligations of the Company, ranking equally in right of payment to all existing and future senior indebtedness, and senior in right of payment to any future indebtedness that is expressly

subordinated to the notes, of the Company. The notes will be convertible, subject to certain conditions.

Upon conversion, the Company will pay cash up to the aggregate principal amount of the notes to be converted and deliver shares of its common stock in respect of the remainder, if any, of the conversion obligation in excess of the aggregate principal amount of the notes being converted. The interest rate, conversion rate, conversion price and other terms of the notes will be determined at the time of the pricing of the offering.

In connection with the offering of the notes, the Company plans to enter into convertible note hedge and warrant transactions with an affiliate of the initial purchaser. The convertible note hedge transaction is intended to reduce the potential dilution upon conversion of the notes. However, the warrant transaction will have a dilutive effect on the Company's earnings per share to the extent that the price of its common stock exceeds the strike price of the warrant.

The Company expects that the counterparty will enter into various over-the-counter derivative transactions with respect to the Company's common stock concurrently with, or shortly after, the pricing of the notes and may unwind or enter into various over-the-counter derivatives and/or purchase the Company's common stock in secondary market transactions following the pricing of the notes. If the initial purchaser exercises its option to purchase additional notes, the Company may enter into additional convertible note hedge and warrant transactions.

Continued strong growth in revenues and profitability for IQE

Sales have been driven by the optoelectronics market and gallium arsenide products for wireless devices and gallium nitride for the radar and wireless infrastructure markets.

IQE, a global supplier of advanced semiconductor wafer products and wafer services to the semiconductor industry, is providing an interim

trading update for the six months to 30 June 2011.

The Group expects to report first-half revenues of at least £38 million and EBITDA of at least £6 million, despite the adverse impact of foreign currency exchange. Compared with the first half of 2010, this represents underlying growth in US dollar revenues of over 20%, which includes approximately £1m from the Galaxy business acquired in September 2010.

The strong organic revenue growth has been driven by both the wireless and optoelectronics markets. Wireless sales have been driven by sales of GaAs products into wireless devices and strongly supplemented by the rapid growth of GaN sales into the radar and wireless infrastructure markets.

Organic revenue growth in the optoelectronics market has been driven across a range of end markets including IQE's VCSEL technology for consumer and industrial applications, optical communications, and solar power.

The Group continues to make good progress with its electronics division, which is focussed on combining compound semiconductors with silicon to create the next generation in advanced semiconductor materials for a broad range of ultra high speed and high performance applications.

The outlook for the second half remains upbeat. The Board expects continuing robust growth in the Group's core wireless and optoelectronics businesses, as demand for both industrial and consumer end user devices containing IQE products remain strong. This confidence is strengthened by the continued progress being made in new product developments and qualifications.

Drew Nelson, IQE's Chief Executive, commented, "The continued growth in demand for our wireless products and accelerated growth for our optoelectronic wafers have enabled us to maintain our rapid growth. The prospects for the Group are very exciting and, with our highly geared business model, provide the Board with considerable confidence in a continued improvement in financial performance for the second half."

IQE expects to report its interim results on 7 September 2011.

New mini signal generators perform up to 20 GHz

Vaunix has expanded its Lab Brick LMS series of USB-compatible synthesised signal generators with two new models which can test the 8 GHz to 20 GHz X-band. They have low phase noise, fast 100 microsecond switching time, and 100 Hz frequency resolution.

Vaunix Technology Corporation, a designer and manufacturer of RF and microwave test equipment and communications products, has introduced two new models to its Lab Brick product line that together cover frequency ranges from 8 to 20 GHz.



The LMS-203 operates from 10 to 20 GHz, while the LMS-163 operates from 8 to 16 GHz. Both boast low phase noise, fast 100 microsecond switching time, and fine 100 Hz frequency resolution. The LMS series also offers advanced operating features such as phase-continuous linear frequency sweeping, optional internal/external pulse modulation, and a selectable internal/external 10 MHz reference.

Typical spurious for the two models is at -80 dBc, with typical harmonics of -40 dBc and subharmonics at -25 dBc. They deliver at least +10 dBm output power, and can be adjusted over a 40 dB dynamic range, with 0.5 dB resolution. The pulse modulation feature offers internal or external triggering with pulse widths as low as 100 ns and pulse repetition intervals of 200 ns.

Other previously released models in the LMS family include the LMS-802 covering 4 to 8 GHz, the LMS-103 covering 5 to 10 GHz, and the LMS-123 covering 8 to 12 GHz. Lab Brick signal generators are known for their compact size, low power

consumption, and USB compatibility. Lab Brick signal generators measure 4.90 x 3.14 x 1.59 in. (124 x 80 x 40 mm) and weigh less than 1 lb. (0.45 kg).

They connect to a host computer by means of a standard USB cable and are controlled via the Graphical User Interface (GUI) software supplied with each unit. The simple GUI features large display windows to quickly view and adjust the signal generator's operating parameters. They are powered and controlled by means of any USB equipped PC or laptop. They can also be run from battery power or from a remote power supply for non-USB embedded or automated applications.

They are available for purchase at www.vaunix.com.

Based in Haverhill, Massachusetts, Vaunix Technology Corporation designs, manufactures, and services RF and microwave test equipment and communications products. It says its Lab Brick product family sets a new standard for cost, size, and simplicity for microwave test equipment.

Tiger Optics appoints manager for its environmental unit

Graham Leggett has previously worked for AEA Technology and NPL and will use his gas analysis expertise to address the critical needs to measure and curb emissions.

Tiger Optics has announced that Graham Leggett has joined the company as product manager of its environmental division.

Leggett brings more than 15 years of experience in gas analysis, ranging from research science at the United Kingdom's National Physical Laboratory, to the measurements of specialty gases in semiconductor manufacturing and environmental applications.



Graham Leggett, Product Manager, Environmental Division

Prior to joining Tiger Optics, Leggett served as a project director and manager at AEA Technology, an international environmental consulting firm, where he oversaw such projects as the UK's National Atmospheric Emissions Inventory, the UK's Greenhouse Gases Inventory, and the European Topic Centre on Air Pollution and Climate Change Mitigation.

Earlier in his career, he managed a portfolio of projects at the National Physical Laboratory (NPL) relating to atmospheric environmental measurements, for a total of nine years' experience in the greenhouse gas and air quality sectors.

"With such expertise, Graham is the ideal manager for our new environmental unit, which we formed to address the critical needs to measure and curb emissions," said Lisa Bergson, Tiger Optics' founder and chief executive. "We receive daily requests from people around the world, who wish to use our powerful CW-CRDS technology for all sorts of environmental applications. Graham will help us sort this out and spearhead the development of the best products."

Tiger Optics, the manufacturer of laser-based

trace gas analysers, already helps its customers dramatically reduce emissions through cleaner manufacturing. With their low flow and freedom from routine calibration, the company's CW-CRDS products use less of the fossil fuel-based gas needed by conventional analysers, thereby eliminating the environmentally compromised aspects of molecular analysis. They also require no consumables and are generally low power. More importantly, they reduce waste by helping their customers achieve greater quality and throughput.

In addition to his environmental experience, Leggett has a distinguished record in academics, research science and industrial applications. He has a pure chemistry background, having earned his bachelor of science degree (1994) and PhD (1997) from the University of London's Queen Mary and Westfield College. His doctoral thesis, entitled "Chemical Strategies for the Removal of Trace Impurities from Gases and Solvents," led to the development of novel, patented technologies and two successful commercial products at Air Products, where Leggett worked as a research scientist and project manager from 1997 until 2001.

At the NPL, where Leggett worked as a senior research scientist, project leader and reporting leader from 2001 until 2008, he devoted significant time to experiment design and implementation in the analytical laboratory, as well as to industry consultancy work. He was awarded the NPL Silver Award for his role in developing a new cylinder valve and connector for handling reactive species that ultimately became a successful commercial product.

University of Glasgow expands fabrication capabilities for CS research

The academic institution has purchased an Oxford Instruments plasma etch tool which will be used for a number of applications including optoelectronics, mm-wave & terahertz, lab-on-a-chip and photovoltaics research.

The James Watt Nanofabrication Centre in Glasgow, UK, has added a PlasmaPro System100 ICP plasma etch system to its existing installed

base of Oxford Instruments etch and deposition tools.

The PlasmaPro System100 ICP will be used to etch compound semiconductor materials used in applications such as optoelectronics, mm-wave & terahertz, bioengineering, biotechnology, lab-on-a-chip, energy harvesting and photovoltaics.



Mark Vosloo, Sales and Marketing Director at Oxford Instruments comments, "As a company Oxford Instruments is focussed on developing leading edge tools for research and development, and this additional system order for Oxford Instruments tools emphasises our commitment to providing the research equipment of choice for the University of Glasgow."

"We have been working closely with Oxford Instruments for many years, utilising their etch and deposition systems successfully for our research," says Douglas Paul, Director of the James Watt Nanofabrication Centre. "We placed this recent order for an additional Oxford Instruments system as we continue to be impressed by the tools' flexibility and performance. We have used their tools for many years, and continue to use them to develop new etch and deposition processes for nanofabrication as we push technology below 5 nm feature sizes. In addition, maintaining our equipment is vital in order to maximise our usage and investment, and we are extremely satisfied with the consistent high levels of support we receive from Oxford Instruments," he continues.

Steed Technology and Highvac merge

The pollution control equipment manufacturer is teaming up with the vacuum equipment and service provider to offer complete, turnkey vacuum and abatement solutions for the compound semiconductor, LED and solar industries.

Steed Technology, a provider of thermal processing equipment and process gas abatement systems has merged with Highvac Corporation of Colorado Springs.

Highvac is a supplier of vacuum pumps, accessories and related equipment and services. Steed Technology and Highvac both primarily serve customers in the Semiconductor, LED and Solar Industries, which lends to the marriage of these two companies.

The newly-merged company will operate under the name Steed Technologies with headquarters at Highvac's 45,000 sq. ft. manufacturing and distribution facility in Colorado Springs.

A main focus of the merger involves ramping up sales channels, as well as expanding existing channels both domestically and internationally while putting an increased focus on new customers in regions with new, stricter air quality restrictions.

With the combination of Steed's EcoGuard point of use (PoU) abatement systems and Highvac's established vacuum pump sales and service centres, current and future customers will have access to a wider variety of vacuum/abatement solutions to better serve their specific application requirements.

Highvac has service centres throughout the U.S. around the world. These locations will serve as the foundation for growth into different global regions going forward, providing customers with faster, more convenient access to service and support for vacuum and gas abatement products.

Highvac's long term, core competency of process vacuum pumps and support lends itself well with Steed's newly introduced EcoGuard PoU abatement technology. Through this strategic alliance, Steed and Highvac have developed a total

“Sub-Fab” solution that they will offer to end user customers and OEMs alike. The Sub-Fab solution is a totally integrated system that includes vacuum and abatement technologies, and an onboard environmental control panel feature developed by Steed Technology.

By combining these technologies into a packaged, turnkey product, customers will no longer have to piece together vacuum and abatement systems from separate technology providers, and will be able to purchase process vacuum pumps and exhaust abatement equipment as a totally integrated system through a single vendor.

Continuing the Highvac model of local support centres is a key ingredient when it comes to providing customers the services required to maintain mission-critical manufacturing lines in a highly responsive manner. Support centres will be expanded throughout the U.S. and globally, including Taiwan, Korea, China, Singapore and Europe as efforts are aggressively ramped up to support customers demand for process vacuum and abatement technologies.

An additional aspect of the merger is the creation of Steed’s Green Consulting Service. The merger adds considerable value to this consulting service with the addition of the Highvac “Vacuum Pumping Solutions” team, which boasts a combined 50 years of Gas Abatement and Vacuum Equipment experience.

With new, increasingly strict, environmental regulations such as the “Greenhouse” law (AB32), many companies in the Semiconductor, LED, Solar and other industries are closely examining ways to increase the effectiveness and efficiency of their current abatement systems. There is little doubt environmental control will play a major role in these industries in the years ahead, and to assist companies in making the transition to cleaner, more efficient manufacturing technologies Steed will offer Green consulting and solutions services. These will help companies dramatically reduce emissions of gases such as Perfluorocarbons, NOx and CO₂. Steed’s Green Consulting hopes to provide a fast-track to compliance for companies struggling to comply with local and federal laws, while offering significant savings through the reduction of consumed utilities such as fuel and water.

“This is certainly a win-win for both Steed and Highvac, and even more so for our existing and prospective customers,” said Gerry Catalano, President and CEO of Steed Technology. “The companies we serve face steep and complex challenges when forced to work with separate vendors to piece together environmentally responsible solutions to the toxic and harmful exhaust created in their manufacturing process, while at the same time trying increase machine up-time. High tech companies will face tougher standards in the future and will need advanced vacuum and abatement equipment to be in compliance with regulations and provide the maximum up-time.”

“With this merger, we look forward to the new capabilities we can bring to our customers through expanding our scope of supply with the EcoGuard Abatement system. Vacuum Pumps and PoU Abatement are a perfect product mix, and Steed’s products are a direct extension that adds considerable value to the core products and services that we have offered to our customers for the past 18 years. Additionally, the added scope enables us to expand into geographical regions and bring Highvac’s proven model of being a ‘Local Vendor’ to our new customers,” says John Catalano President and CEO of Highvac Corporation.

SEMI-GAS Systems safely supply hazardous gases

The firm’s latest bulk specialty gas source systems, which can be used in compound semiconductor manufacturing, provide flow rates of up to 1,000 slpm.

SEMI-GAS Systems, a division of Applied Energy Systems (AES) and a manufacturer of ultra-high purity gas source and distribution systems, has unveiled a new series of bulk gas source systems that safely deliver hazardous specialty gases from large vessels at high flow rates.

The source systems are designed to supply toxic gases such as those used in compound semiconductor manufacturing. For example, NH₃ which is used to make LEDs, SiH₄ which is used as a dopant in III-V compounds, and H₂ which is used as a carrier gas in MOVPE growth. The

systems provide flow rates ranging from 100 slpm to 1,000 slpm.



SEMI-GAS Systems' bulk specialty gas source systems consolidate many gas cabinets into a single system for high volume semiconductor production, as well as for high gas volume consuming processes, as found in LED and solar cell production applications. With consideration to the local climate, the source systems can be installed indoors or outdoors.

Source vessel heating is incorporated into the system to facilitate the liquid to gas phase change and to sustain the high gas flow rates. Additional heating elements within the process gas lines, prior to pressure regulation, also control the enthalpy and undesirable phase changes.

Bulk specialty gas source systems help increase operator safety by minimizing the frequency that the operator must change the empty gas cylinders. Safe operation is also ensured through several

levels of system redundancy designed into the source system to continue critical gas supply and system operation at all times, avoiding costly downtime.

Every source system from SEMI-GAS Systems includes a PLC controller designed to monitor analogue and digital process sensors, perform purging and cylinder switchover automatically and continuously monitor system conditions for alarms, including flow, pressure, exhaust and fire. The source system will shutdown automatically in the event of an alarm trip. All of these elements can be monitored and controlled via the color touch screen operator interface.

The standard source system enclosures are 86" tall, 40" wide and 23" deep and constructed of welded 11 gage steel. Each features a self-closing and self-latching door and window with ¼ " thick safety glass and polycarbonate face shield for increased operator protection. The included fire sprinkler is UL-approved.

Precision Flow awarded \$1.5 m to develop LED and solar cell equipment

The NYSERDA award will help accelerate the firm's growth and help ensure that it can meet increasing demands.

Provider of outsource manufacturing, gas and chemical handling equipment, Precision Flow Technologies (PFT), has been awarded \$1.5 million from New York State Energy Research and Development (NYSERDA).

This money will be used to help the company expand its capacity to manufacture solar thin-film and LED production equipment.

Since 2007, NYSERDA has provided funding to help New York State companies develop or expand facilities to manufacture innovative renewable, clean energy or energy efficient products. Including this award, NYSERDA has competitively awarded \$13 million to help nine New York State companies expand their operations and create jobs. These awards are projected to leverage more than \$150

million in private sector investment.

Francis J. Murray, Jr., NYSEERDA President and CEO said, "NYSEERDA's partnerships with companies that are manufacturing innovative products is helping support the growth of the clean energy economy in New York State. These cutting edge companies are creating the products that will help New Yorkers save energy, create jobs, and improve our environment for the future."

"This investment is going to build on the federal support I've already helped deliver to create even more solar energy jobs here in the Hudson Valley," said Congressman Maurice Hinchey. "As Precision Flow ramps up production, they'll hire more and more workers. Earlier this week I was proud to announce that a new company, LEDs America, would be setting up shop at Tech City and creating up to 100 new jobs. Today's news is icing on the cake, and yet another example of how targeted investments from the Federal and State levels are helping make our part of New York a clean energy leader."

"Helping local companies like Precision Flow secure government contracts is an important part of what we do," said Assemblyman Kevin Cahill. "Teaming up with local business leaders like Kevin Brady and Precision Flow is how we are succeeding in transforming Hudson Valley businesses. I am proud to have helped with the successes of Tech City, this growing company and the good work of NYSEERDA in making New York a leader in the new energy economy."

"I commend NYSEERDA for supporting Precision Flow Technologies, Inc. at this pivotal time," said Senator Bill Larkin. "This is just the type of public-private cooperation that is needed to keep New York at the forefront of emerging technologies. I want to thank Precision Flow Technologies for supporting the community by expanding their business and making Kingston and TechCity a leader in the field of clean energy and energy efficient products."

"This support from NYSEERDA will enable Precision Flow to accelerate our growth," said Kevin Brady, President. "The markets for our products are growing at breakneck speed, and New York State's investment in our growth will help ensure that we can grow fast enough to meet the demand."

Empyrean honoured with 2011 R&D 100 award

PANalytical's latest XRD tool, which can be used to analyse compound semiconductors, has been selected by a renowned independent jury as one of the top high technology innovations of the year.

Dutch supplier of analytical instrumentation and software for X-ray diffraction (XRD) and X-ray fluorescence spectrometry (XRF), PANalytical, has announced that its X-ray diffractometer, Empyrean, has been recognised as a 2011 R&D 100 award winner.

In its 49th year the R&D 100 awards are widely recognised as the 'Oscars of Innovation' identifying and celebrating the top high technology products of the year.

Awarded under the, 'winning technology' category, PANalytical says that Empyrean has the unique ability to measure all sample types – from powders to thin films, from nanomaterials to solid objects – on a single instrument. The system also has the ability to see inside solid objects without having to cut them up. Using computed tomography analysis, it becomes possible to determine the area of interest for subsequent X-ray diffraction analysis, or check the presence of pores or inclusions inside the object.

"We are truly honoured to receive this prestigious award," said Jan van Rijn, General Manager X-Ray Systems at PANalytical. "It is gratifying to be recognised for our commitment to developing new generation platforms, products and solutions that enable innovation within multiple industries, helping them to survive and thrive amidst today's challenges."



Empyrean is PANalytical's answer to the challenge of modern materials research. Coupled with a comprehensive software suite, Empyrean supports multiple users, unattended and remote operations, automatic data collection and analysis reporting. Today's research themes are nanomaterials, life sciences and renewable energy; tomorrow science may move in a different direction.

The lifetime of PANalytical diffractometer stretches beyond the horizon of a single research program. For many scientists the ability to accommodate change is a unique 'must have' feature when deciding to invest in an XRD system. Time to value has become increasingly important for sustainable businesses today.

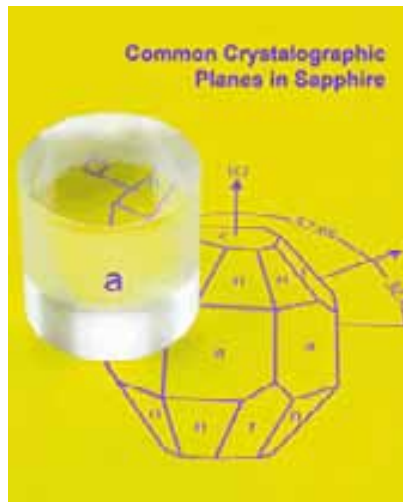
The 49th annual R&D 100 Award was open to a number of industry sectors, academia and government laboratories who despite the recent economic downturn have continued to innovate. Winners were chosen following an extensive review by an independent judging panel and the editors of R&D Magazine.

X-ray goniometry service orients single-crystal sapphire

The service validates the sample or substrate orientation when polarisation effects are critical and when the user is looking for a cleavage plane or wants to avoid one.

An X-ray diffraction analysis service that employs X-ray goniometry to identify and document differences in the orientation of single-crystal materials has been introduced by Meller Optics, of Providence, Rhode Island.

Meller Optics' X-Ray Goniometry Service measures a specific sample plane of a single-crystal material and provides a flat reference with accuracy on the order of 0.5-3 min. to assure more accurate outcomes of experiments. Suitable for samples from 0.25" sq. and of materials such as sapphire and silicon, the firm can also correct a plane and provide a reference flat, if desired.



Performing sample plane measurements per customer specification, Meller Optics' X-Ray Goniometry Service is typically necessary to validate orientation when the thermal expansion, thermal coefficient and the index of refraction have to be the same in all directions; when birefringence must be maximum or minimum; when polarisation effects are critical; and when the user is looking for a cleavage plane or wants to avoid one.

Meller Optics' X-Ray Goniometry Service is priced from \$150.00, depending upon customer requirements. Quotations are provided upon request.

MHI's micro miller machines ultra-hard materials

The firm's "microV1" can cut through silicon carbide and sapphire and saves production time and reduces costs by eliminating the photomasking process step.

Mitsubishi Heavy Industries (MHI) has successfully machined four types of extremely hard, difficult-to-cut wafer materials, including SiC and sapphire, using the company's "μV1" micro milling machine.

The μV1 is able to create grooves and grids with 1 μm level accuracy on wafers by a cutting process only. In other words, various additional processes that are necessary when creating grooves and grids by photolithography or etching are not required. This enables significant reductions in production time and cost. MHI looks to expand sales of the

μ V1 as the most suitable machine and technology for trial machining of semiconductor materials and sample production.



Figure: "μV1" micro milling machine

MHI has also succeeded in the machining of wafer materials made of glassy carbon and silica glass. On the revised Mohs hardness scale, which rates the hardness of a diamond at 15, SiC is rated at 13, making it the third hardest wafer material, and sapphire is a 12, the fourth hardest. Glassy carbon is rated between 10 and 11 and silica glass is a 7.

For machining of wafer materials, the μ V1 uses a cutting tool made of diamond. To remove hard fine swarf mixed with coolant oil, the machine is equipped with a special fine swarf collection filter. The company's proprietary Optical Image-type Tool Measurement System can accurately measure the position of the rotating tool end using a CCD (charge-coupled device) camera, thereby enabling real-time monitoring of tool tip position precisely. This feature lets the machine obtain tool rotation dynamic accuracy data and offset thermal displacement caused by the heat generated by the machine itself, ensuring precise cutting of grooves with 1 μ m level accuracy.

The μ V1 was released in 2006 as a three-axis milling machine for machining of precise die and mould, electrodes as well as precision parts. In 2008, a five-axis model, which has table tilting function with rotary axes, was added to the series. To date applications of the μ V1 have been expanded to include machining of nonferrous materials and production of small-sized jigs.

When photolithography or etching is used for semiconductor shaping in trial or sample production – applications in which production quantities are inherently limited and production is subject to frequent changes - these methods tend to inflate costs as they require the production of multiple masks for each modification in semiconductor shape. These methods also require long time for processing patterns in case of deep shape, and they impose limitations on 3D free-curve shape processing. MHI views machining by the μ V1 as a new technology that addresses these shortcomings, and the company is aiming at additional applications such as micro flow channels required for bio-chips. To promote use of the machine in those new fields, MHI will leverage its machining knowhow and expertise to firmly support potential users in all phases from initial consideration of the μ V1 through to its actual operation.

Imtec introduces stand alone and integration ready vapour dryers

Both IPA Accudry models are suitable for processing compound semiconductor wafers as well as solar cells and leaves them spotless and free from watermarks.

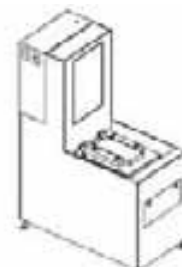
Imtec's line of Accudry surface tension gradient dryers include both stand alone and integration ready models which are available for end users and OEM customers.

Figure: The Accudry Dryer - A surface tension IPA vapour dryer that yields substrates; wafers, integrated circuits, solar cells, fuel cells, MEMS, and disk drives, spotless and watermark-free.



Stand Alone Model: ADF-XXXX

The ADF model is designed to fit within the same foot print as a Spin Riser Dryer (SRD) making installation and retrofitting effortless.



OEM Model: ADO-XXXX

The ADO model is designed for custom integration in to any OEM wet station.

Mark West, Sales Manager for Imtec, stated that the Accudry IPA dryer fits in well with its current extensive offerings of wet process modules that it has been providing to the semiconductor and related industries for almost 40 years. "We see a growing market for IPA dryers", continued West.

Some customers just want to get away from the problems associated with spin rinser dryers. Others are processing fragile substrates, such as solar cells or III-V materials. Others have high aspect ratio structures that trap water and cause die-killing water spots. The Accudry is claimed to be a perfect solution for all these requirements.

Imtec's patented IPA drying technology is simple, effective, and easy to implement. Its stand-alone dryer (ADS-XXXX) is designed to fit in the same space as a typical spin dryer. Programmable IPA vapour and N₂ flow rates allow for recipes to be optimized for different substrates and surface conditions to be processed in the same dryer.

Thermal Microreactor has a new view

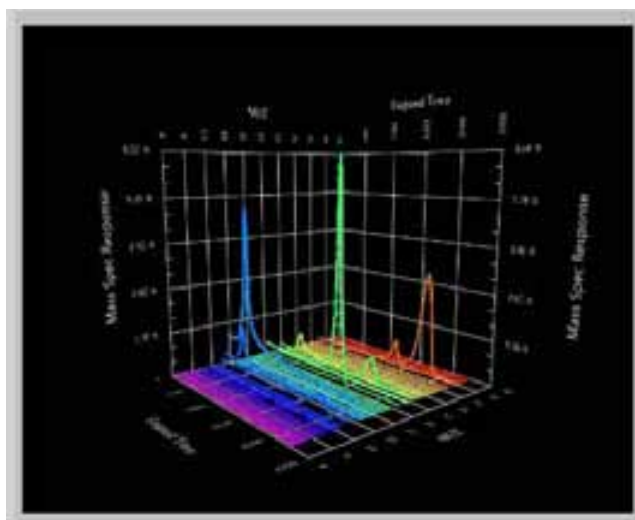
The CATLAB tool controls temperature and ramp rate, gas stream selection and flow rates from up to eight gas streams used in compound semiconductor manufacturing.

Hiden Analytical has just revealed the CATLAB thermal microreactor system with the new CATsoft LabVIEWbased operating program to further optimise and simplify operation in both Quality Control and R&D applications.



CATLAB Microreactor Module

Designed for precise characterisation of catalytic and of general thermal reaction studies, the system features a 1000C fast response furnace with integrated mass spectrometer and is fully programmable for both automated and manual operation with the CATsoft program controlling furnace temperature and ramp rate, gas stream selection and flow rates from up to eight gas streams, mass spectrometer function and data processing.



3D Bar Mode

The benchtop CATLAB integrated system is uniquely manufactured by Hiden which has over 20 years proven expertise in both thermal analysis and in mass spectrometry.

Tiger Optics' new gas analyser pounces on contaminants

In order for customers to meet targets for the 15-year International Technology Roadmap for Semiconductors, they need to monitor their process gases at ever increasing levels of purity.

Expanding the capabilities of its patented CW-CRDS technology, Tiger Optics has plans to introduce the LaserTrace 3 trace gas analyser at the Semicon West trade show in San Francisco.

The LaserTrace 3 can detect moisture, oxygen, methane, and other analyte contaminants at limits that are more than two times lower than previous generations of the product line.



Tiger, in the industry vanguard, sells laser-based trace gas analysers to semiconductor manufacturers, tool manufacturers, purifier manufacturers and the gas companies that supply bulk and specialty gases to the industry.

In semiconductor manufacturing, contamination in process gases has a destabilising effect and negatively impacts deposition processes. As a result of as little as single-digit parts-per billion impurities in process gases, product yields are reduced. To remedy this problem, the LaserTrace 3 allows users to monitor for intrusions at levels that were never previously available.

“The leading semiconductor manufacturers have adopted our patented CW-CRDS technology due to the superior detection range, ease of use, the lowest total cost of ownership in the industry, and the fact that this is an absolute technology. No calibration gases are required,” said Lisa Bergson, Tiger’s founder and chief executive. “In order for our customers to meet targets for the 15-year International Technology Roadmap for Semiconductors, they need to monitor their process gases at ever increasing levels of purity.”

“The technological advancements of the LaserTrace 3 are a result of Tiger Optics’ on-going investment in research and development. We’re thrilled that our customers will now be able to realise a two-fold improvement in their detection limits.”

Since its debut in 2003, the LaserTrace platform has been widely accepted for semiconductor applications, based on its versatility, ease-of-use,

and low cost-of-ownership. The multi-species, multi-point, multi-gas product line accommodates up to four sensor modules in a standard 19-inch rack, or permits placement of individual sensor models as far as 200 feet from the computerized control unit. In 2005, the company introduced its LaserTrace O2 as the world’s first laser-based, trace oxygen analyzer to detect parts-per-trillion levels in ultra-high-purity gases.

In 2008, the LaserTrace+ made possible the lower detection limit of 200 parts-per-trillion, which the company says at the time had the widest dynamic range of any dedicated analyser currently in the market.