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An Angel Business Communications publication

October 2011 Volume 17 Number 7

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The steady rise of silicon subs

A decade or so ago it was rare for anyone to manufacture compound semiconductor devices on silicon, and suspicion greeted the resultant products. But times have changed: Silicon is becoming a more popular foundation for III-Vs, particularly in the electronic sector, and in future silicon substrates could well become the norm.

If this happens, one company that is sure to win the plaudits as a trailblazer is the GaN-on-silicon RF chipmaker Nitronex. This Durham, North Carolina outfit started producing HEMTs on 4-inch silicon way back in 2001 on home-built MOCVD tools, and it has never looked back. Sceptics may have initially questioned whether it was possible to build reliable products from GaN on silicon, but there's not much talk on that front today.

Several power electronics firms have followed in Nitronex's footsteps, including multi-national giant International Rectifier, which is making products on 150 mm silicon. In fact, the growth of GaN-on-silicon has now reached such a level of maturity that it is possible to outsource this step to various epi-houses. This is the route adopted by MicroGaN, a spin out of the University of Ulm that is pioneering development of 600 V transistors and switches incorporating a three-dimensional architecture. This approach enables the realisation of very low parasitic resistances and capacitances, and it promises to open the door to higher levels of device integration (the company's technology and vision is discussed on pages 14 to 18).

LED manufacturers are also starting to find a home on silicon. Bridgelux is leading the way with its development of LEDs grown on 200 mm substrates, which can be processed at under-utilized 8-inch silicon fabs dotted around the globe. Samsung has also started efforts in this direction, which it reported at ICNS-9 in Glasgow, and it is likely that several other leading LED chipmakers have secretive programmes in this direction.

There is also a band of academic and industrial researchers approaching the growth of III-Vs on silicon from the other direction – that is, they are not looking to cut costs with silicon substrates, but enhance speeds with the compounds. These researchers are the developers of next-generation logic circuits, who see III-Vs as the most promising candidate for extending the march of Moore's Law.

This topic will feature strongly at CS Europe 2012, which will be held in Frankfurt on 12 and 13 March next year. Although we are still putting the finishing touches to the programme, I can disclose that representatives from Sematech, imec, and many of the leading universities in this field will be speaking at this event.

So why not go to our web-site, book your place today, and make sure you don't miss out on this event that will also detail the manufacture of LEDs, lasers, power electronics, wireless chips and multi-junction solar cells. I hope to see you there.

Richard Stevenson PhD
Consultant Editor

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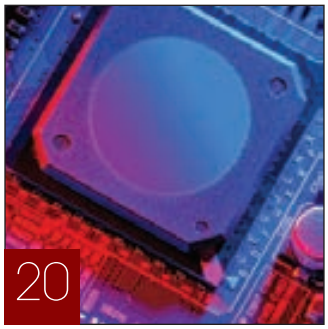

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IMS expects LED market to stall in 2011

AFTER 60 percent growth in 2010, the GaN LED market is expected to pause in 2011, rising just 1 percent to $8.7 billion. That's according to market analyst IMS Research, which attributes the slowdown to three factors. One of these is slower than expected growth in backlighting, which accounts for over 60 percent of GaN LED revenues. Backlighting is now expected to fall 3 percent in 2011 to $5.4 billion, after 80 percent growth in 2010, despite a 36 percent increase in units due to aggressive price reductions.

Another factor is LED supply growing more than two times faster than demand, as both existing players and many new entrants significantly expanded capacity in a disappointing year for demand putting pressure on prices.

Un-yielded 2-inch equivalent wafer capacity is expected to rise 67 percent in 2011, compared to a 29 percent increase in LED demand to 75 billion die causing the surplus that occurred in the second half of 2010 to widen in 2011.

Third, the growing over supply has led to ASP declines of up to 44 percent for 2011 depending on the segment and a blended

ASP decline of 21 percent. With costs falling slower than expected on under utilization, margins have worsened for most LED manufacturers.

According to IMS Research SVP Ross Young, "All the LED backlighting segments are expected to fall in revenues in 2011 except for TVs which are now expected to rise 13 percent. However, the growth in TVs is not sufficient to offset the weakness in other segments.

In addition, the LED TV market is growing below expectations in 2011 on overall TV market weakness in developed countries which are most able to afford LED TVs and price sensitivity in the developing countries which are enjoying the fastest growth. As a result, we have revised downward our LED penetration into TVs from 45 percent to 43 percent in 2011, up from 23 percent in 2010, and from 73 percent to 68 percent in 2012."

The lighting market is the fastest growing application for packaged LEDs in 2011, rising 24 percent to $1.7 billion and reaching a 20 percent share of packaged LED revenues, up from 16 percent in 2010. Despite the rapid growth, LEDs are only expected to achieve a 1percent unit and 14 percent revenue share of the lighting market in 2011, leaving significant potential for future growth.

According to Young, "Looking forward, we expect faster revenue growth for packaged LEDs through 2015 with both backlighting and lighting growing in 2012 and 2013 and lighting offsetting declines in backlighting in 2014 and 2015 with all major panel markets saturated by LEDs from 2014.

However, by 2016, lighting growth will slow and won't be able to offset the growing weakness in backlighting worsened by gains from AMOLEDs."

Raytheon GaN modules excel

RAYTHEON'S transmit/receive modules for the U.S. Navy's Air and Missile Defence Radar (AMDR) program have passed a significant developmental testing milestone. The firm's GaN modules have exceeded navy-specified requirements for extended, measured performance, demonstrating no degradation after more than 1,000 hours of testing.

Raytheon is developing a technology demonstrator for the system's S-band radar and radar suite controller. During the radio frequency operating life testing, the modules demonstrated consistent power output across multiple channels.

"The threats that AMDR is designed to counter require leap-ahead technology that Raytheon is ready to deliver," said Raytheon Integrated Defence Systems' Kevin Peppe, vice president of Seapower Capability Systems. "We are seeing our gallium nitride modules exceed the program's performance requirements, which ensures that the navy will get the capability and reliability they need for this sophisticated radar system at an affordable cost."

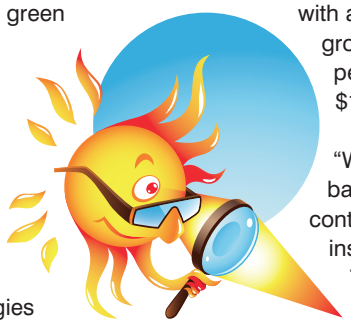
AMDR provides capabilities for the navy including Arleigh Burke-class destroyers. It fills a critical gap in the joint forces' integrated air and missile defence capability, enabling highly effective missile defences to be deployed in a flexible manner wherever needed. The radar suite consists of an S-band radar, X-band radar and radar suite controller.

The system is fully scalable, enabling the radar to be sized according to mission need and to be installed on ships of varying size as necessary to meet the Navy's current and future mission requirements. The radar's digital beam forming capability enables it to perform multiple simultaneous missions, a critical feature that makes the system affordable

and operationally effective for the Navy.

Raytheon's skill and experience working with large-scale active phased-array radars spans the frequency spectrum from UHF to X/Ku-band and dates back to the Cobra Judy and Upgraded Early Warning Radar programs, continuing today with the advanced Dual Band Radar, AN/TPY-2 and Cobra Judy Replacement programs. The knowledge and experience gained from these programs will ensure that the AMDR S- and X-band radars operate in coordination across a variety of operational environments.

Accelerating penetration for CPV



INCREASING demand for green energy solutions that will replace the global dependence on fossil fuels is pushing terrestrial photovoltaic installations. The Strategy Analytics Gallium Arsenide and Compound Semiconductor Technologies (GaAs) service report, "Terrestrial Opportunities for Compound Semiconductor Photovoltaics," forecasts that almost 200GW will be installed worldwide by 2016, with III-V compound semiconductor-based concentrator photovoltaics (CPV) technology growing at a compound annual average growth rate of 75percent from 2011-2016.

Global demand for renewable energy is growing rapidly. The terrestrial photovoltaics (PV) market was estimated to be worth over $80 billion in 2011, with conventional silicon-based technology dominating roughly 82 percent of the total market. Strategy Analytics predicts that the terrestrial photovoltaics market will grow with a compound average annual growth rate (CAAGR) of ten percent to reach a value of $100 billion by 2016.

"While conventional Silicon-based technologies will continue to dominate PV installations, that will decline to 74 percent by the end of 2016," predicts Asif Anwar at Strategy Analytics. "Thin film and CPV technologies will be the primary challengers to silicon-based PV installations. Strategy Analytics predicts that the CPV market will grow at a faster rate than conventional PV technologies and account for almost 5 percent of new PV installations by 2016."

"Even though the performance capabilities of III-V CPV technologies are well established, deployment has been limited to date," noted Eric Higham, GaAs Service Director. "However, the III-V CPV industry has successfully established III-V CPV technologies as economical and competitive alternatives to conventional technology solutions.

Infinera to scale InP PICs with Aixtron

THE California-based company placed the order for one AIX 2600G3 IC deposition system during the first quarter of 2011. Following delivery in the third quarter of 2011, the system will be used for next generation InP Photonic Integrated Circuits (PICs).

The system is capable of growing 49x2, 12x4 or 7x6 inch wafers. One of Aixtron´s local support teams will commission the system at the Infinera InP PIC fabrication facility in Sunnyvale, California, USA.

Fred Kish, Senior Vice President, Optical Integrated Circuit Group, comments, "We were looking for the world's foremost MOCVD system to provide a foundation for the fabrication and scaling of our next generation PICs. The Aixtron MOCVD system will be of significant importance not only in development but also in production of these challenging indium phosphide circuits."

He continues, "Our decision was based on several distinguishing factors and not the least being that Aixtron is considered to be the industry's best in-class vendor. Their systems have the highest reputation and capabilities and include precise epitaxy control, excellent run uniformity as well as scalability for guaranteed future proofing. Couple that with the excellent support service and we were certain the AIX 2600G3 IC deposition system uniquely suited our needs."

Infinera's systems and PIC technology provide customers with simpler and more flexible engineering and operations, faster time-to-service, and the ability to rapidly deliver differentiated services.

Most recently, Infinera has demonstrated next-generation PICs capable of both 500 Gb/s and 1 Tb/s implemented on two monolithic InP chips which integrate over 600 functions.

Kyma raises the bar for GaN thermal conductivity

KYMA TECHNOLOGIES, supplier of crystalline AlN and GaN and related products and services, has announced results of an analysis of the thermal conductivity of several of its GaN based products. The thermal conductivity analysis was carried out over the past three years by researchers in the group led by John Muth of the Materials Science and Engineering Department of North Carolina State University. Muth's group has published many of the results during this three year period for bulk and template single crystal GaN materials. More recently Muth's group also measured the thermal conductivity of Kyma's high purity polycrystalline GaN.

Kyma says the results indicate that its products have beaten two records. Firstly, its bulk GaN has been measured to have thermal conductivities in the range of 260 ± 5 W/mK. Also, its high purity polycrystalline GaN has been measured to have thermal conductivities in the range of 165 ± 5 W/mK.

Additionally, the thermal conductivity of Kyma's GaN on sapphire templates is found to vary from 180 W/mK to 220 W/mK for thicknesses between 100 microns and 400 microns, respectively, a result of declining dislocation density from approximately 8 x $10^{8}cm^{-2}$ to 3 x $10^{7}cm^{-2}$, respectively. Kyma's more typical GaN template product has 5 microns of GaN thickness and was not measured but is expected, based on NCSU's analysis of the literature, to have a thermal conductivity of approximately 130 W/mK, which Kyma says is ~20 percent higher than typical values for a 2 micron thick MOCVD GaN buffer layer grown on sapphire.

While defect density clearly impacts bulk GaN thermal conductivity, there is not a significant dependence of doping density for intentional doping levels between $10^{16}cm^{-3}$ and $10^{18}cm^{-3}$.

"We are enjoying incremental improvement in our bulk GaN materials properties, which is being born out in their thermal conductivity, as well as in other properties," stated Kyma CTO Ed Preble. Preble added, "We are also pleased to learn from Professor Muth's research group that our polycrystalline GaN is also a pretty good thermal conductor.

In retrospect this is not extremely surprising: The grains are relatively large (10 to 40 microns) and relatively low in extended defect density, plus the material density is close to its theoretical value, and the chemical purity level is 6N's (less than 1 part per million in impurities by weight) or better."

Kyma's polycrystalline GaN is available in customer defined shapes, ranging from 1cm wide cubes to round wafers with diameters of 1-inch, 2-inch, 3-inch and 100mm and thicknesses between 0.5 and 5 mm. The round form factor can be polished to an optically flat level.

Optogan launches LED 60W replacement lamp

MADE of state-of-the-art technology and consisting of German-Russian components, Optogan says its E27 lamp has features on par with the best of world standards. The new light source is claimed to be significantly less expensive than its European counterparts. From September onwards, the first contingent of bulbs will be available for 995 Rubles in both Moscow and St. Petersburg. In early 2012 the bulb will be introduced to the global market – the target price then should be around €30.

Optogan´s designer bulb is a convincing contribution to global energy savings. The lamp's power consumption tolls 11 W, which is about 6 times lower than of an incandescent lamp. The life cycle exceeds 50,000 hours, corresponding to 6 years of continuous illumination. Should the bulb be used 3 to 4 hours per day, the Optogan E27 is designed to operate for more than 46 years.

Optogan says its E27 has solved the problem of light fluctuations, in particular fluctuations which adversely affect human health when working long-term under artificial lighting;. the E27 is claimed to provide a smooth, warm white light which has a positive effect on a person's well-being. Unlike incandescent and fluorescent lamps, it does not contain dangerous substances such as mercury or lead.

"We have managed to create not just a lamp that has excellent technical performance, but also one highly attractive to consumers. Optogan´s E27 is the fruit of the work of leading European scientists combining world-class technology and creative development of Russia's leading design studios," said Maxim Odnoblyudov, president of the Optogan Group.

"Besides that, we are proud of the high quality of our E27. The vertically integrated manufacturing structure of Optogan allows us to control quality at every stage of production, from the German chip manufacturing to packaging and assembling the final product in St. Petersburg".

LED light sources are not affected by turning them on or off frequently. This does not affect their life as drastically as it does with incandescent or worse still, fluorescent lamps.

Optogan says that presently, the market share of LED light sources in Russia is about 5-6%. Experts estimate that by 2015 the share of LEDs in the domestic market will exceed 25%. Global acceptance too hovers around the 3% mark. The addition of late adopters is expected to push this contingent up to the 20% mark by the middle of this decade.

Avancis raises thin-film PV module record

AVANCIS, a manufacturer of CIS solar modules, has presented a new world record in efficiency for thin-film modules at the EU PVSEC. The company has achieved a new world record of 15.8 percent on a 30 cm x 30 cm CIS solar module.

Avancis has improved its last efficiency record of 15.5 percent from the beginning of the year in time for the recent EU PVSEC and takes the lead in the efficiency ranking list of externally certified thin-film modules.

The new aperture efficiency degree of 15.8 percent on the fully-encapsulated and framed Champion module has been confirmed by TÜV Rhineland in an advance announcement.

According to the current efficiency record table of the magazine Prog. Photovolt. 19 (2011) 565 from August of this year, the Avancis result represents a new, independently certified efficiency record for a thin-film photovoltaic module with a size of 30 cm x 30 cm.

"The renewed efficiency improvement can be traced back to the reduction of the layer thickness of the CIGSSe absorber by approximately 10 percent and an optimised in-line selenization process for the thinner absorbers.

In addition, the P1 laser structuring was optimised and the structuring process between P1, P2 and P3 improved with the aim of further enlarging the active surface. The result was the achievement of an aperture efficiency of 15.8 percent", Franz Karg, CTO of Avancis, explains the most recent success.

Important for the future application of the new technology, is that the efficiency improvement was not achieved at the expense of impaired long-term stability. The research and development department has carried out climate tests (so-called damp heat tests in accordance with the valid IEC storms) with several of the efficiency-optimised modules. All tests demonstrated long-term stability comparable with that of the previous products.

Lowest power downconverters

NXP SEMICONDUCTORS has introduced the TFF101xHN, a family of integrated downconverters for use in Low Noise Block (LNB) 10.7-GHz to 12.75-GHz Ku band satellite receiver systems. Designed for downlink signal reception for TV satellite dishes, NXP's new family of DVB-S compliant downconverters are claimed to consume 50-percent less current (52 mA) than other integrated solutions, significantly increasing the lifetime of the LNB and improving its reliability.

The new downconverters are the most recent additions to NXP's portfolio for satellite LNB, including other discrete products such as oscillators, amplifiers and switches, to provide complete coverage for all LNB architectures.

The TFF101xHN family offers simplicity and integration in a leadless 16-pin package with a conversion gain ranging from 37 dB to 45 dB. They also offer integrated phase noise of 1.5 degrees RMS and a low noise figure of 7 dB. This high level of integration guarantees the stability of the local oscillator (LO), which improves overall system reliability by eliminating LO drift over lifetime due to temperature changes.

For satellite LNB makers, assembly is also made easy due to the high integration level of functionality and minimum requirement for external components. The TFF101xHN family comes in four fully RF-tested versions with pre-set LO frequencies, which significantly reduces the need for manual adjustments on the production line, speeding up the manufacturing process and time to market, as well as lowering operating costs.

The Low Noise Block downconverter is the device at the front of a parabolic satellite dish antenna that receives the very low level microwave signal from the satellite, amplifies the signal and converts it to a lower frequency band
in order to send it down the cable to the indoor receiver. The Ku band is primarily used for satellite communications, particularly for editing and broadcasting satellite television.

Ammono n-GaN substrates in a different class

Ammono has added a new series of high transparency n-type gallium nitride substrates to its portfolio. During the last twelve years Ammono has been developing a technology allowing the manufacture of GaN wafers with carrier concentrations between $2x10^{17}$ and $2x10^{20}$ cm^{-3}. Today the standard n-type product has a carrier concentration of $10^{19}cm^{-3}$.

Responding to market needs, Ammono is introducing new products based on an innovative n-type material which has a higher transparency and a lower carrier concentration of $3x10^{17}cm^{-3}$.

The firm believes its new ammonothermal GaN substrates present additional advantages for the production of LEDs, UV LEDs and also for photovoltaic applications. The dislocation density in this material remains at a level of $5x10^{4}$ cm^{-2} which Ammono says is currently the best commercially available. Initially Ammono will offer high transparency substrates in form factors of 10 mm x 10 mm square wafers and circular 1" wafers. In 2012 besides its standard 2" n-type AMMONO-GaN substrate, the company aims to introduce a 2" product based on this new high-transparency material.

LG Electronics welcomes Aixtron reactor for GaN/Si applications

Aixtron has announced that LG Electronics Woomyeon R&D Campus (LG Electronics Advanced Research Institute), an existing customer in South Korea, has placed an order for one AIX G5 HT MOCVD system in an 8x6-inch wafer configuration. LGE will use the system to develop GaN-on-Silicon power electronics in partnership with Aixtron.

The contract also includes a cooperation agreement in order to optimise LGE´s GaN/Si processes and to accelerate its proprietary device-oriented production.

The reactor was ordered in the first quarter of 2011 and following delivery in the third quarter of 2011 will be installed and commissioned by a local Aixtron service support team alongside the company's already existing Aixtron MOCVD systems at a state-of-the-art facility in South Korea.

LGE will develop power electronic devices offering the best combination of performance and cost demanded by markets such as home appliances and electric vehicles.

Aixtron equipment is particularly well suited for customers such as LGE who plan to transition from R&D to mass production. LGE's application will also benefit from the excellent thickness uniformity across the wafers and across the platter as well as run-to-run dependability.

Overall, the AIX G5 is the appropriate choice to fulfil the needs for LGE's special process parameters and device structure. It will also directly address the requirements for large-wafer process developments right from the start.

The mutual trust arising from many years of cooperation between LGE and Aixtron will now continue through the new partnership for this GaN-on-Silicon project which will involve all of their professional expertise in the installation and process development. In due course, the joint development project will be a great success further proving LGE's leadership in GaN-on-Silicon technology, something that has the potential for great change across the nitride industry.

MicroGaN takes nitride transistors into the third dimension

Purchasers of power electronics want transistors and diodes that deliver SiC performance at silicon prices. Next year they should get their wish when MicroGaN launches a range of 600 V, GaN-on-silicon devices. **Richard Stevenson investigates.**

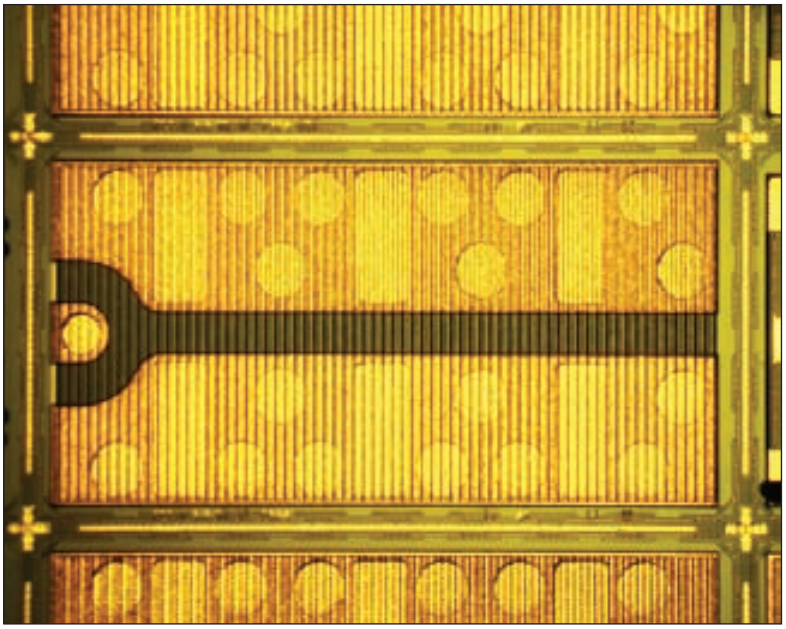
Interest in energy efficiency continues to rise. This is evident in the values for the power consumption of electrical goods that are no longer tucked away in the small print of the owner manuals – now they displayed along with the item for sale, and considered to be an important consideration for every potential customer.

Heightened interest in the energy efficiency of electrical products by individuals and corporations is partly behind increasing sales in the multi-billion dollar power electronics market. Silicon dominates this arena, with ten or so firms taking the lion's share of this market that provides electronic components for various products, including switch mode power supplies used in PCs, solar invertors and the power electronics in hybrid electric vehicles. However, these multi-million dollar chipmakers are facing ever stiffer competition from wide-bandgap semiconductors.

Leading this charge are SiC diode and transistor manufacturers such as Cree, Infineon and SemiSouth. In terms of efficiency, their products outperform those made from silicon by a significant margin. However, high costs hamper sales, with customers having to pay, for example, around $90 for a 1200 V SiC MOSFET from Cree.

Fortunately, there is another promising option: GaN-on-silicon. "We promise SiC performance for the price of silicon," claims Ertuğrul Sönmez, business development manager at the German GaN-on-silicon start-up MicroGaN, which is a spin-off of the University of Ulm.

According to him, the pairing of silicon and GaN also has the potential to deliver of high levels of integration, because it can accommodate several power devices, including power diodes and switches, on a single chip.

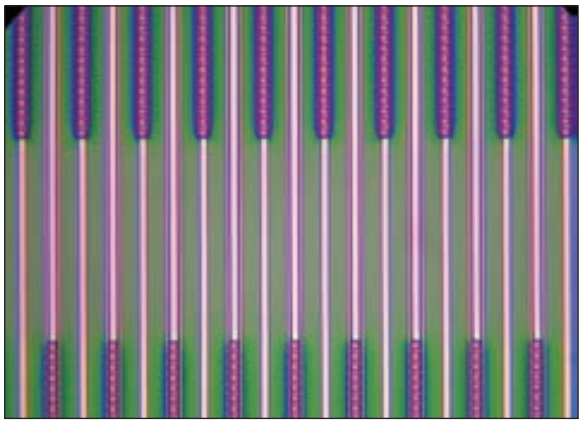


MicroGaN die are fabricated from GaN-on-silicon epiwafers

Strength in numbers

MicroGaN, which is currently sampling 600 V diodes and transistors, is not alone in pioneering power electronics with this class of material: International Rectifier is shipping 30V/12A modules, EPC is selling normally off transistors with voltages ranging from 40 V to 200 V, and a handful of other firms dotted around the globe are developing similar products.

Such competition, especially from industry heavyweights, could alarm many a small start-up. Sönmez, however, offers a completely different take on the situation: "If you have a new materials system, it needs to be convincing to application engineers. They



A partially processed die produced by MicroGaN, a spin-off of the University of Ulm

will use one that is efficient, known and trusted, and competition helps greatly to increase that trust." He hopes that all players in the GaN-on-silicon power electronics sector will work together to extol the virtues of this platform, and believes that there will be a place for many of them in this market.

Within the GaN-on-silicon fraternity, MicroGaN is the sole developer of 600 V devices featuring a three-dimensional chip architecture, which delivers benefits in terms of cost and performance. The Ulm start-up applies its three-dimensional technology to the surface-state transistor, which is a simple, robust technology with the strengths of no doping or implantation steps.

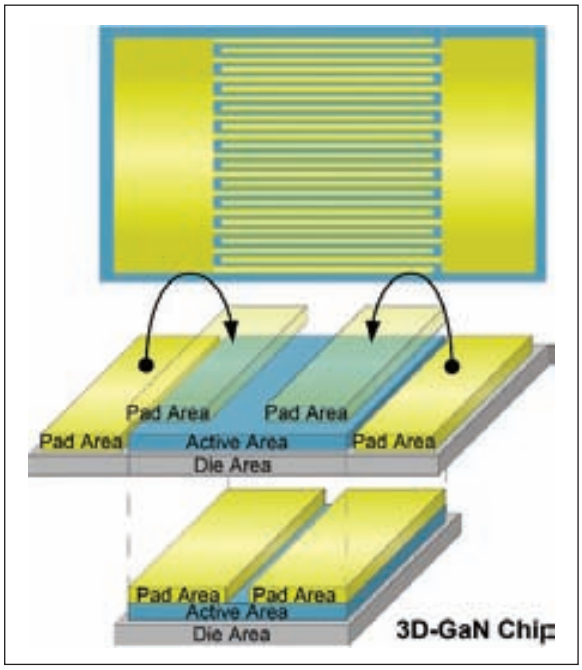


Figure 1. By adopting a three-dimensional architecture, MicroGaN is able to build more compact diodes and transistors that have lower manufacturing costs and reduced parasitics

Epitaxial growth of GaN and AlGaN on silicon forms a two-dimensional electron gas thanks to the internal electric fields in these materials, and depositing metallic ohmic contact layers tens of microns apart from one another forms devices. Contact widths of typically 100 mm enable the realisation of devices with sufficiently low resistance. The practical way to do this is to employ a 'folded-down topology' incorporating many, many fingers (see Figure 1).

Although such devices could be fabricated with a planar technology, it is far better to adopt a three-dimensional architecture. "It's really the only way for large area, power integrated circuit solutions," argues Sönmez. He points out that in addition to the obvious cost benefit stemming from a reduction in device dimensions, the three-dimensional architecture paves the way to a lower specific on-resistance.

For devices with a metallic contact strip width of 100 mm, on-resistance is just 170 mΩ, and additional improvements in the quality of the epitaxial material could substantially reduce this figure further.

One of the strengths of MicroGaN's approach is its common platform. By altering the contact architecture and working with both GaN and silicon devices it is possible to build diodes and normally on and normally off transistors (see "Utilizing a common approach" for details).

A strong GaN-on-silicon pedigree

MicroGaN developed the three-dimensional architecture that lies at the heart of this common platform in-house. These efforts were driven by its founders, Mike Kunze and Ingo Daumiller, who started the company in 2002 after carrying out doctoral research that included the growth of III-V materials. This pair focused on GaN-on-silicon technology from the very beginning.

Funding to found the company and enable it to form its initial business plan came from the German investment bank KfW. This backer provided additional financing with a series A round at the end 2005, along with MAZ Level One and Technostart ventures, and in 2009 the Ulm spin-off had a further cash injection from KfW and Technostart. A location for the start-up has been provided by the University of Ulm, which is a strong supporter of spin-offs and has played a major role in the success of VCSEL manufacturer Ulm Photonics.

Initially the university provided offices to MicroGaN, and also granted its employees access to a 1000 m^2, fully equipped cleanroom. But as the company grew it

needed more space of its own, so in 2009 it moved into the basement of this building, assembling a fab just for itself. "We just share the central supply systems, like gases and clean water," explains Sönmez.

Additional milestones for MicroGaN include the demonstration of 1000 V devices in 2007 and the establishment of intellectual property for three-dimensional devices the following year. "In 2009 we set up our 6-inch capability and in 2010 the initial prototypes of our switches went to customers," adds Sönmez. "2011 will be the year of our fully featured prototype."

Spreading the load

Despite having tremendous expertise in hetero-epitaxial deposition of nitride films, the founders of MicroGaN decided to outsource epi-growth. "You cannot do everything at the same time – our decision was to make close partnerships and jointly develop epi with our partners," says Sönmez.

The only significant change to MicroGaN's strategy over the years has been to switch its focus from RF devices to power devices. Sönmez reveals that the reason behind this move was an increase in the electrical field strength of GaN, which at one point was insufficient for making power devices. "Our RF technology was transferred to high-voltage technology after having the first high-voltage results from the epi."

Today the firm is making products on 4-inch wafers. "In parallel, we are taking a close look at 6-inch, but for 600 V applications the critical field strength and homogeneity are tough requirements," explains Sönmez. Device development is almost complete, and it will not be long before MicroGaN starts to demonstrate its products, both in-house and with lead customers.

The German outfit is already discussing the results of its prototype diodes and switches. Its 600 V Schottky barrier diode, which it claims to be 'best in class', turns on at 0.3 V and delivers 4 A at 1.2 V. This compares to a turn-on voltage for SiC diodes of over 0.9 V, a difference that accounts for the lower DC loss of the GaN-on-silicon product.

Meanwhile, the company's 600 V, normally off switch has an on-resistance of 320 mΩ – and at a gate-source voltage of 0 V, it has a drain current below 1 mA at a drain-source voltage of 600 V. Fix the drain-source voltage to 0.7 V, and drain current exceeds 2 A when the gate-source voltage hits just 3 V.

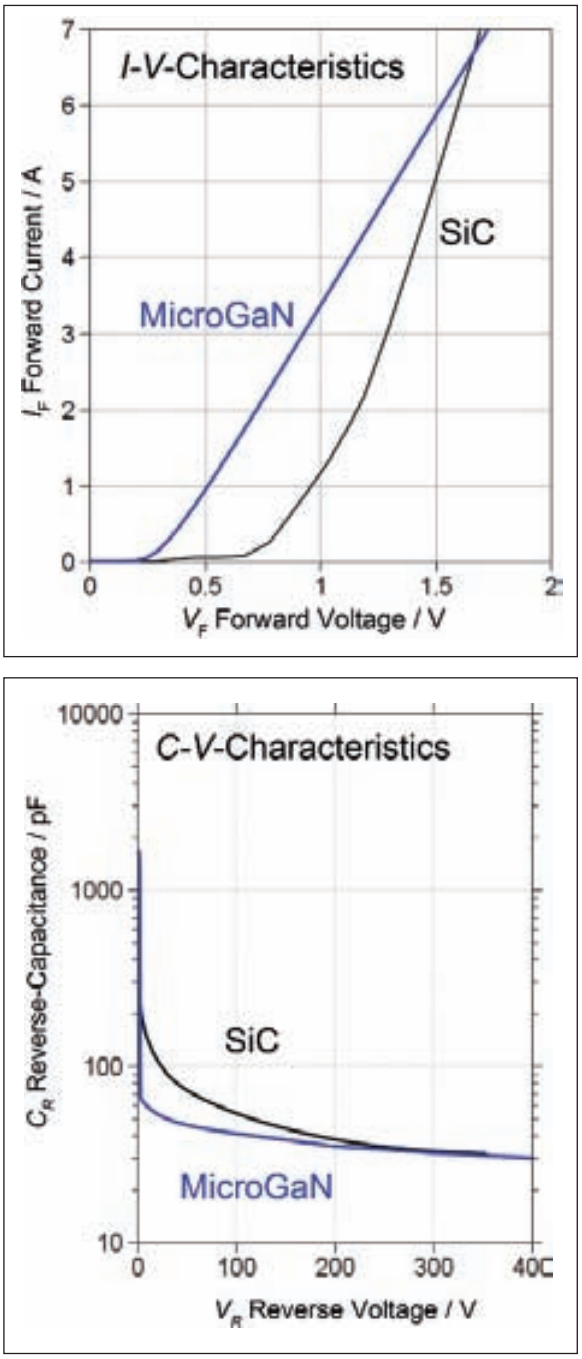
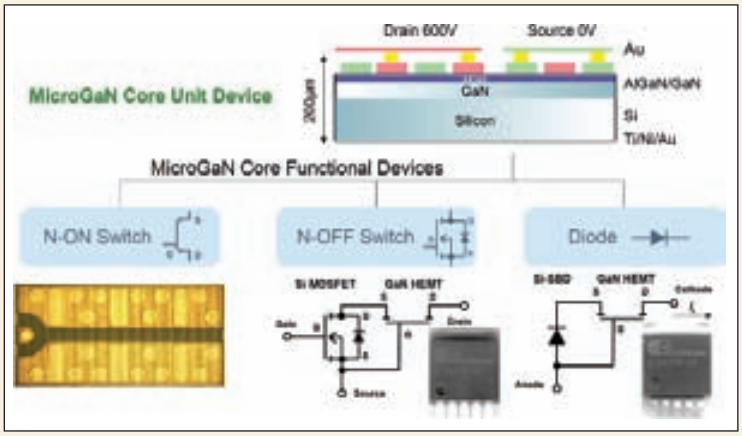


Figure 2. The combination of a GaN HEMT and a silicon Schottky diode allows the exceptional low-voltage characteristics of this diode to be transferred to higher voltages

Utilizing a common approach

MicroGaN has a common platform for forming three different types of device: a 600 V diode and normally off and normally on transistors operating at the same voltage.

The normally on transistor has the simplest construction – it's just a GaN HEMT with a source, drain and gate. But this class of device is unlikely to be a big seller because in many applications concerns over safety lead to the requirement for a normally off transistor.



The architecture for the diode is more complex, combining a GaN HEMT with a silicon Schottky barrier diode. "Silicon's low-voltage diode properties, which are fantastic at low voltages, are transferred to 600 V," enthuses Sönmez.

He explains that it's a similar story for the normally off transistor, which pairs a GaN HEMT with a MOSFET in a cascode configuration. "The advantage then is that you don't need a free-wheeling diode," explains Sönmez, who adds that the MOSFET that is used is of very high quality and features a low-voltage barrier diode.

According to him, silicon MOSFETs perform poorly at high voltages due to high levels of stored charge. "But you don't have this problem for silicon MOSFETs at low voltages – they are incredible." So, just like the diode, this approach allows the strengths of silicon to be translated to high voltages.

That's not the only advantage of this approach, though, says Sönmez: "If you want to make an AlGaN/GaN system operate normally off, you have to destroy the nature of the two-dimensional gas at the location of the gate." By sidestepping that issue, MicroGaN can produce devices that excel in a key figure of merit – the on-resistance, multiplied by the area of the device.

Great performance is of little benefit in the commercial arena if manufacturing costs are high. This is certainly not the case, according to Sönmez, who claims that the cost of making these normally off GaN-on-silicon switches is lower than that for manufacturing sophisticated silicon products. "Our processing complexity is very low – lower than sophisticated silicon, such as coolMOS, and far lower than SiC transistors that might have trenches or other technological steps to ensure normally off operation."

He admits that the costs for epitaxy are higher than those for silicon, but points out that this can be offset by resistance figures up to ten times lower. "You end up with a really competitive cost structure even to silicon."

Initially, MicroGaN's products will probably be used as drop-in replacements for those made from SiC and silicon. Employed in that way, circuits don't have to be re-designed, making it relatively easy to displace SiC free-wheeling and boost diodes that are used in boost stages of power factor correction units, and in H-bridge circuits that are used to control the current flow in solar applications and motor drives.

Further inroads into the power electronics market require a re-design of the H-bridge circuit Currently, these circuits require four separate silicon IGBTs and additional free-wheeling diodes. To begin with, MicroGaN's transistors could replace the IGBTs and eliminate the need for diodes. But further down the road the changes could be far more radical: "I can see a fully integrated power conversion technology that can be made on one chip and will, for the first time, facilitate today's three-dimensional technology advantages," says Sönmez.

Over the next few months MicroGaN will be preparing its technology for its initial sampling phase with selected customers that is planned for the first quarter of 2012. Mass production will follow as the Ulm start-up establishes manufacturing partners.

"Our process has been developed from the beginning to be transferable," explains Sönmez. This allows the company to not just outsource epitaxy, but the entire production process, a move that the company is preparing to make. "This will start using 4-inch, using its maturity at 600 V. But we are tracking 6-inch in parallel, and as soon as the electrical properties fulfil our needs - in terms of yield, homogeneity, breakdown voltage, leakage current, and so on – we will switch." If the company can make these transitions smoothly, it should to be a major force in the power device market.

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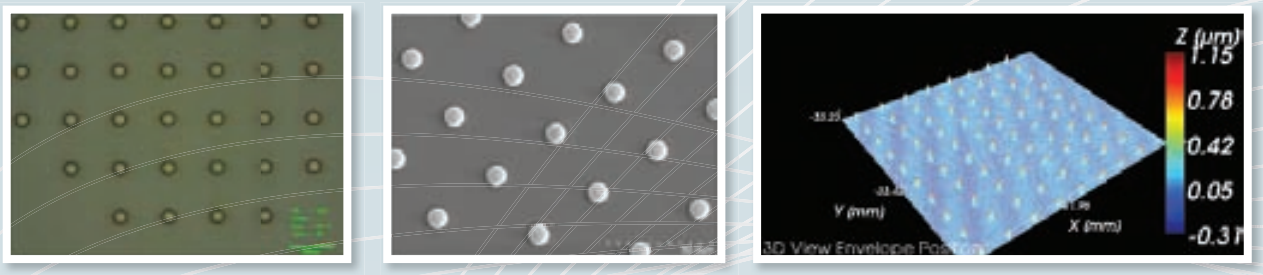

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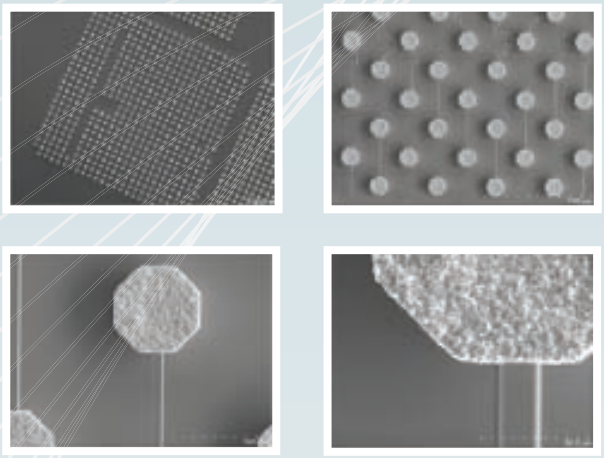

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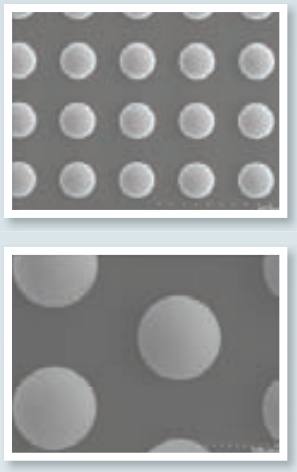

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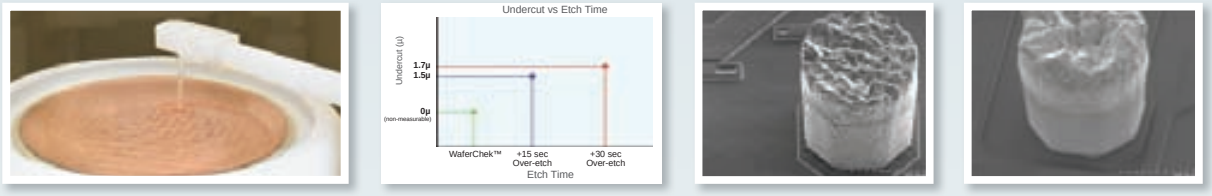

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Simulations enhance the development of power devices

Simulations hold the key to unlocking the potential of wideband gap semiconductor transistors with novel architectures, say **Hugh Wong, Nelson Braga, Shiyang Tian and Ricardo Borges from Synopsys.**

Growing interest in greener forms of electricity generation and fuel efficient vehicles is spurring the development of a new breed of power electronic system. In turn, this is creating new opportunities for the semiconductor power device technologies lying at the heart of most of these systems.

Examples of such activities include increased efforts to harness the power of the sun and wind, which have motivated the development of more efficient inverters. Similarly, future power grids will require new power-switching and flow-control technologies to manage and distribute increasingly diverse energy sources, including renewables with seasonal and diurnal variation. And in transportation, it is possible to increase the driving range of hybrid and electric vehicles with more efficient inverters and converters that can operate at a higher temperature, require less cooling, and enable a reduction in the weight of the car.

Silicon power devices are dominant in today's power electronics and they will continue to evolve. However, wide bandgap alternatives based on SiC and GaN are now starting to fulfil their long-held promise for high-power, high-temperature applications, and they are gaining traction in applications beyond the performance envelope of silicon.

At a given breakdown voltage, silicon is inferior to both SiC and GaN in terms of on-resistance, which is a key figure of merit in power switching applications. In the case of SiC, whether used as a device technology or as a substrate for GaN devices, its higher thermal conductivity improves heat dissipation. What's more, in SiC and GaN, the low intrinsic carrier concentration resulting from the large energy gap allows device operation at higher junction temperatures. Both effects simplify heat sink design and cooling systems and could unleash a range of products setting new benchmarks for affordability, size and weight.

Recently, an increasing interest in GaN and SiC has spawned many new device designs that – when combined with improved processing techniques, higher quality SiC substrates, and lower-defect GaN heteroepitaxy – have led to promising demonstration devices. But there remains a strong impetus for further optimisation of device design and the tailoring of device characteristics to a wide range of applications.

One tool that engineers can use to develop novel device structures and exploit the benefits of wide bandgap semiconductors to the full is technology computer-aided design (TCAD). At Synopsys, which is based in Mountain View, CA, we have developed software capable of doing precisely that – the Sentaurus Device simulator. In this article we illustrate the capability of this tool through simulations of a normally off GaN HFET and a SiC insulated-gate bipolar transistor (IGBT) designed to meet low loss power switching applications.

Simulating GaN and SiC devices presents a set of challenges that are not faced when working with more common semiconductors, such as silicon and GaAs. One of these is the vast range of values for some of the characteristics associated with wide bandgap materials. For example, the intrinsic carrier concentration innate in GaN and SiC is incredibly low, but the doping levels of contact and cap layers can be very high. For accurate simulation of leakage currents and the onset of avalanche breakdown, the simulator must be capable of numerically resolving 25 or more orders of magnitude.

Recent versions of Sentaurus Device address this issue through extended precision arithmetic, which improves the relative accuracy of the numerical resolution.

Normal 64-bit floating-point representation has a relative accuracy of 2.22×10^{-16}. 80-bit extended precision arithmetic, which is supported in hardware with no noticeable degradation in performance, has a relative accuracy of 1.08×10^{-19}. In contrast, moving up to 128-bit and 256-bit improves the relative accuracy to 4.93×10^{-32} and 1.22×10^{-63}, respectively, but at the expense of longer simulation time.

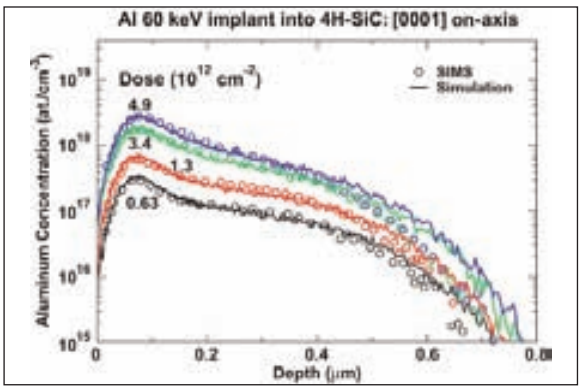

Figure 1. 4H-SiC on-axis, 60 keV, aluminium implant at doses (0.63, 1.3, 3.4, 4.9) x 10^{12} cm^{-2}. Since the implant is performed on an on-axis wafer, deep channelling tails are created - their close match to the experimental SIMS profile attests to the accuracy of the Monte Carlo implant model

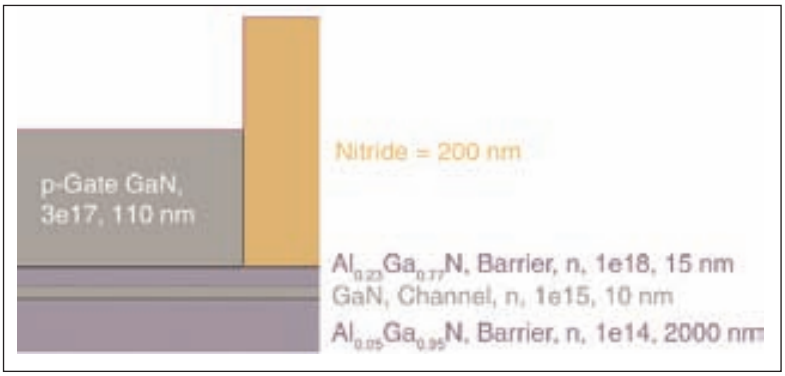

Figure 2. A cross-section of the simulated HEMT structure (gate region)

Catering for crystallinity…

Simulations of wide bandgap power devices must also cater for intrinsic properties specific to each material. Except for its cubic 3C polytype that has limited commercial application, all polytypes of SiC have hexagonal crystal structures. Consequently, anisotropy features in many important physical parameters – mobility, impact ionization, thermal conductivity, effective mass and electrical permittivity.

What's more, doping techniques employed for SiC can also differ from those used for other semiconductors. *In-situ* doping of epitaxial layers is common, especially for low-doped regions, but ion implantation is gaining popularity in modern SiC devices. Here, too, the technology differs from silicon.

In SiC, ion implantation tends to be carried out at a high temperature to activate the dopants during the implant. Fortunately, models for ion implantation in SiC have substantially improved over the years, and our latest simulation tool accounts for wafer off-axis angle and temperature. Thanks to these refinements, our simulations of dopant concentration are a good match to real data (see Figure 1). We are also currently working at modelling other SiC processes, including oxidation, where different growth rates and interfacial fluxes occur for the silicon and carbon faces, and dopant diffusion takes place at very high temperatures. We detailed our calibration of SiC physical models applied to TCAD simulations three years ago in this magazine (see *Compound Semiconductor*, October 2008, *p* 31).

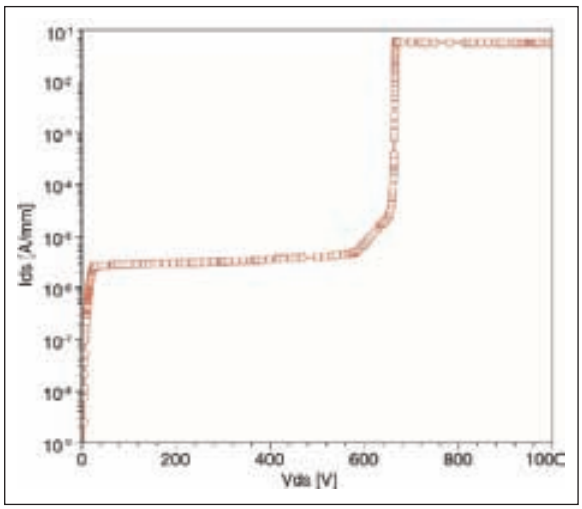

Figure 3. Off-state leakage curve for device with 8 μm field plate and 18 μm gate-drain spacing

…and polarization

In GaN devices – particularly HFETs, where a two-dimensional electron gas functions as the conduction channel – it is paramount that models handle polarization effects. The polarized wurtzite crystal structures of AlGaN, InGaN and GaN have dipoles across the crystal in the [0001] direction that lead to spontaneous (pyroelectric) polarization. In addition, there is strain-induced (piezoelectric) polarization in III-N devices incorporating pseudomorphic heterostructures. The primary effect of these sources of polarization is the creation of an interface charge, which is due to abrupt variations in the polarization at the AlGaN-GaN heterointerface and at the AlGaN surface. We compute this interface charge with a built-in polarization model that accounts for spontaneous and piezoelectric components.

More recently, Jesús del Alamo's group from MIT has reported degradation in GaN-based HFETs and postulated a link with the converse piezoelectric effect. High electric fields develop near the drain side of the gate, leading to strain relaxation through formation of mechanical defects and, consequently, the generation of electrical traps. When negatively charged, these traps cut drive currents, shift the threshold voltage positively, and increase drain access resistance. We believe that simulations can help to optimise the device design to mitigate these deleterious effects because they enable visualization of the spatial distribution of converse piezoelectric fields when the transistor is stressed.

Early efforts to develop GaN HEMTs focussed on physical characterization of trapping effects and ways to mitigate them. These traps hampered device commercialisation for many years, so it is of no surprise that early TCAD simulations focused on providing insights into the bulk and surface trapping behaviour to guide process improvements. Such efforts paid dividends, revealing the benefits of limiting carbon impurities in buffer layers and showing ways to optimise the device structure to suppress operational conditions conducive to trapping.

An important illustration of these early efforts was a simulation by us of the impact of field plates on the electron temperature in the channel. This study, which we detailed in *Compound Semiconductor* in 2006 (July edition, *p* 17), showed that field plates can reduce the

electric field at the drain-edge of the gate, contributing to a reduction of the electron temperature and trapping. If a plate is not in place, hot electrons diffuse into the bulk, where they became trapped. Insert a field plate and trapping falls, due to a lowering of electron temperature that limits electron spillover from the channel into the bulk. Our gate-lag transient simulations revealed key insights into the so-called current collapse phenomena, with the addition of field plates aiding the recovery of the drain current following a gate off-on switching pulse.

Thanks to improvements in epitaxial material and processing, devices now exhibit nearly ideal characteristics. Although extensive reliability studies of GaN devices are still underway, the nitride community has entered a phase in which simulation of their devices takes on a more conventional role: It provides a tool for designing and optimising device structures for specific applications.

For power switching, gate-drive circuitry is greatly simplified if the switching FET operates in enhancement mode, because the device is then normally off. Interest in this class of device has recently taken off, because it has tremendous commercial potential for power switching.

One interesting and promising variant of the normally off nitride transistor is the p-type GaN gate device that has been pioneered by Oliver Hilt and co-workers from the Ferdinand-Braun-Institute in Leibniz, Germany. As the paper presented by this group at last year's International Symposium on Power Semiconductor Devices and ICs did not report some of the key dimensions of their transistors, we have had to adopt reasonable assumptions to create a structure consistent with the device performance results (see Figure 2 for details).

In this p-type gate device, highly doped regions are created under the source–drain electrodes that stretch down to the GaN channel to emulate metal spikes and to control contact resistance. Magnesium-doped GaN is used as the p+ gate to deplete the channel at V_g=0, yielding a normally off transistor. An AlGaN buffer is used to increase the threshold voltage, and increasing the aluminium content in this layer reduces the on-resistance.

We assume that the $Al_{0.05}Ga_{0.95}N$ buffer is completely relaxed, and the subsequent channel and barrier layers are strained to match the lattice constant of $Al_{0.05}Ga_{0.95}N$, but with 20 percent of relaxation. The large polarization divergence at the AlGaN barrier surface (barrier/nitride interface) produces a large sheet of negative polarization charge. One might expect holes to accumulate at that interface and completely deplete the

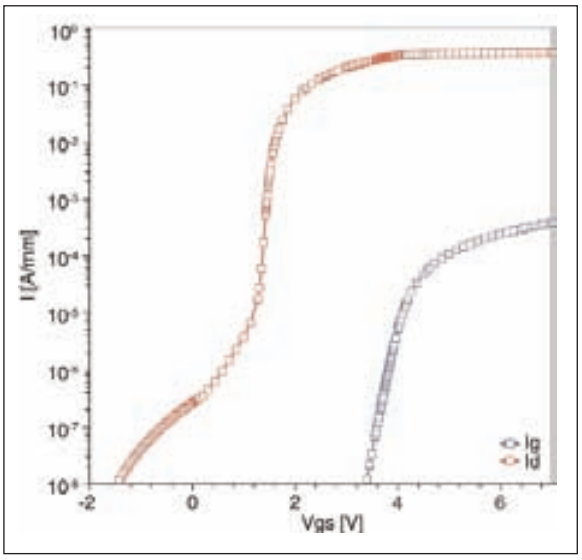

Figure 4. I_d-V_g and I_g-V_g curves for a structure with a 1.8 μm field plate and 6 μm gate-drain spacing, biased at V_d=15V

channel of electrons. However, in reality it is still not clear whether the polarization charge is compensated by fixed charges or interface trap states. According to our simulations, accumulated holes at the surface of the AlGaN barrier are completely compensated by deep, single-level trap states.

To assess the device performance for power-switching applications, we perform voltage sweeps of I_d-V_g, I_d-V_d and off-state breakdown voltage. To match the sub-threshold slope of the I_d-V_g curve reported by Hilt and his co-workers, we add traps to the AlGaN barrier/GaN channel interface. As expected, our simulations reveal that the off-state leakage current and breakdown voltage are strongly influenced by the passivation nitride thickness and field-plate length. What's more, traps in the buffer affect both the sub-threshold slope and off-

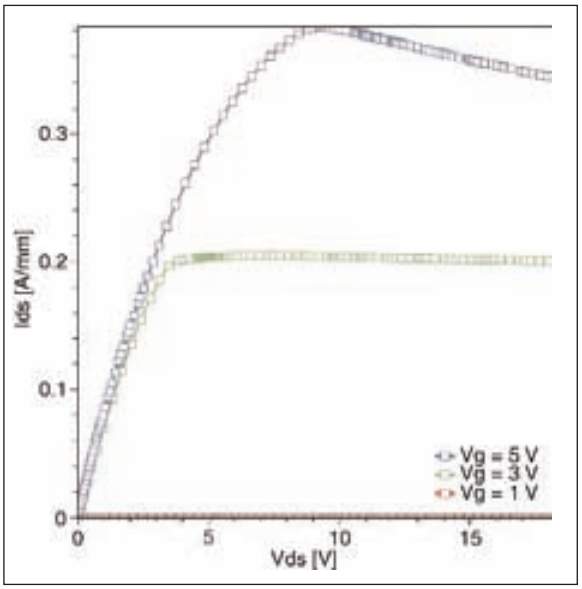

Figure 5. I_d-V_d curves for structure with a 1.8 μm field plate and 6 μm gate-drain spacing. The negative output conductance shown in the top trace is due to self-heating

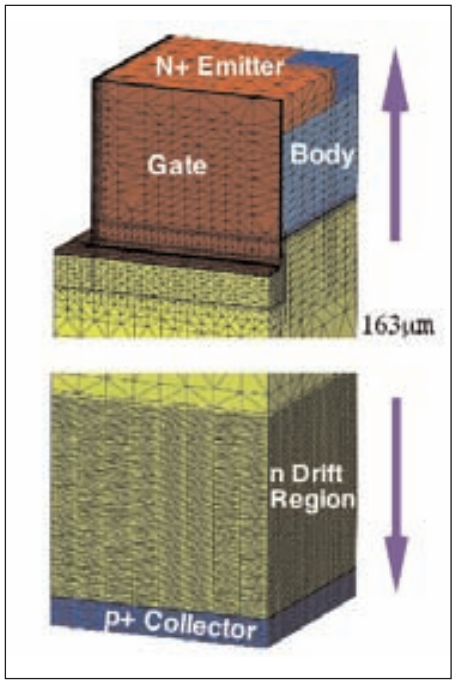

Figure 6. The meshed n-type SiC IGBT with n+ polysilicon gate and 50 nm SiO_2 gate insulator. For clarity, middle portion of the drift region is truncated

state leakage current. Our simulations employ Schottky contacts for the source and drain. Electron tunnelling is turned on and the electron tunnelling mass is made to be arbitrarily small so the contact is essentially ohmic. Taking this approach improves convergence and avoids abrupt band bending near the contacts. The tunnelling mass can also be used to tune the contact resistance.

The simulations that we have performed reveal that a breakdown voltage in excess of 600 V is possible for a HFET with an 8 μm field plate and gate-drain spacing of 18 μm – such a device promises to make a commercial impact on the power device market (see Figure 3 for a plot of the off-state leakage curve). A similar structure with a 1.8 μm field plate had good gate control at a drain voltage of 15 V (see Figure 4), and exhibits negative output conductance due to self-heating (see Figure 5).

SiC IGBTs

In the power industry, the silicon IGBT is widely used, thanks to its combination of a very low on-state resistance and superior on-state current density at high voltages. These attributes also hold for SiC equivalents that promise to increase operating voltage range.

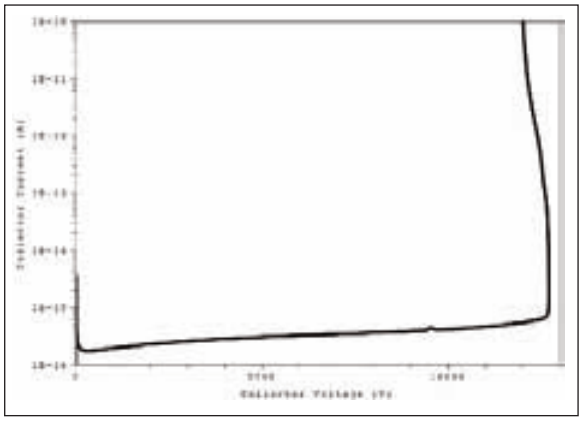

Figure 7. The n-type SiC IGBT has an incredibly high breakdown voltage. This curve also catches snapback, a sudden lowering of the device internal resistance as the collector current increases. The initiation of the avalanche breakdown at the bottom corner of the trench is captured in the inset

In reality it is still not clear whether the polarization charge is compensated by fixed charges or interface trap states. According to our simulations, accumulated holes at the surface of the AlGaN barrier are completely compensated by deep, single-level trap states

We have performed three-dimensional simulations with a 4 μm by 4 μm domain over a trench SiC IGBT amenable to current SiC process technology (see Figure 6 for details of the device architecture). Due to the relatively low doping level of just 6 x $10^{14}cm^{-3}$ in this long drift region of about 160 μm, very high breakdown voltage is expected.

Simulations re-enforce this expectation, suggesting that the breakdown voltage should exceed 12 kV (see Figure 7). To perform this simulation, we turned to extended precision arithmetic (80-bit) to resolve the extremely small off-stage leakage current that is present before the onset of avalanche breakdown.

As GaN and SiC devices gain market traction and target a growing array of applications, simulation will play an ever-increasing role in fully exploiting the excellent set of attributes of these wide bandgap materials. The design of power devices has many degrees of freedom, opening the way to radical device structures and the optimisation of current designs, all of which are well supported by simulation.

In the future, modelling of fabrication process in SiC and GaN technology will become more important, as not only structural details but also process conditions will be subject to optimisation. And since the performance of power modules is tightly coupled to the performance of the discrete power devices assembled in the module, simulation efforts allowing the co-design of devices and modules will see the use of TCAD data in the characterization of behavioural models for circuit and system-level design.

FURTHER READING

J. Joh and J. A. del Alamo, IEDM Tech. Dig **415** (2006)
O. Hilt *et al*., Proc. ISPSD **347** (2010)

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Testing times

Keithley Instruments recently launched an electrical characterization tool that caters for the needs of producers of wide bandgap power electronics and high-brightness LEDs. David Ridsdale quizzes the company's marketing director, Mark Cejer, about the capability of this new product.

Q Keithley has introduced a new tester that is suitable for scrutinizing the performance of LEDs and high-power semiconductors. Test is clearly an important part of the manufacturing process, but many manufacturers see it as an annoying additive to the process. Should they view it in that manner?

A It's long past time for device manufacturers to start thinking about test as much more than 'a necessary evil'. The growing demand for higher efficiency semiconductors is driven in part by the push for more energy-efficient devices. One of the goals for end products that employ lots of power semiconductors, such as power supplies for servers, must be reducing their energy consumption. When the power supply is in standby/off mode, leaky semiconductors in the inputs will waste a lot of electricity, especially when that leakage is multiplied by the number of power supplies in a big server farm.

To improve energy efficiency, IC manufacturers are constantly exploring ways to create more efficient silicon devices, as well as those based on compound semiconductors like SiC and GaN, which are inherently more efficient than silicon. All of that means greater testing challenges: 'more efficient' means materials and devices that are less leaky, 'less leaky' means IC makers need to be able to characterise ever-lower leakage currents, which is especially challenging in production.

Older instrumentation designed for characterizing relatively leaky silicon is typically not up to the challenge. The ability to characterise power semiconductors with pulsed measurements is also critical to ensuring accuracy because pulsed measurements let you test using high current levels without creating the self-heating problems that would occur if you were sourcing high DC currents.

High-brightness (HB) LEDs also present some critical testing challenges. For the types of applications that these devices serve, the colour of the light they output must be highly consistent from device to device because they're typically packaged with multiple LEDs in a module, and multiple modules in a single end product. Any significant colour variation is immediately obvious and would be unacceptable to the consumer. Ensuring high colour consistency requires the ability to test these devices with extreme accuracy.

Here, too, high-throughput pulse testing is essential because HBLEDs are very susceptible to self-heating, which will affect the colour of the light they output. And, of course, in production, test throughput is equally critical. And those are the big issues the Model 2651A High Power System SourceMeter instrument was designed to address.

Q Many companies highlight the generic capacities of their tools over a number of areas but with this tool Keithley have deliberately focused on the specialities the tester provides. What motivates such a decision and what process advantages does it provide the manufacturer?

A For some of our customers, all we have to say is 'We've got a terrific new 50A SMU' and they'll know exactly how to use it in their applications. But for the rest, we feel that test vendors have a big responsibility to their customers to help them choose and use their products effectively. You're right, this product is designed to address a specific set of applications, but it's undoubtedly the fastest growing area of the semiconductor industry. Power semiconductors are used throughout more industries every year: in the auto industry for hybrid and electric vehicles, electric grid applications, solar and wind power generation, power supplies for PCs and consumer electronics, and many more. Just about every segment of the electronics industry and their downstream customers are using power semiconductors and HB LEDs in some way. And we want to serve all of them.

Q Test has become an ever increasing part of the manufacturing process but also an ever increasing part of the cost. In industries where margins are so tight how does this new tool help manufacturers with cost? And when they see specific tool requirements, should they assume that the cost will also be higher?

A Until recently, manufacturers of power semiconductors had to rely on what we call 'big-iron' ATE functional testers. And those systems were pretty expensive – typically hundreds of thousands of dollars each. Even more important, those systems aren't really optimised to characterise modern power semiconductor materials and devices with their lower leakage currents and higher power levels.

In contrast, the Model 2651A is designed for exactly those characterisation challenges – and it costs about one-tenth as much. From a production test perspective, it not only dramatically lowers the cost of ownership, but provides higher-accuracy, better-quality measurements without a loss of throughput. That's because the combination of the Test Script Processor (TSP) embedded in the Model 2651A, and the TSP-Link virtual backplane that system integrators can use to link multiple instruments together, makes it easy to scale a system as large as they need while ensuring high throughput. TSP makes embedded scripting and execution of commands possible, in contrast with line-by-line execution of commands over GPIB as in traditional instrumentation.

Q The area of industry Keithley is targeting crosses some intense research fields as well as the growing production needs. Do you have a strategy that enables cost of ownership at the research level and the ability to transfer to production stage with minimal disruption or added cost?

A Absolutely. The Model 2651A, and in fact, the entire Series 2600A System SourceMeter family, incorporates this strategy. For example, researchers often need to characterise a device very quickly by just taking a few measurements. Series 2600A instruments have an embedded TSP Express software tool that allows researchers to perform common I-V tests quickly and easily without programming or installing software. TSP Express, which is LXI compatible, runs from the instrument and is controlled via a web browser running on a PC connected to the instrument via an Ethernet cable. It has an intuitive user interface that resides on the instrument's built-in web page. A user can just connect a laptop to the instrument with an Ethernet cable, open up a web browser on the laptop, type the instrument's IP address into the browser, and up comes the test application that's embedded in the instrument. And from there, the user can quickly point, click, run any of a number of tests, and download the resulting data to a .csv file or view it in graphical or tabular formats. TSP Express supports basic and advanced tests, including nested step/sweeps, pulse sweeps, and custom sweeps for device characterisation applications.

As useful as this software tool is, this is obviously not the approach for production test applications. For system-level applications, our TSP architecture is designed to simplify building high speed, multi-channel IV test systems of multiple instruments. The on-board microprocessor allows each Series 2600A instrument in the system to run its own test scripts, which can contain any sequence of routines that are executable by conventional programming languages. That means the instrument can manage an entire test without sending readings back to a PC for decision-making, eliminating delays caused by GPIB traffic congestion and greatly improving overall test times.

In April 2011 Keithley Instruments launched its Model 2651A High Power System SourceMeter, an instrument specifically designed for characterizing high power electronics

The TSP-Link bus allows system builders to connect multiple Series 2600A and other TSP instruments in a master-slave configuration so they behave as one integrated system. TSP-Link supports up to 32 units or 64 SMU channels per GPIB or IP address, so it's pretty easy to scale a system to match the requirements of an application. We also have built-in 500 ns trigger controllers to ensure precise timing and tight channel synchronization of multi-instrument systems.

Series 2600A instruments also provide a parallel testing capability that allows each instrument in the system to run its own complete test sequence, creating a fully multi-threaded test environment. That means you can run as many tests in parallel as you have Series 2600A instruments in the system, which can boost throughput dramatically. And when test requirements change, it's pretty simple to reconfigure a Series 2600A-based system via software without rewiring. Obviously, one of the big advantages of using the same instrument in the lab and on the production floor is measurement correlation. If manufacturing engineers discover a problem on the production floor, they can work with design engineers to track down the source of the problem much faster, because they can scratch data correlation concerns off their list of "unknowns."

Q What are the key interconnect issues that this testing platform addresses?

A With the ability to source and measure currents as high as 50A and the ability to resolve leakage currents as low as a picoamp, the Model 2651A offers the widest dynamic range of any SMU currently on the market. To make this possible, we put a lot of effort into developing specialized low resistance cabling and connectors to ensure our customers could make low noise measurements on any range. That specialized cabling is included with the product, so users don't have to worry if their measurements are being compromised by noisy connections.

Q Temperature control at interconnect junctions is of concern to manufacturers of high end products. How does the new platform address the industry needs?

A To minimize the unwanted effects of device self-heating during testing, the Model 2651A supports pulsed measurements. A single Model 2651A can pulse

up to 50 A; two units can be combined using the TSP-Link bus to pulse up to 100 A. It can capture transient behavior such as changing thermal effects with one-microsecond per point (1 MHz) sampling. The width of a sourced pulse can be programmed from 100 µs to DC and duty cycles from 1 percent to 100 percent are also programmable.

The Model 2651A provides a digitizing measurement mode that uses 18-bit A/Ds for characterising transient behavior precisely. A separate integrating measurement mode, based on 22-bit A/Ds, provides the maximum measurement accuracy and repeatability.

For applications like studying the thermal impedance of power diodes and LEDs, characterising the slope of the measured voltage at the top of the pulse is important. This capability is also useful for characterizing pulse amplitude flatness. The Model 2651A's high speed A/Ds simplify digitizing the top of the pulse accurately when the measurements are made synchronously with the source.

Q What are the key areas of power semiconductors that this testing platform addresses?

A Perhaps the most significant area is the enhanced efficiency of new materials and the testing challenges that come along with that greater efficiency. 'More efficient' means that when the semiconductor is 'on', it's really on and when it's 'off,' it's really off. Because it is designed to source and measure pulses of up to 50 A and measure voltages down to a microvolt, the Model 2651A offers the developers of new materials the ability to characterize the resistance from drain to source when the device is on (R_{DSon}) with high accuracy. At the same time, manufacturers of these new materials are striving to minimize leakage current from drain to source when the device is 'off'(I_{DSoff}); with its one-picoamp current measurement resolution, the Model 2651A makes it possible to characterise this parameter with high confidence.

Q What are the key areas of LED brightness that this testing platform addresses?

A One of the methods HBLED manufacturers use to control the brightness of the devices they produce is known as pulse width modulation. In this technique, the current through the HBLED is pulsed at a constant frequency with a constant pulse level, but the width of the pulse is varied. This changes the amount of time the device is in the 'on' state, as well as the perceived level of brightness. In this drive scheme, the HBLED is actually flashing, but the frequency of the flashing is so high that the human eye can't distinguish it from a constant light level.

Although it's possible to control the brightness of a HBLED simply by lowering the forward drive current, the pulse width modulation technique is preferable for several reasons, the most important of which is to maintain the consistency of the colour of the light as the device's brightness is reduced. In a HBLED, the colour of the light it emits is related to the forward voltage at which it operates. Although the forward voltage will remain relatively constant as the forward current is changed, it actually does vary by as much as tens to even hundreds of millivolts. This occurs especially at lower current levels. This slight variation in forward voltage equates to a slight variation in light colour, which is undesirable for the end user. If heating effects are ignored, in the pulse width modulation technique, the LED is pulsed using exactly the same current level on every pulse, so the forward voltage is the same for every pulse; therefore, the colour of the light emitted won't vary.

Fortunately for HBLED device developers, the Model 2651A is capable of outputting a pulse width modulated waveform with up to 100 percent duty cycle from 020 A, 50 percent duty cycle from 20–30 A, and 35 percent duty cycle from 30–50 A. Its advanced trigger model allows for precision pulse widths and duty cycles and tight synchronization with other instruments. These synchronization features can be used to combine two Model 2651As to achieve a pulsed width modulation waveform with pulse current levels twice as high as a single Model 2651A allows with the same duty cycle.

Q Keithley has a long history of test and measurement in the semiconductor and related industries. What are the key issues that Keithley sees facing the industry over the next five to ten years as more advanced and multiple device requirements are needed to meet roadmap intentions?

A Obviously, the demand for higher efficiency devices won't be going away. That means that not only will current manufacturers be experimenting with new materials – new companies will also enter this segment of the market. Typically, when that happens, to meet the new manpower demands, less experienced people are going to be chasing more complicated technologies. That obliges Keithley and other test vendors to keep producing products that are as simple as possible to use, so someone doesn't have be a test expert to start using them effectively. It also means we have to stay on top of providing applications support to get these new users up to speed quickly so they can find the products they need to do their jobs more efficiently. High accuracy products alone aren't enough—we have to continue making those products easy to use.

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Europe improves reliability of GaN microwave devices for space applications

Guaranteed access to leading edge GaN component technology is essential to maintain a competitive space industry in Europe. So companies and institutions are working together to build their own reliable, non-dependant, manufacturing supply chain for fabrication of space compatible GaN microwave transistors and integrated circuits, says **Andrew Barnes and Fabio Vitobello from the European Space Agency and Joachim Daeubler, Klaus Hirche, Jouni Laetti and Mirko Rostewitz from Tesat-Spacecom.**

GaN is the most promising semiconductor since silicon. Its attributes enable it to create bigger, brighter TVs, and better performing mobile phones and wireless base stations. And its potential is not just limited to terrestrial applications – in fact, it actually holds particular appeal for the space sector. In this environment, devices made from GaN promise to deliver reliable operation at far higher voltages and temperatures than current equivalents built from silicon and GaAs, and initial results indicate that this wide bandgap variant is also far better at withstanding the high levels of radiation found in space.

The attractions of deploying GaN in space have spurred development of microwave devices designed for that environment. Benefits of switching from the incumbents to this wide bandgap semiconductor include a major improvement in radiation hardness, a five-to-ten-fold increase in RF power output and the opportunity to reduce the mass and size of cooling systems.

If high reliability GaN microwave devices are produced, they could be widely deployed in space because microwave signals form the backbone of space communications, thanks to their suitability for carrying broadband data that can pass through the Earth's atmosphere. In addition, the microwave region of the electromagnetic spectrum can also be used to transmit spacecraft telemetry data back to Earth and deliver vision to radar imaging missions, such as Europe's Envisat.

Partner	Country	Primary responsibility
TESAT	Germany	Project management, component packaging and space assessment
united monolithic semiconductors	Germany, France	Technology transfer tools, production process development and validation, foundry process supplier
imec	Belgium	Epitaxy growth optimization on SiC and Si substrates and discrete power transistor processing on SiC and Si substrates
FBH Leibniz Ferdinand-Braun-Institut	Germany	Reliability optimization, processing of discrete power transistors
Fraunhofer IAF	Germany	Epitaxy growth and optimization on SiC, MMIC processing and reliability optimization
University of BRISTOL	United Kingdom	Thermal analysis and measurement
Tor Vergata	Italy	Device physics modelling

Figure 1: The project partners within GREAT² include foundries, research institutions and universities

Commercial production of GaN power transistors has been spearheaded by the US firm Cree and the Japanese chipmaker Eudyna (now part of Sumitomo Electric Device Innovations Inc.), who both commercially introduced devices on to the market about five years' ago. However, evaluating these overseas devices' performance and scrutinizing their reliability data is not always easy for any organization outside the borders of the manufacturer, due to International Traffic in Arms Regulations (ITAR) controls and restrictive end-user licence agreements on these components.

When microwave products from Eudyna and Cree were unveiled, the primary developers of GaN microwave components within Europe were research institutes and universities. Funding for these programmes came through

Figure 2: Activities within the €8.6 million GREAT² project have been divided into several work packages

national agencies, with efforts supported by innovative component development activities at the European Space Agency (ESA) and EU defence initiatives, such as the Korrigan project. Although these activities produced a portfolio of devices with very impressive performance figures that were reported in the 2002-2006 timeframe, European commercial suppliers of GaN microwave devices still had to overcome reliability-related issues before establishing themselves on a commercial basis.

Reliability requirements

If GaN devices are to be deployed in space applications, they must deliver high levels of reliability without compromising performance. Typical satellite operating lifetimes are eight-to-nine years for Earth Observation missions and upwards of 18 years for telecommunication satellites with little room for failure. To address this, in 2008 the ESA launched its GaN REliability And Technology Transfer initiative (GREAT^2), with the aim of establishing a European supply chain for the manufacture of high reliability, space compatible, GaN-based microwave transistors and integrated circuits that would be free from any ITAR or end-user licence restrictions. The first phase of the project, which focuses on device reliability, has secured €8.6 million of funding and there are plans in place for a follow-on phase that will concentrate on validating and qualifying the manufacturing process for the special requirements of the space environment. Seven academic and industrial partners from four European countries are involved in the programme, and each has a specific responsibility (see Figure 1 for details).

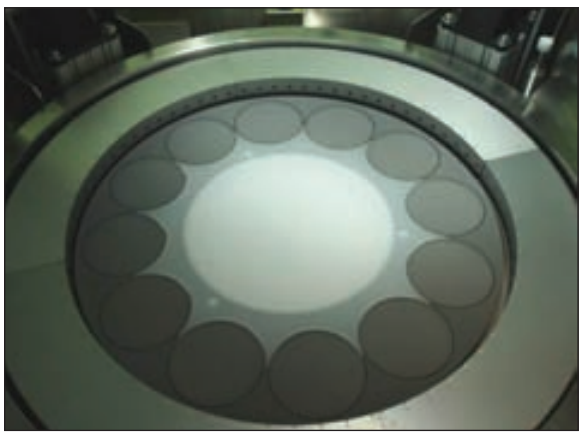


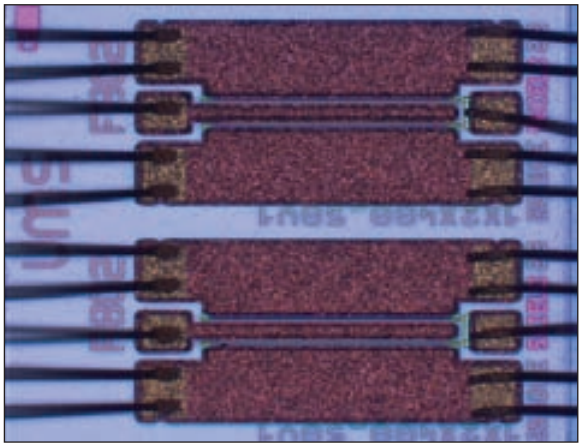
Figure 3. Engineers at Fraunhofer IAF in Germany are fabricating GaN-on-SiC epiwafers with an MOCVD multi-wafer reactor

The German firm Tesat-Spacecom (Tesat) is coordinating and managing the project, which is divided into five primary work packages (see figure 2). The aim of the largest of these, WP2000, involves undertaking process development trials to establish a space-compatible foundry process. Performance validation is being undertaken using L-band and X-band technology evaluation structures.

This work package is led for ESA by United Monolithic Semiconductors (UMS). It is responsible for establishing the final commercial foundry process. Additional support for this effort comes from: IAF and FBH, who are undertaking specific processing trials under the guidance of UMS to help improve the reliability performance of the foundry process; Tesat, which is responsible for device packaging and reliability assessment in RF packages; and the University of Rome, which is providing support for simulating and understanding the physics of GaN HEMT failure. Two types of foundry process are being produced by UMS in this programme: a 0.5 μm gate length process (GH50) for fabrication of discrete GaN HEMTs for operation up to 6 GHz, and a full MMIC process using 0.25 μm gate length technology (GH25) for operation to about 20 GHz.

Two of the other work packages, WP3000 and WP4000, are focusing on optimising device processing and epitaxial growth on silicon and SiC substrates. One of the primary aims of this work is to confirm whether device passivation produces better, i.e. more reliable, devices when this process is carried out *in-situ*, rather than *ex-situ*. The *in-situ* nitride devices are being fabricated at imec, and the *ex-situ* nitride devices fabricated at Fraunhofer IAF. In the WP3000 programme, accurate measurements of channel temperature, which are needed to determine the mean-time-to-failure in accelerated lifetime tests, are being obtained through Raman micrography measurements at the University of Bristol. The GaN microwave devices made during the project are being assessed under space environmental operating conditions by Tesat as part of the work package WP5000.

By the end of the first phase of the project, which is scheduled for completion in November 2012, more than 170 wafers will have been fabricated and assessed for reliability and suitability in a space operating environment. The successes of these efforts will be judged against performance-related milestones, which feature incremental increases in performance and reliability over time, and were drawn up by the ESA. Meeting the interim milestones M3 and M5 requires device operation in excess of 1000 hours and 10,000



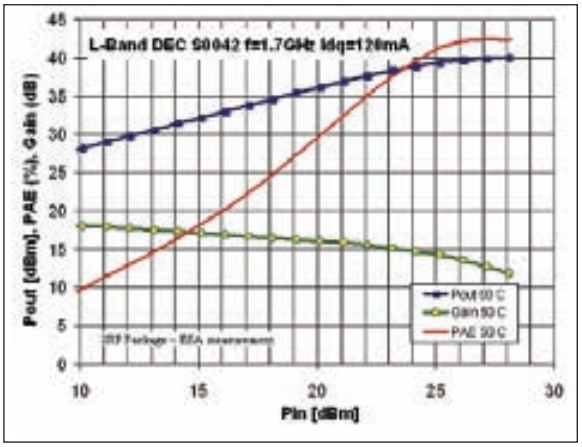
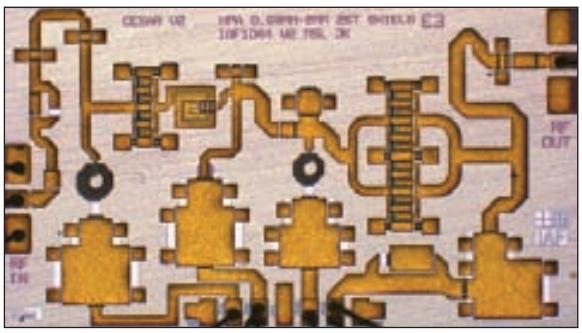


Figure 4: Devices made for the M3 milestone of the GREAT² project include an L-band discrete GaN HEMT. Operating at 50 V and a baseplate temperature of 50°C, this transistor delivers approximately 10W of output power for >15 dB associated gain and a power added efficiency (PAE) >40 percent at a frequency of 1.7 GHz. The PAE performance was not optimised for the reliability test campaign, but with appropriate matching and a deep class AB quiescent bias point the typical PAE value easily exceeds 60 percent with the UMS GH50 process

hours, respectively, and fulfilling the final goal, M7, requires demonstration of device operation of at least 20 years at a junction temperature higher than 230 °C. In addition, the device must be resilient to space environmental effects, including radiation, hydrogen poisoning and electro-static discharge. This level of performance must be realised for both an L-band discrete power transistor and an X-band MMIC for the GH50 and GH25 foundry processes respectively. What's more, specific performance and manufacturing yield targets must be met at each milestone.

When the project kicked-off in 2008, engineers at UMS put together a technology development plan that defined the methodology for technology transfer within the consortium. This included a patent survey and the signature of an intellectual property agreement to allow exploitation of key results.

At the outset, a great deal of effort was devoted to establishing a common methodology for routine device assessment, reliability testing and the analysis and display of measurement data. To allow a fair and sensible cross-comparison of data, all mask sets featured common test structures, such as 1 mm gate-width RF transistors, process control monitoring structures and dedicated radiation test cells. All the partners within the consortium evaluate these structures consistently – this was confirmed to be the case with a 'round-robin' test campaign on an evaluation wafer. The multiple batches of epitaxial wafers that have been used for experimental processing trials within the consortium were grown by IAF and imec (see figure 3 for an example of the growth tools used by IAF). SiC and silicon substrates provided a foundation



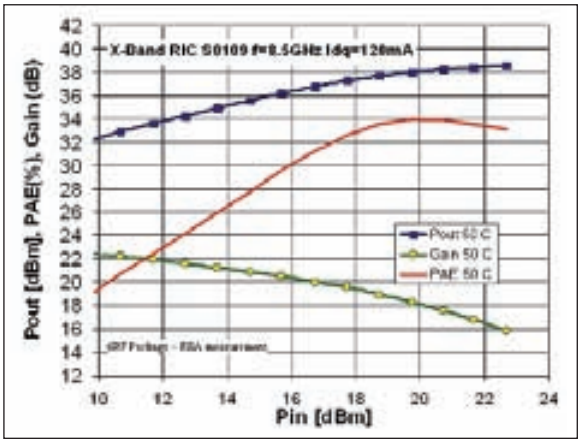


Figure 5: The X-band evaluation vehicle built for the M3 milestone is a two-stage MMIC. Operating at 30 V and a baseplate temperature of 50°C, this device delivers more than 6W of RF output power over the 8 to 8.5 GHz frequency band, with around 18 dB associated gain and a PAE of typically 30-40 percent depending upon the quiescent bias condition

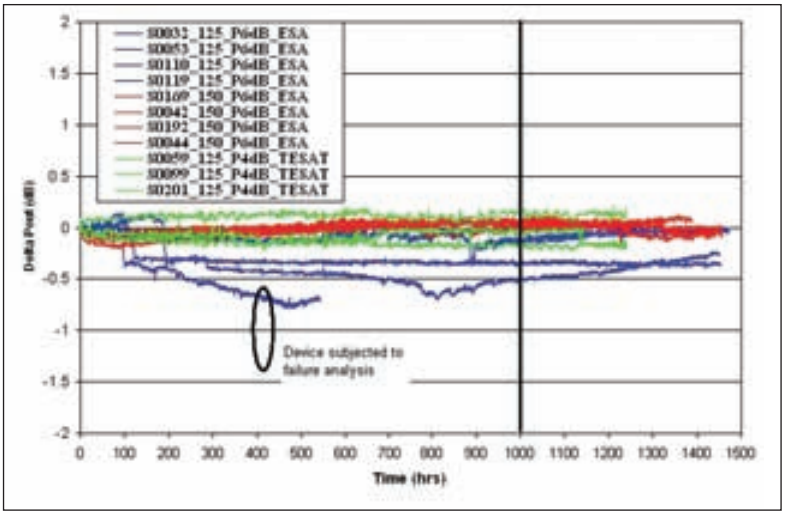


Figure 6: As part of the assessment for the M3 milestone, researchers studied the change in RF output power for 11 packaged L-Band test vehicles with a peak channel temperature of more than 230°C. Some of these devices were operating at 4 dB of gain compression (Tesat), and others at 6 dB of RF gain compression (ESA). Both devices were also assessed at two different baseplate temperatures – 125°C and 150°C. No burn-in or screening, other than electrical performance and assembly integrity test, has been performed before life testing

for these epiwafers, which featured intentional variations in AlGaN composition and GaN buffer structure and were fabricated with both *in-situ* and *ex-situ* nitride passivation. UMS, a firm with considerable manufacturing experience, provides feedback concerning the optimum choice of epitaxial structures and processing recipes to be considered.

By the end of 2010, two wafer-batch-processing trials had been successfully completed at FBH and imec, plus three wafer batch trials by Fraunhofer IAF. In addition, UMS had finished processing 30 wafers focusing on 'pre-process freeze' engineering variations of its GH50_10 production process and development trials on the GH25_10 production process dedicated to GREAT^2. In total, over 74 wafers had been fabricated and assessed, providing enough information to understand the impact of the epitaxial design on the reliability of the structures.

Initial processing batches were screened for DC, pulsed DC and RF performance, plus on-wafer reliability. Wafers delivering the most promising performance were diced and used to form packaged test samples that were evaluated by Tesat. Both the L-band HEMT and the X-band MMIC passed M3, the first critical milestone (see Figures 4 and 5 for details).

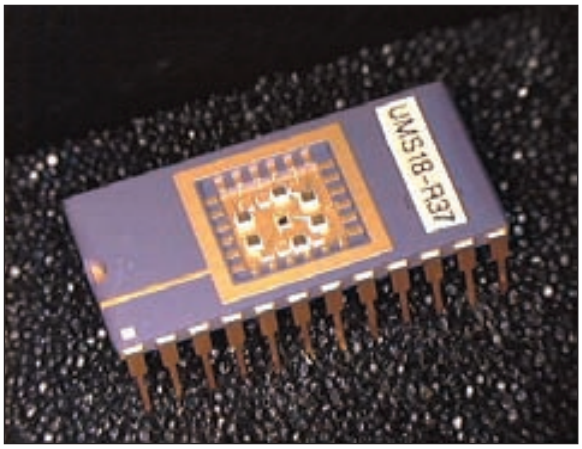
To assess the RF reliability criteria within the M3 milestone, the consortium assembled 68 L-Band and 67 X-band parts in hermetic packages and a further 64 test cells that were housed in DIL24 ceramic packages, specifically for performing radiation and hydrogen poisoning tests. UMS GH50 transistors and IAF GaN25 MMIC devices passed accelerated RF life tests carried out by Tesat in December 2010. Confirmation of reliability to 1000 hours of operation came from independent, internal testing at ESA.

In fact, tests on 11 packaged L-Band test vehicles show that, in general, the RF output power changes very little over 1400 hours of operation at a peak channel temperature in excess of 230°C. Ten devices had a maximum drift in RF output power of less than 0.5dB – just one showed rapid degradation at the start of the test. However, this particular device had been subjected to failure analysis to identify the physical changes occurring within the device and to better understand any underlying failure mechanisms. No burn-in or screening other than electrical performance and assembly integrity test has been performed before life testing.

The radiation tests that have been performed have scrutinized the impact on transistor performance following exposure from gamma radiation, total ionising dose, proton radiation (displacement damage) and single event burnout effects under heavy ions. In assessments made against the M3 milestone, which were carried out using the GREAT^2 radiation test cell (see figure 7), no devices from the batch underwent any appreciable DC parameter drift for a total ionising dose of 1Mrad and for a proton fluence of $1.7x10^{12}$ p/cm^2 (35 MeV proton energy). However, under heavy ion excitation (Xenon: LET_{GaN}=52.93 MeV/mg/cm^2) the open channel current and threshold voltage for UMS GH50 devices drifted by about 10 percent. This variation is still comfortably below the target drift specifications of less than 15 percent. Initial tests on devices fabricated with the UMS GH50 process revealed that DC static burnout occurred at 200 V, while under heavy ion excitation single event burnout typically occurred at 150 V. To verify these findings, the consortium will conduct further tests on multiple wafer batches. Further radiation test campaigns, planned for M5 and M7 milestones, will also scrutinize any changes to larger devices under both DC and RF operating conditions.

The first wafer batches have also been subjected to 24-hour hydrogen poisoning tests, which involve subjecting unbiased devices at 250°C to a mixture of 5 percent hydrogen gas and 95 percent nitrogen gas. These initial measurements indicate that performance is not particularly sensitive to this effect and will be further validated by incresing the hydrogen test exposure time to several hundred hours.

By December 2010, evaluation devices had passed all the tests related to the M3 milestone, an encouraging achievement that suggests there should be no major showstoppers for using GaN technology in space. That is not to say that lessons have not been learnt from this exercise. This programme of work has shown that controlling the strain in the epitaxial layers, appropriate tailoring of the electric field distribution close to the gate, appropriate choice of surface pre-treatments and



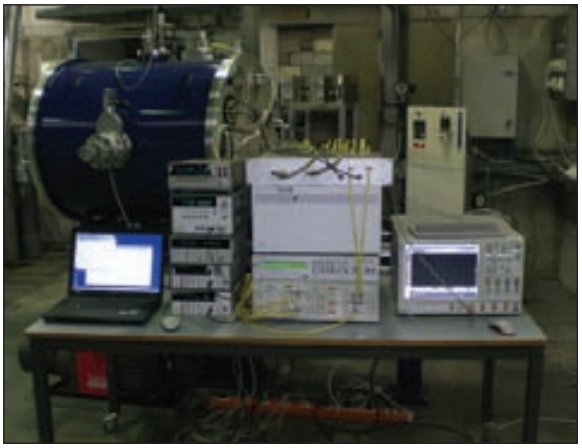


Figure 7: Packaged radiation test cell (left) and the heavy ion test set-up (right) at Lovain La Neuve, Belgium

choosing appropriate metallisation schemes to ensure gate thermal stability are all essential requirements to achieve high reliability, and modifications have been made accordingly to new process batches. The primary goal of these adjustments is further improvement in operating lifetime, while at the same time satisfying performance and manufacturing yield targets.

If these efforts are successful, they will play a big part in helping Europe's space industry to maintain its competitive edge. One of the big hopes behind the GREAT^2 initiative is that it will foster an independent GaN supply chain for space, while also being applicable to dual-use markets. Success on both these fronts promises to create sufficient volume demand to sustain European capability over the long term. However, this is not the only benefit of the GREAT^2 project. During the first year of this programme there has been an opportunity to demonstrate the use of the X-band test evaluation prototypes, fabricated by IAF, in an experimental X-band telemetry transmitter due to be launched in 2012 on PROBA V, ESA's small satellite for global vegetation mapping. Syrlinks is carrying out the transmitter design and fabrication, with spacecraft integration and test the responsibility of QinetiQ Space nv (see figure 8). This demonstration offers a unique opportunity to combine extensive test data that has been gathered on the ground with performance and test data achieved in a real-life, in-orbit operating environment. If successful this will be the first launch of European-sourced GaN technology, which will provide a fantastic feather in the cap of the GREAT^2 project.

Resources

An overview of GREAT2 project is given at http://www.esa.int/SPECIALS/Technology/SEMJ1X9BWUF_0.html

More information on the PROBA V can be found at http://www.esa.int/esaMI/Proba/SEM7QUYOBFG_0.html

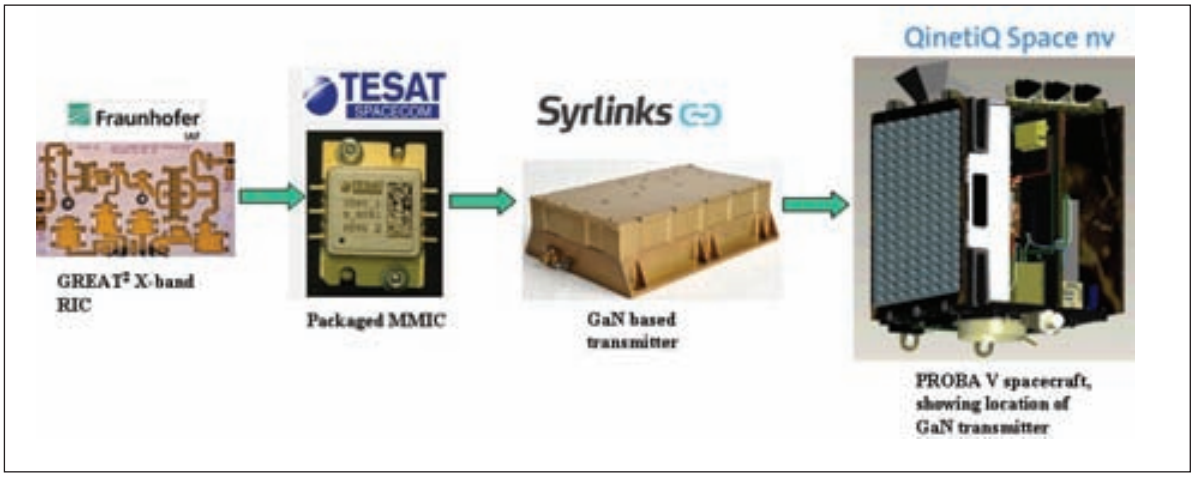
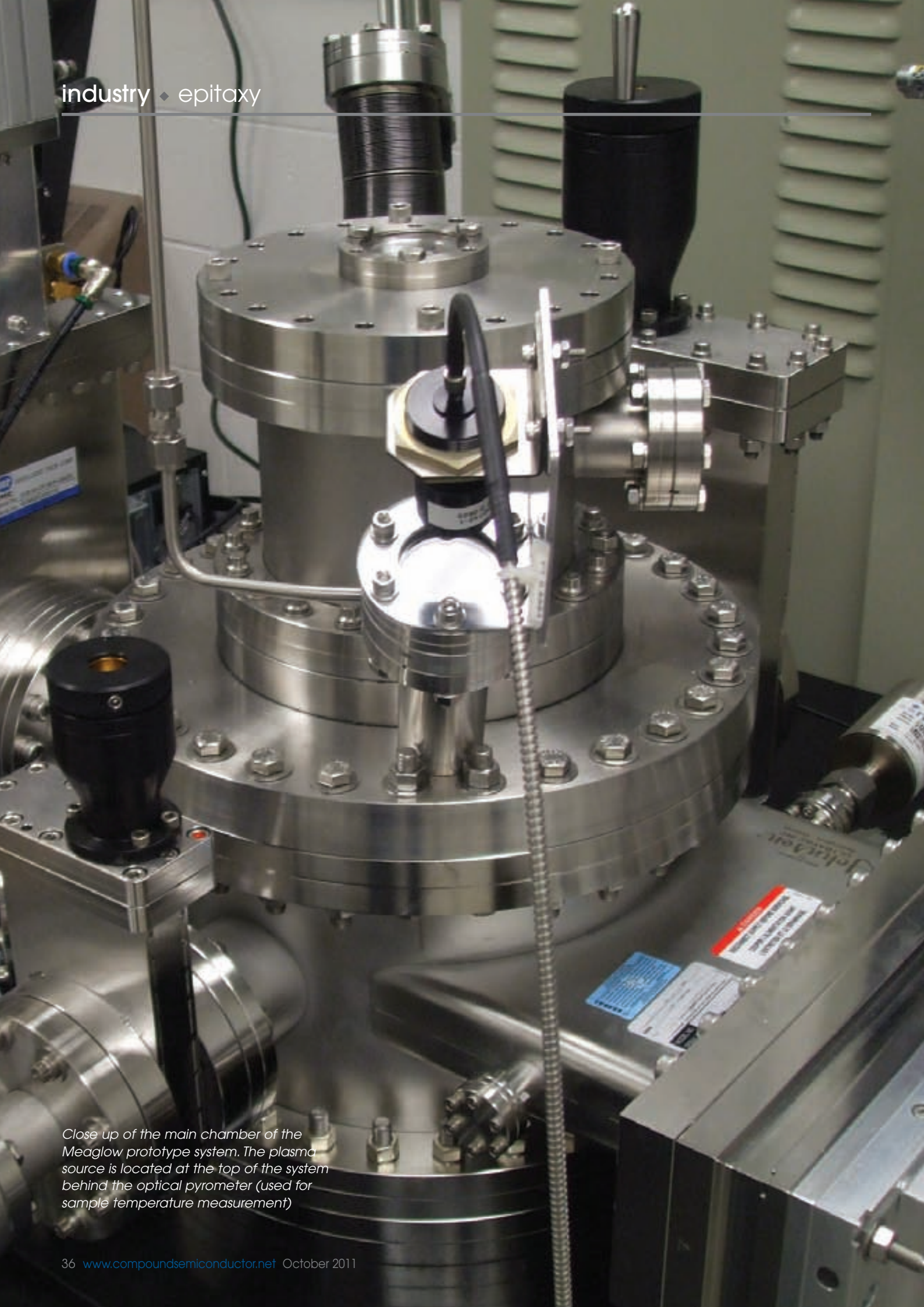
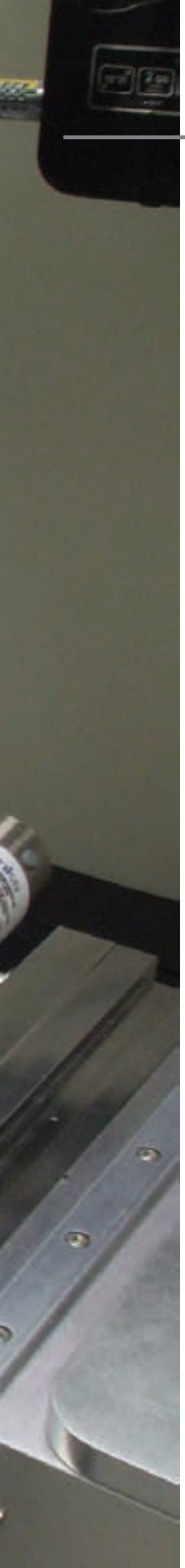


Figure 8: MMICs produced by Fraunhofer IAF are assembled into hermetic packages by Tesat, and finally incorporated into an X-band telemetry transistor that will be launched in 2012 on PROBA V, an ESA satellite for global vegetation mapping



Close up of the main chamber of the Meaglow prototype system. The plasma source is located at the top of the system behind the optical pyrometer (used for sample temperature measurement)



Slashing temperatures for nitride growth

Deposition of nitride epilayer stacks by MOCVD requires high temperatures and plenty of ammonia. But these downsides can be sidestepped with an alternative growth process called migration enhanced afterglow, which has been developed by Canadian start-up Meaglow. **Richard Stevenson reports.**

Sales of MOCVD tools have reached staggering levels. According to IMS Research, around 800 of these reactors were shipped in 2010, and this year the figure is forecast to be 4 percent higher. Many of these tools are heading to China, where they will be used to deposit epitaxial stacks of InGaN and GaN layers, which will form the key ingredient in billions and billions of LEDs.

From a commercial perspective, it is obvious that deposition of nitride layers – partly by chipmakers in China, but predominantly by LED makers in other parts of the world – is a great success. However, that does not mean that there is no room for improvement. The MOCVD growth technique has several downsides, including high temperatures needed for deposition of the nitride layers – typically around 1000 °C. This is a big issue: GaN-based LEDs are grown on silicon, sapphire or SiC, and high growth temperatures exacerbate epiwafer bow that is caused by differences in thermal expansion coefficients between the epilayers and substrate.

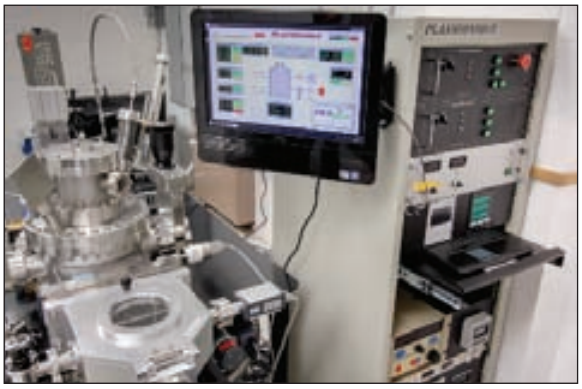
This is a particular challenge for leading chipmakers that are migrating to larger diameter substrates to make LED lighting more affordable, because as the epiwafer get bigger, distortion is more pronounced. Complex buffer layers incorporating strain management can combat bowing, but a more attractive solution is to simply grow the epilayers at lower temperatures.

Slashing growth temperature has other benefits too: A greater range of substrates is then available, including ZnO, which is temperature sensitive and closely lattice-matched to GaN; and it is also possible to grow indium-rich InGaN layers at lower growth temperatures. The latter advantage will help expand the spectral range of green LEDs, and also aid the development of other classes of device, such as higher mobility field effect transistors and solar cells covering the entire spectral range.

An alternative, well established deposition technique with the potential to grow nitride films at lower temperatures is MBE. If this is to follow in the footsteps of MOCVD, growth should predominantly be N-face GaN. However, when MBE is used to form layers of such films at low temperatures, they tend to have rough surfaces. That's because columnar poly-crystals form, which have pyramidal tops. Switching to the Ga-face – which is renowned for yielding better quality material that is suitable for the development of most GaN-based devices including LEDs and laser diodes – is problematic, because it is harder to deposit this class of material at low temperatures. It can be done, but MBE growth of Ga-face material has only been widely successful on MOCVD grown GaN templates, or on AlN buffer layers grown at higher temperatures. Direct growth of Ga-face material on nitrided sapphire is largely unheard of.

Fortunately, another growth option is now available – migration enhanced afterglow. This borrows some insights from MBE, but it is afundamentally different technology, combining far higher pressures of close to a Torr with a CVD-based plasma technique. Trailblazing this novel growth process is a spin-off of Lakehead University in Northwestern Ontario, Canada, called Meaglow. This start-up that was formed in late 2009 is now starting to commercialise its growth technique via a two-pronged approach: It is producing growth tools with low capital cost; and it has plans to offer epiwafer services for the growth of InN films later this year.

The current driving force behind the Thunder Bay start-up is Chief Scientist Scott Butcher, a veteran of InN film growth with a strong academic and industrial background: "We've been growing for 6 months with the prototype system, and large leaps are being made forward in these early days. However, we're still nowhere near reaching the limits of what it can do."



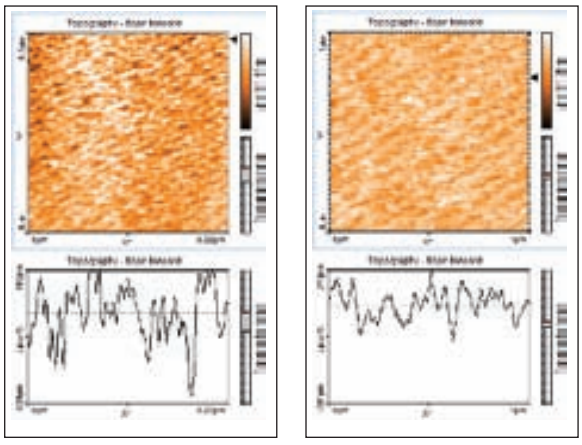
The stainless steel UHV growth chamber (left) and computerized electronic control system (right) of the prototype Meaglow reactor housed at Lakehead University

Butcher is willing to offer some insights into the pioneering deposition process. He explains that the high pressures associated with migration enhanced afterglow cause the high-energy plasma species, which are also present in MBE, to be largely converted into active species with lower energies. "High energy bombardment encourages N-face growth," adds Butcher. "By avoiding such conditions, using predominantly lower energy species, we have been able to grow Ga-face material at 630 °C directly on nitrided sapphire."

Examples of success to date include GaN and InN films with a very low surface roughness. Atomic force microscopy scans on a 200 nm-thick GaN film revealed a root-mean-square (RMS) surface roughness as low as 0.24 nm. "We've also seen atomic terracing for InN grown at 470 °C. This has a 0.10 nm RMS surface roughness." Crystal quality of both these films is very good, according to X-ray diffraction measurements. For the GaN film, engineers at Meaglow have recorded (0002) ω-2θ XRD reflections with a full-width half-maximum as low as 223 arcsec, and corresponding values for the InN layer of 290 arcsec.

Standing out from the crowd

Butcher's interest in low temperature nitride growth can be traced back to his days as a PhD student in the early 1990s when he worked in the group of the late Trevor Tansley from Sydney's Macquarie University, Australia. "When [Shuji] Nakamura first demonstrated his blue GaInN/GaN LEDs, huge resources from Japan, America and Europe were diverted into MOCVD growth of GaN," reminisces Butcher. "Trevor had the foresight not to try and compete with the larger groups overseas. Our group, who had been active in nitrides a good ten years before then, took a different route, concentrating on the low temperature growth of nitrides."



Above left: Migration enhanced overflow can form Ga-face GaN films with a thickness of 200 nm at 630 °C. Atomic force microscopy reveal that the root-mean-square surface roughness of this film is 0.23 nm. Molecular terraces can be distinguished in the image.

Above right: Atomic force microscopy reveals that the InN surface has a root-mean-square roughness of 0.1 nm and features molecular terraces

Working in partnership with colleagues Bing Zhou and Xin Li, Butcher constructed a low-temperature film growth system using laser-induced CVD (LICVD). This included a remote plasma microwave source that Butcher developed. "However, later on I dropped the laser system out of the development as the uniformity using LICVD was too problematic."

Butcher's career briefly headed into new directions: He worked for Pacific Solar (now CSG Solar AG) from 1995 until 1997, while he finished his PhD; and for two years after that he was employed by the Australian Nuclear Science and Technology Organisation. However, he was still an Honorary Research Associate at Macquarie University, and in 1999 he was able to return to full-time research at this institution, after his and Tansley's work caught the attention of Colin Wood from the US Office of Naval Research. Wood was able to fund Butcher's research.

During the middle of the last decade, Butcher started to think how it would be possible to exploit the low-temperature deposition technology developed at Macquarie University. This culminated in the launch of the spin-off BluGlass in 2005, a company that set itself the ambitious task of building optoelectronic devices not only on sapphire, but also on glass, an incredibly cheap substrate. According to recent announcements by Bluglass on the Australian Stock Exchange, its material's crystal quality still needs improvement.

As Bluglass made progress, the health of Butcher, the firm's Chief Technology Officer, went into decline – he was diagnosed with cancer. Although he received successful treatment in 2007 and 2008, he needed a year out to recover. And as he regained his strength, he started to mull over what he should do next. "I found that I wanted to get back to science and tackle some of the fundamental problems of low-temperature growth by developing a new technique that is a generation or two beyond what I was doing before." This dream has

become reality thanks to an opportunity through his friendship with the academic Dimiter Alexandrov from Lakehead University. Alexandrov offered Butcher a role at Meaglow.

Growth issues

Recently, Meaglow has been wrestling with approaches to improve the crystal quality of nitride material grown at low temperatures. One issue is the presence of impurities – dopants or otherwise. At concentrations above the solubility limit, these impurities lead to inclusions, extended defects, and, in extreme cases, crystalline boundaries. Of all the impurities, oxygen is the biggest concern with plasma-based deposition. The main source of oxygen contamination is from the dielectric windows typically used for both microwave plasma sources and RF induction plasma sources, which can be addressed with a routine of passivation that can take up to three days after opening the system to air. However, Meaglow has learnt to sidestep these issues by developing a high-density plasma source that does not use a dielectric window and is scalable to very large areas.

The Canadian outfit has also overcome a more fundamental challenge. Reducing growth temperature slashes the surface mobility of the gallium atoms, which drop to a fraction of that associated with MOCVD growth temperatures. Ideally, these atoms must diffuse far enough to reach the end of an atomic terrace before combining with nitrogen in order to realize two-dimensional epitaxial growth. “If the surface mobility is too low, and the time to form a GaN molecule is too short, the diffusion length of the gallium atoms may be well short of this distance,” explains Butcher. “Three dimensional growth then dominates and polycrystalline N-face material is formed.”

It is not possible to overcome this limitation with conventional crystal growth methodologies, unless unreasonably slow growth rates are employed. “However, physics let’s you cheat this process,” says Butcher, who explains that the trick to overcome this problem has its roots in migration enhanced epitaxy methods developed for MBE. “The idea is to saturate the surface of the substrate with a pulse of so much metal that it’s basically everywhere on the surface, while maintaining at most a low flux of active nitrogen.” The metal is then slowly consumed after the metal pulse is ended by the plasma species introduced during the growth. “However, there is enough time for the gallium atoms to find energetically favourable lattice positions that allow two dimensional growth to proceed,” adds Butcher. A series of such pulses can build up a film of desired thickness. Butcher points out that this form of epitaxy has been around for several years, but was traditionally much slower than normal film growth. “Recent advances have overcome this limitation and Meaglow has taken advantage of that in its new film growth system.”

Metalorganic vapour delivery system used for the Meaglow reactor. Operating at close to 1 Torr carrier gases are not required for most metalorganics - greatly simplifying the vapour delivery system compared to MOCVD

The company is now looking to win sales for these tools and develop its epiwafer services. The strengths of the novel reactor are not just its ability to grow InN and GaN films at low temperatures: Running costs are low, because the deposition process is free from ammonia; and it is relatively easy to control the diffusion length of gallium atoms, which hold the key to the growth of nanostructures such as quantum dots and nanowires. The Thunder Bay start-up is also demonstrating and refining its technology via a prototype tool housed at Lakehead University, and it has a research contract with its alumni to develop the migration enhanced afterglow technology for high-speed FETs, and other device applications. Continued efforts will help to develop a commercial, alternative technology to the well-established MOCVD process, which has weaknesses that growth by migration enhanced afterglow addresses.

A wide view of the prototype Meaglow reactor, showing the UHV central growth chamber with load lock, RGA and RHEED analysis chamber, MO delivery system (on left), control electronics (on right)

Scaling sapphire underpins the solid-state lighting revolution

Flat, stress-free substrates with great surface quality will help to drive mass adoption of solid-state lighting. Such platforms reduce the impact of edge effects, allow the MOCVD deposition process to run more efficiently and ultimately cut the cost of LED chips, says **Rubicon's Raja Parvez.**

Consumer demand for energy-efficient, environmentally safe lighting will help to drive a solid-state lighting revolution. The US market research firm Strategies Unlimited predicts that LED lighting will grow from $5 billion in 2010 to $20 billion in 2015, and then continue at a compound annual growth rate of 33 percent. By 2020 this market has the potential to consume more than 100 billion LEDs, according to Jed Dorsheimer from the financial firm Canaccord Genuity.

This tremendous growth in the deployment of solid-state lighting will be underpinned by a shift to larger diameter sapphire substrates. Large wafers are essential to accommodate the increasing LED chip size while maintaining high chip yield over the wafer surface. Moving to these larger substrates is not just a challenge for sapphire substrate makers – it also impacts the entire LED supply chain, which must scale up its operations to meet the growing demand for lower-cost chips.

Rubicon's sapphire growth process produces boules that can be processed into a wide variety of wafer sizes

Economies of scale

Many leading LED chip manufacturers have already moved from 2-inch to 4-inch substrates, and they are now announcing their intentions to migrate to 6-inch. The benefit of this move – and what is possible by moving to even larger sizes – is illustrated in Table 1.

One benefit of turning to bigger wafers is that more LED chips can fit along the outer perimeter due to reduced curvature, especially for larger high-brightness chips. This so-called 'edge-effect' provides incrementally more chips than just a raw calculation of geometrical area. For example, the surface area of a 6-inch wafer is nine times that of a 2-inch wafer, but it can yield between ten and twelve times as many chips.

Switching to growth on larger substrates also leads to more efficient film deposition. That's because large diameter wafers provides more efficient utilization of useable surface area in the MOCVD reactor, thereby increasing chip productivity. According to a recent study by the German tool-maker Aixtron, if a platter in an MOCVD tool is filled with seven 6-inch substrates rather than 42 substrates that are 2-inch in diameter, throughput increases by 52 percent. These significant gains in cost reduction mirror the savings made in the silicon industry as it has scaled production to larger and larger wafers.

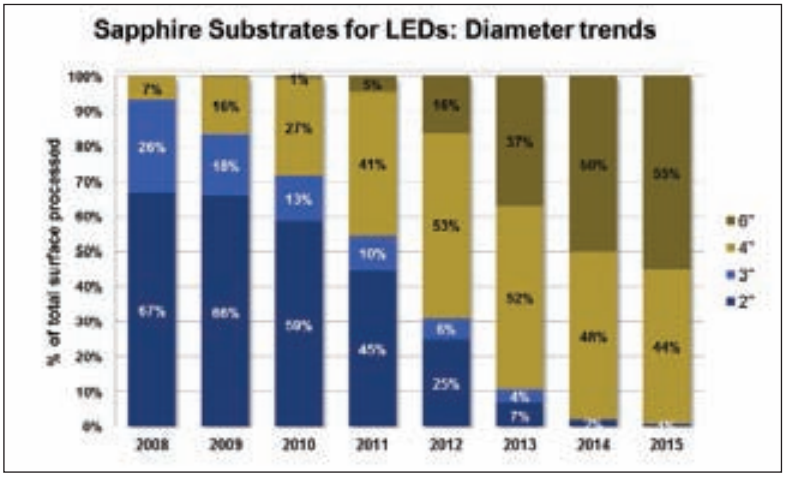
An additional incentive for moving to larger wafers is the existing legacy equipment and expertise with large wafers. Many LED companies have a heritage in the optoelectronics or semiconductor industries, and are already possess large diameter equipment and process expertise for 6- and 8-inch LED production. What's more, they understand the logistical issues involved in migration to large diameter wafers.

Meeting the needs

From the perspective of a sapphire substrate maker, increasing wafer size is not trivial. LED makers need substrates that are flat, uniformly polished, and have a surface free from contamination. Meeting these tight product specifications becomes increasingly difficult with larger substrate sizes.

Another key requirement made by LED manufacturers is for the sapphire substrates to be stress-free. During the MOCVD process these wafers are subjected to temperature cycles of up to 1200° C, which can introduce stress and ultimately lead to small cracks.

At Rubicon, headquartered in Bensenville, IL, we have developed proprietary crystallization and wafer processing technologies to produce stress-free crystals in an unconstrained environment most mimicking nature. We use this unconstrained process to manufacture 6-inch wafers that not only meet industry requirements, but exceed them. What's more, our wafers offer an excellent surface for MOCVD growth, thanks to our expertise in both equipment customisation and polishing process development. Such efforts are needed, because slicing, lapping and polishing this material is not easy – sapphire is the second hardest naturally occurring material on earth after diamond, and cutting and polishing it requires specialized equipment and process expertise.



According to analysis by Yole Developpé-ment, 6-inch sapphire will provide the foundation for the majority of LED chips by the middle of this decade

We are able to produce our substrates in high volume, and the variation between them is minimal. This is a major asset for LED makers, who can only turn in a profit if they can churn out wafers with very small variations in properties such as emission wavelength and brightness. Delivering on these fronts means that the wafer yields a high proportion of LEDs that meet their key specs, such as those for colour and efficacy.

How large can we go?

The key to producing high-quality, large diameter wafers is an end-to-end stable process that starts with crystal growth and goes right through to wafer polishing. It is impossible to make such wafers without a high-quality, single sapphire crystal boule. We, along with some of our competitors, are well placed in this regard because we are vertically integrated. This means that we can ensure quality from the raw material, aluminium oxide,

Wafer Size	Surface Area	# LED Chips
2 inch	S	N
4 inch	4 S	4.5 N ~ 5 N
6 inch	9 S	10 N ~ 12 N
8 Inch	16 S	20 N ~ 22 N
12 Inch	36 S	45 N ~ 50 N

Thanks to edge effects, a four-fold increase in wafer diameter that results from a doubling of substrate diameter increases chip production quantities by up to a factor of five. Numbers are estimated, based on typical dimensions for a high-brightness chip

To date, we have shipped 100,000 wafers with a 6-inch diameter that have formed the foundation for the manufacture of 2 billion LED chips. And we are well positioned to increase these shipments , thanks to the construction of our new Batavia, IL, facility that focuses on crystal growth, and the new facilty in Malaysia that focuses on the polishing of large diameter wafers in high volume. The latter was recently qualified by a major customer for 6-inch sapphire wafers

to finished polished wafers in a controlled manner. One of our biggest accomplishments is the fabrication of the world's largest single-crystal sapphire boules, which can be as large as 200 kg, with no variation of quality as the boule size increases. Our process expertise has enabled us to reach volume production of high-quality 6-inch diameter sapphire wafers and R&D volumes of 8-inch diameter sapphire wafers. According to the French market research firm Yole Developpément, the proportion of LEDs made on sapphire substrates that are 6-inch in diameter will increase from 5 percent this year to 16 percent in 2012 and more than 55 percent in 2015. Sampling of 8-inch wafers at the research and development stage has also commenced at several LED chipmakers.

Weighing in at 200 kg, Rubicon's single-crystal sapphire boule is claim to be the largest in the world

Alternative substrates

The industry continues to explore alternative substrates for the growth of GaN LEDs, such as those made from silicon, which are cheaper. Progress has been made, but devices grown on this platform still have a performance that lags that of GaN-on-sapphire LEDs.

One of the challenges that the R&D community has struggled with for more than a decade is the fundamental barriers imposed by the large mismatch in the thermal coefficient of expansion of GaN and silicon. In addition, there is intermixing between this pair of materials during MOCVD growth. This introduces a multitude of crystal defects, leading to physical cracking of the epitaxial layers. One consequence of this is a compromise in the long-term reliability of LED lamps.

In comparison, GaN-on-sapphire LEDs are proven in the industry, thanks to field-demonstrated, long operating service life (long-term reliability). During the last two decades, billions of these LED chips been successfully tested in multiple applications. This has led the industry to recognize sapphire as the only commercially viable, 'field proven' substrate for LEDs. At this time, more than 80 percent of LEDs are built on a sapphire foundation.

More and more of these LEDs are going into general illumination, but this technology will not dominate until the cost of ownership of this form of lighting is competitive with today's incumbent, the compact fluorescent bulb. According to Dorsheimer, LEDs account for 40 percent of the bill of materials for LED light bulb. Chips costs will fall as LED makers move to larger diameters that aid operational efficiency and yield, and this will spur affordability of LED bulbs.

We believe that this growth in solid-state lighting is a tremendous opportunity for every sapphire manufacturer. Our recent completion of two state-of-the-art manufacturing facilities that deliver large diameter sapphire wafers in high volume to customers puts us in a great position to dominate the sapphire market.

To date, we have shipped 100,000 wafers with a 6-inch diameter that have formed the foundation for the manufacturer of 2 billion LED chips. And we are well positioned to increase these shipments, thanks to the construction of our new Batavia, IL, facility that focuses on crystal growth, and the new facility in Malaysia that focuses on polishing large diameter wafers in high volume.

This latter facility was recently qualified by a major customer for 6-inch sapphire wafers, the diameter that will be used to drive significant penetration of LED bulbs in the lighting market.

Slashing epi costs for a lighting revolution

LED light bulbs will only catch on when their prices plummet. Various measures can help to realise this, including turning to growth on the Crius II-L, an MOCVD tool that sets new benchmarks for throughput, epiwafer uniformity and efficiency of gas and precursor consumption, says **Aixtron's Rainer Beccard.**

With some devices, the euphoria of their invention is followed by a lengthy period of figuring out what to do with this new contraption. But when the white LED was invented in the 1990s, that was certainly not the case. It's killer application was abundantly obvious from its very inception – solid-state lighting.

Tapping into this lucrative market was not a foregone conclusion and would hinge on tremendous reductions in device manufacturing costs. Great strides continue to be made in this direction, with costs falling by typically 90 percent per decade. And hand-in-hand with this progress, the LED's efficiency, in terms of its lumens per Watt, has increased at a similar rate.

Given these rapid gains in affordability and efficacy, it would be easy to think that nothing now stands in the way of a solid-state lighting revolution. After all, LEDs already exceed the magical 100 lm/W threshold, making them at least as efficient as compact fluorescent bulbs. What's more, LED-based replacement lamps with standard sockets are now widely available in many parts of the world, with sales in some countries aided by legislation to phase out incandescents. And if sales do take off really rapidly, the supply chain will be able to cater for this hike in demand, because LED manufacturers have already ramped up their production capacities to accommodate for this eventuality. But there is still one crucial issue that must be addressed – cost.

Even though a few LED light bulbs have been offered in Asia at extremely attractive prices, the average 60 W equivalent LED light bulb retails today for $30 to $40, far more than most people are willing to pay.

Breaking down costs

Although the cost of LED plays a major role in determining the price of an LED bulb or luminaire, other factors also come in to play. According to the solid-state lighting roadmap published by the US Department of Energy this July, half the cost of the luminaire is related to the packaged LED, with the remainder dictated by the optics, mechanical and thermal assembly and driver electronics.

Costs relating to the packaged LED can be sub-divided into those associated with substrates, wafer processing, phosphors, packaging and last but not least, epitaxy. This growth process is not the largest contributor to the overall cost; however, in 2010 epitaxy still accounted for one-fifth of the LED costs.

Given the strong track record in cost reduction that stretches back more than a decade, it is widely expected that the packaged LED will get far, far cheaper. For example, the Department of Energy predicts that prices will fall by more than 90 percent in the next ten years. But if that is to happen, costs associated with epitaxy must also fall tenfold (see Figure 1).

Slashing epitaxial cost by another order of magnitude within a decade is a tall order. To uncover the solutions to make this possible, it makes sense to begin by understanding how previous cost improvements were realised.

During the first 15 years of LED manufacture, the biggest drivers behind reductions in epitaxial costs were increases in MOCVD tool throughout and productivity. At Aixtron, which is the world's largest manufacturer of MOCVD systems, we have led the way, launching new production platforms offering much larger wafer throughput than their predecessors every three-to-four years. For example, this progression has occurred in our Close Couple Showerhead (CCS) range of reactors. This began with a 3 x 2-inch R&D platform that was launched in 1996; a far more recent model, the Crius II, can accommodate either 55 x 2-inch or 13 x 4-inch wafers. This large capacity makes the tool a popular choice for today's LED manufacturers that are looking to expand capacity.

The bad news is that it is not possible to simply extrapolate historical cost and productivity improvements into the future. That's because many factors influence the running cost of an MOCVD tool: Wafer capacity, growth rates, uptime, degree of automation, reproducibility and yield. Although all of these have already been used by MOCVD manufacturers to improve productivity, further gains will be possible by optimising many of these factors simultaneously.

This is a long-term goal, and it is not reflected in the activities of the LED industry, which has experienced rapid growth over the last two years and delivered a tremendous hike in the performance of LED products. This acceleration, along with the tail wind it has created, has led us to embark upon a quest to uncover the fastest, most effective solution for cost reduction.

We began by making a detailed analysis of the total cost of ownership (TCO), carried out with a home-built model that we have refined over many years. This model – which has been validated by our customers, who are impressed with its accuracy at predicting costs – calculates throughput and accounts for the reactor type, its wafer capacity, growth times, non-growth times and uptime. Also included in this model are realistic LED structures and processes, plus typical yield figures.

This model considers a wide variety of costs: depreciation; chemicals, including carrier gases, metal organics and ammonia; consumables, such as those related to hardware, and also spare parts; labour costs for operators and supervisors; and fab costs, for both the cleanroom and the facility. This model distinguishes between costs governed by the reactor chamber, which is considered to be the core part of the MOCVD system – these are depreciation, chemicals and consumables – and those that are related to the MOCVD platform, which are not directly related to the reactor and include fab and labour costs.

The key finding of this TCO analysis is that reactor-related costs account for more than 90 percent of overall costs (see Figure 2). In other words, attempts to significantly cut costs under the current circumstances must focus on the reactor design. Although changes to the MOCVD platform or periphery can deliver savings, the potential for driving down costs is far smaller.

Reactor design considerations

Based on these conclusions, our development team has focused on reactor improvements that will reduce epitaxy cost in the short term. However, this was not our only goal. One of the great strengths of our Crius tools is their incredibly high level of stability – this is a major aid to process engineers, who don't have to keep tweaking their recipes from one run to the next. We decided that it was unacceptable to compromise this stability and reproducibility, and if it could be improved, so much the better.

Finally, and possibly the most important condition of all, we decided that we had to be able to guarantee a seamless process transfer from the CRIUS II reactor to its successor. To meet all these requirements, we selected an evolutionary approach that resulted in the development of the enlarged CRIUS II-L reactor.

This MOCVD tool can accommodate many wafer sizes: 69 x 2-inch, 16 x 4-inch, 7 x 6-inch or 3 x 8-inch (see Figure 3). Switching between these sizes is simple – it just requires an exchange of the susceptor plate. No adjustments to the process are needed.

Scaling up the process for the Crius II-L reactor is just as straightforward as it was for migrating between previous Close Coupled Showerhead reactor generations. All the gas flows can be scaled up by the same amount because the major geometrical and mechanical parameters are unchanged and only the susceptor and showerhead diameter have increased. The area of the new susceptor is 9 percent bigger than its predecessor, so gas flow rates for carrier gases, ammonia and group III alkyls must be increased by that amount. However, thanks to gains in the susceptor fill factor, 25 percent more wafer area is utilized, translating into a reduction in metal organic and ammonia consumption by 13 percent, and ultimately a significant cut in LED manufacturing costs.

Crius reactors are renowned for excellent levels of uniformity that hold the key to impressive yields. This uniformity stems from the combination of homogeneous gas injection through the proprietary showerhead and a unique heating system design that provides extremely uniform temperature distribution. It is imperative that these foundations underpinning the success of the Crius feature in the II-L, so special care was taken to design a heater delivering the required level of temperature uniformity across the entire growth area.

Wavelength uniformity of epiwafers produced on the II-L showcases the success of these efforts. In runs using a full load of 2-inch wafers, the typical wavelength uniformity for epiwafers with a peak emission of 460 nm

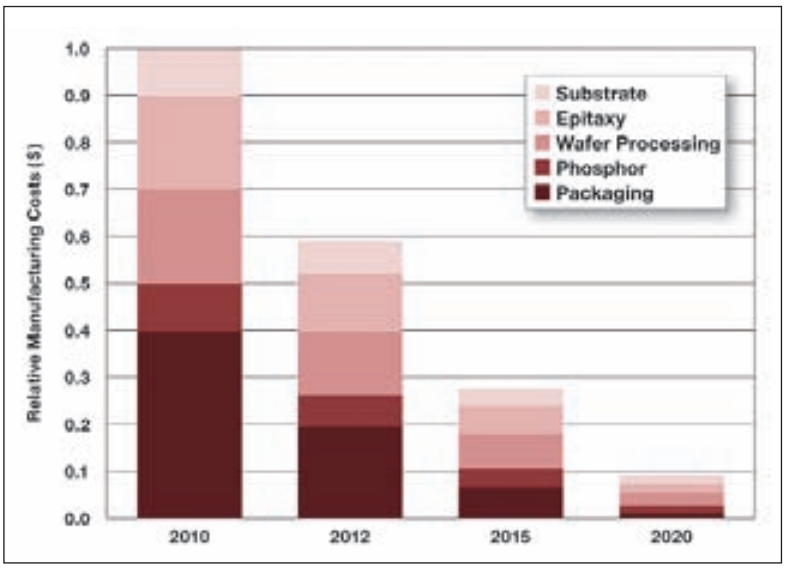


Fig. 1: Cost reduction roadmap for packaged LEDs (Courtesy of the United States Department Of Energy's Office of Energy Efficiency and Renewable Energy)

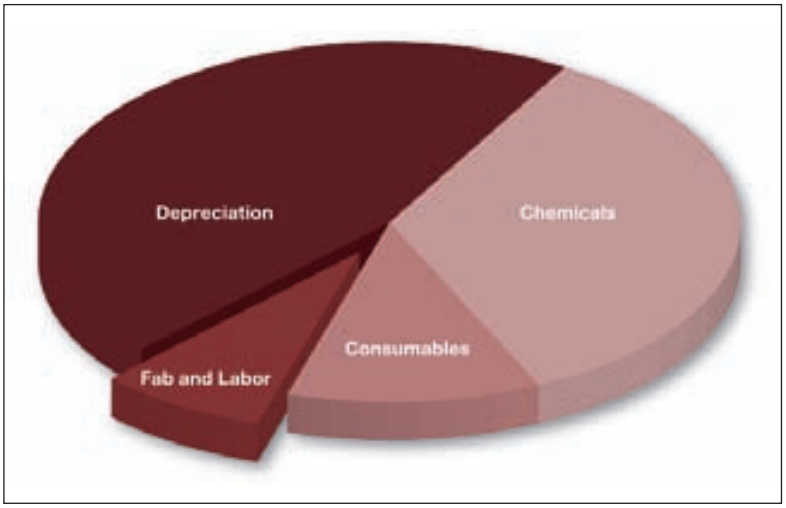


Fig. 2: Total cost of ownership breakdown for a GaN LED MOCVD system. Reactor related costs account for more than 90 percent of the total cost

was just 0.9 nm, in terms of the standard deviation (2 mm edge excluded). Variations in wavelength between all 69 wafers can be as low as 3.1 nm.

Similarly impressive results are obtained for a full 16 x 4-inch reactor load: 1.3 nm uniformity on each wafer and an absolute wavelength range of just 2.1 nm for all 16 wafers (see Figure 4). Values from epitaxial yield can be calculated from the uniformity figures, and indicate that

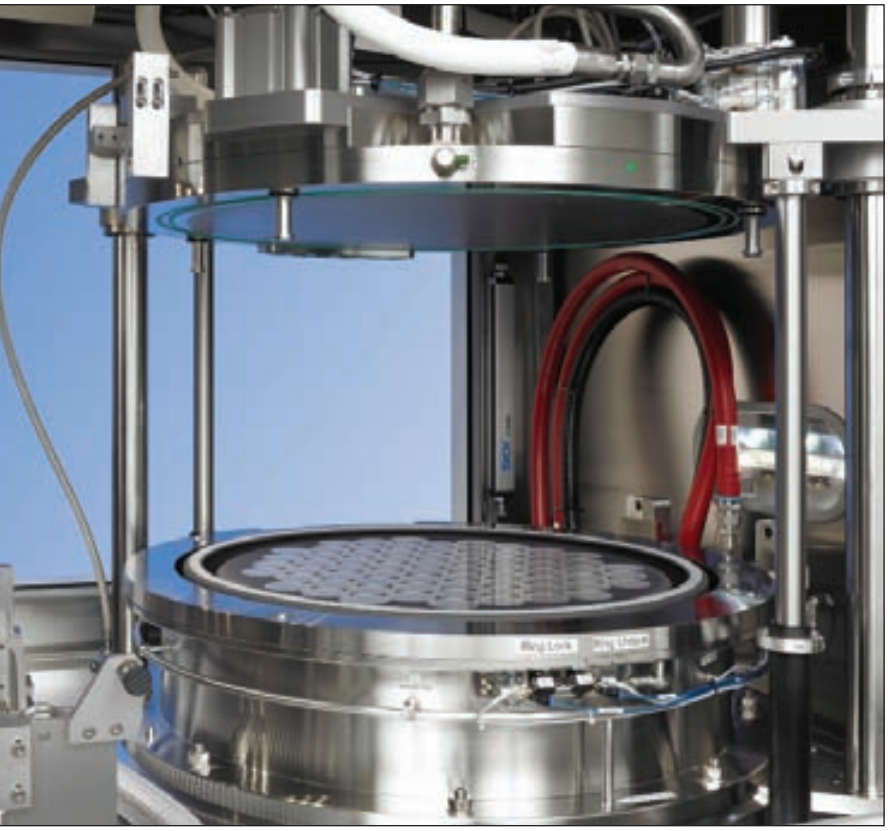


Fig. 3: CRIUS II-L reactor in 69 x 2-inch configuration

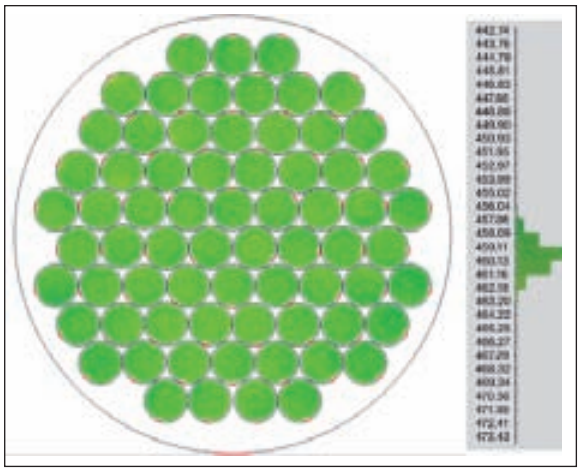
more than 95 percent of the wafer can be processed into devices differing in peak emission wavelength by 5 nm or less.

In addition to very high levels of uniformity that enable high yields, we decided that our Crius II-L reactor must allow measurement of the most important MOCVD parameter of all – the temperature distribution across all wafers. So we include an Argus wafer-temperature-mapping device in every Crius II-L system. Armed with this tool, engineers can monitor the temperature distribution on each single wafer, compare the temperature between wafers within in a reactor load, and also scrutinize differences between growth runs and even variations between different reactors.

The Argus tool made its debut on earlier generations of the Crius range, but it is now available in a larger version that is compatible with the II-L susceptor size. This *in-situ* monitoring tool features a line of photo diodes. Ech of these determines temperature by detecting thermal radiation emitted by the wafers during epi-growth. No viewport is required, thanks to optical access to the wafer carrier via the small openings in the showerhead that are primarily used to inject reactive gases into the growth chamber. The rotation of the wafers during growth allows for scanning of the entire wafer area, which yields temperature distribution for the whole wafer load.

Our introduction of the Crius II-L represents another milestone along the path of ever-greater productivity. Additional gains will come as LED chipmakers move to larger wafers, a transition that our latest tool caters for. As time goes forward, our reactor chamber will continue to be refined, hand-in-hand with the development of the platform and its periphery. Metrology will advance too, driving improvements in yield and throughput.

Fab integration will also play a more important role; functionality of current manufacturing execution system interfaces, which are a standard option for Crius systems today, will be enhanced by advanced process control systems. What's more, automation solutions will be included whenever they can to provide substantial improvements in productivity and performance. Each of these advances on its own will help to drive down the costs of LEDs, and working together these efforts will usher in an era of widespread adoption of solid-state lighting.



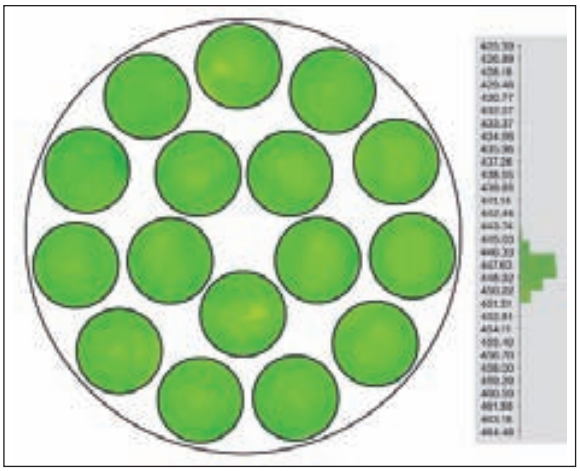


Fig. 4: PL wavelength uniformity plots of full wafer loads in a CRIUS II-L reactor. Left: 69 x 2-inch configuration; right: 16 x 4-inch configuration

Simplifying blue RCLED fabrication

Optimised laser-lift-off eases the fabrication of high-quality, blue RCLEDs

CHINESE researchers have built high-quality, blue-emitting, resonant-cavity (RC) LEDs with a relatively simple two-step substrate transfer technique.

This team's efforts shows how to avoid the complex processing techniques that have previously hampered fabrication of blue RCLEDs, which are promising sources for printers and displays.

"RCLEDs offer a number of advantages over conventional LEDs, such as improved directionality, spectral purity, spectral stability and enhanced output power," explains corresponding author Bao-ping Zhang from Xiamen University. For example, the superior directionality of the emitted light from the RCLED enables an increase in the dots-per-inch capability of printers and scanners.

Fabricating blue RCLEDs with the approach used to make their GaAs-based, red-emitting cousins is very tricky, because in this case the pairing of materials needed to make the mirrors – GaN and AlGaN – differ very little in refractive index, but have substantially different lattice constants.

Back in 2000 a team from Brown University and Agilent Technologies reported how to overcome this issue with two dielectric mirrors – these can be added with a series of processing steps involving electrodeposition, bonding and laser lift-off. However, processing is complex, due to difficulties associated with bonding, the need to dry etch the silicon-doped GaN layer to form the n-contact, and realising a sufficiently smooth GaN surface by polishing to allow high-quality deposition of the top mirror.

Through the development of a high-quality laser lift-off process, the Chinese team avoids many of these issues. They have devoted tremendous effort to finding a high-strength adhesive with a low curing temperature and worked hard to realise a uniform energy distribution of the spot size through optimisation of the energy density of the laser, its spot size and the scanning speed. "AFM scans indicate a root-mean-square surface roughness of about a few nanometers," says Zhang.

The 461 nm RCLED produced by the team has a turn-on voltage of 3.3 V and produces a 0.3 nm emission line width at a current density of 2 kA cm^{-2}. Zhang says that the performance of this device compares favourably to that produced by the US team more than a decade ago: "Our device exhibits a lower voltage due to the good ohmic contact between indium tin oxide and p-GaN, and a higher 'Q-factor' was obtained."

Improving RCLED efficiency is the team's next goal. "A green RCLED will also be fabricated because it is an excellent light source for PMMA-based plastic optical fibre communication. However, to fabricate a blue VCSEL is our main target."

X. -L. Hu *et. al.* Electron. Lett. **47** 986 (2011)

Submerged microscopic voids increase LED output

Cortex-like patterning of sapphire boosts the brightness of blue LEDs through improvements in material quality and extraction efficiency

A PAIR of Taiwanese researchers has shown that non-periodic, nanosacle patterning of sapphire can dramatically increase the output power of blue LEDs.

Devices fabricated on this foundation by Yu-Sheng Lin and Andrew Yeh from National Tsing Hua University, Hsinchu, produce a peak external quantum efficiency above 60 percent, roughly three times that of the control sample.

The patterning process pioneered by Lin and Yeh creates cortex-like nanostructures with a morphology similar to cortex in human brains. "Typical nanostructures for LEDs include nanopillars, nanoholes and nano-lenses – nano-patterns well-arranged in a certain way," says Yeh. "We report that semi-random patterns could yield better performance with lower cost."

Brighter LEDs result from a combination of a cut in nitride epilayer defect density by one-to-two orders of magnitude and a hike in light extraction efficiency that stems from the creation of voids near the sapphire-GaN interface. These voids reduce internal reflections.

Nanopatterning of the substrate involves: Depositing a 2 μm-thick layer of polysilicon on 2-inch sapphire by low-pressure CVD; etching this layer for 30 minutes in Wright solution to form a hard mask; vertically etching into sapphire with an inductively coupled plasma for 10 minutes, using a BCl_3/ Cl_2 mix; and finally removing the hard mask with a hot potassium hydroxide solution (see Figure 1).

MOCVD formed a GaN buffer layer on this patterned sapphire, which features 80-150 nm nanostructures typically spaced 5-150 nm apart, according to atomic force microscopy (see Figure 2). The pit density of the nitride film is just 10^7 – 10^8 cm^{-2}.

On top of this buffer layer the researchers deposited LED structures with a five period InGaN/GaN active region and a 30 nm-thick electron-blocking layer constructed from a magnesium-doped GaN and AlN superlattice. This growth was repeated on a conventional sapphire substrate that acted as a control.

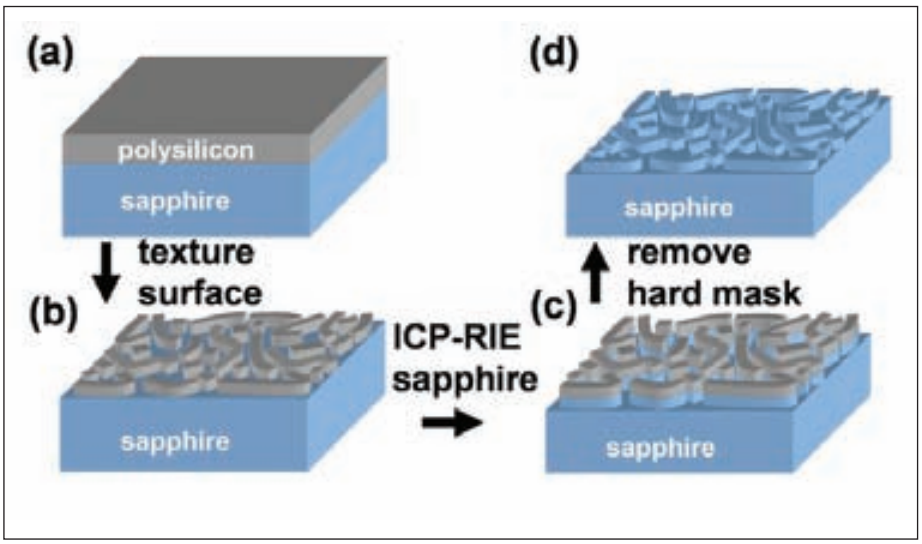


Figure 1. The four-step process for fabrication of nano-patterned sapphire with cortex-like nanostructures involves: (a) depositing polysilicon on sapphire (b) wet-etching this film (c) creating nano-patterns in sapphire with inductively coupled plasma, reactive-ion etching (d) removing the hard mask in a potassium hydroxide solution at 80 °C.

Wafer-level measurements reveal that cortex-like patterning increases the output power at 20 mA from 13.9 mW to 33.1 mW. "Commercial products manufactured on sapphire substrates [typically] fall between 20 mW and 25 mW," explains Yeh.

One weakness of the LEDs grown on nano-patterned sapphire is greater susceptibility to droop. Crank up the drive current to 160 mA and the standard and novel LED architectures produce 100 mW and 160 mW, respectively. Yeh says that he and his co-worker will continue to pursue the development of devices with higher efficiency. In addition, they will develop non-polar GaN epilayers for LEDs.

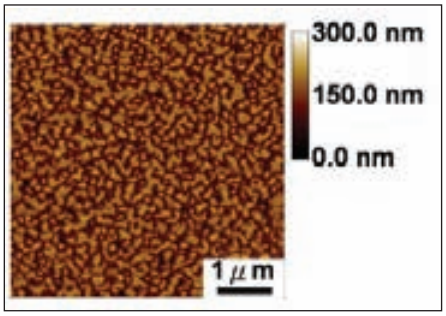


Figure 2. Atomic force microscopy reveals the non-periodic pattern formed in sapphire

Y.-S. Lin *et. al.* Appl. Phys. Express **4** 092103 (2011)

Polarity ups UV power

Polarity control layer spurs deep UV LEDs to record-breaking external quantum efficiencies

A JAPANESE TEAM has raised the bar for the output of ultraviolet LEDs operating in the short-wave band. Such devices, which have wavelengths below 280 nm, could serve many applications, including air and water purification, surface disinfection, UV curing and medical phototherapy.

Driven in continuous-wave mode at 60 mA, the 266 nm UV LEDs produced by engineers from UV Craftory, Meijo University and Nagoya University deliver an output power of 5.3 mW at an external quantum efficiency (EQE) of 1.9 percent. When the emission wavelength is increased to 278 nm, an output power of 8.4 mW at an EQE of 3.4 percent is realised at the same drive current.

According to lead-author Myunghee Kim from UV Craftory, these LEDs set a new benchmark for performance in this spectral range – up until now, state-of-the-art results were an output of 2.7 mW at 273 nm for an LED driven continuously at 700 mA. This equates to an EQE of just 0.04 percent.

Kim says that the key to the team's success was the polarity-controlled layer beneath the lateral epitaxial overgrowth. This enabled growth of AlN films with very low defect densities.

UV LED fabrication began by etching 2 μm-wide stripes with a 10 μm period into sapphire with inductively coupled, plasma-assisted reactive ions. MOCVD with a low III-V ratio formed 0.5 μm-thick AlN films with Al polarity, before the additional growth of 8 μm of AlN created a crack-free, smooth surface, indicative of good coalescence.

Cross-sectional microscopy of this structure reveals that defects plague AlN that is close to the interface with sapphire. These defects are composed of inversion domains and threading dislocations, which terminate within 400 nm of the interface and do not propagate through the film. According to plan-view, transmission electron microscopy images, the threading dislocation on the terrace and groove are 4×10^7 cm^{-2} and 3.1×10^7 cm^{-2}, respectively.

LED structures featuring five period multi-quantum wells and a magnesium-doped, aluminium-rich AlGaN electron blocking layer were deposited on this AlN platform. This enabled fabrication of 266 nm and 278 nm, square-shaped LEDs with 800 μm edges. Driven at 20 mA, the forward voltages for the 266 nm and 278 nm LEDs were 6.11 V and 5.98 V, respectively. Under these operating conditions both LEDs showed relatively little degradation during the first 1000 hours.

Kim hopes to continue to study defects in UV epilayers: "It is still a challenge to grow high-quality, III-nitride films on sapphire due to various defects, such as threading dislocations, stacking faults, voids and inversion domains."

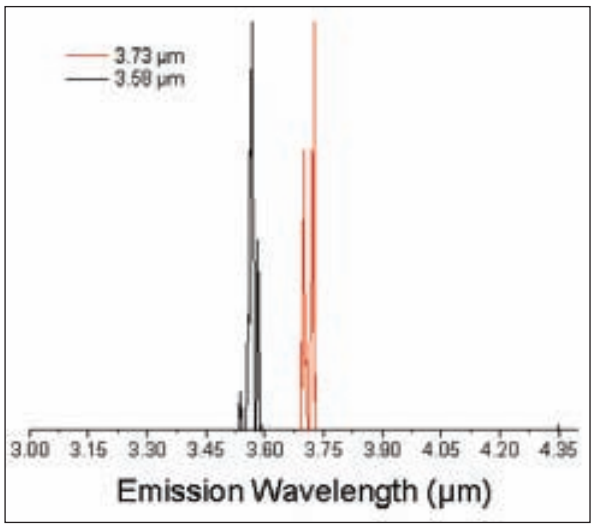
M. Kim *et. al.* Appl. Phys. Express **4** 092102 (2011)

Quinternary barrier propels GaSb lasers to longer wavelengths

Improving hole confinement in the active region stretches GaSb-based laser emission to 3.7 microns

THE record for long wavelength emission for room-temperature GaSb-based type I lasers has been broken by a pair of researchers from the Technical University of Munich.

Extending the emission of this form of GaSb-based laser from its previous record of 3.44 μm to the new benchmark of 3.73 μm makes this device a more promising candidate for various applications. That's because the spectral range around 3.6 μm is well suited to gas sensing, free-space communications and spectroscopy, thanks to its location within the water-absorption-free atmospheric window spanning 3.4-5.0 μm.



Emission spectra of 3.6 – 3.7 μm Fabry-Perot lasers at 15 °C under pulsed operation

"It enables one to monitor greenhouse gases in the atmosphere without water interference," explains corresponding author Kristijonas Vizbaras, who points out that methane and ozone can be monitored using 3.6 μm lasers. "Moreover, wavelengths around 3.6 μm can access the first absorption lines of sulphur dioxide, which is a very important pollutant gas and is highly interesting for various combustion control processes."

According to Vizbaras, the key to extending the emission of these GaSb-based lasers beyond 3.5 μm is the improvement of the epitaxial growth technology for the quinternary AlGaInAsSb barrier, so that this enables good hole confinement in the quantum well. Optimising this layer requires tremendous effort because characterisation of the quinternary is complex and time-consuming.

Better hole confinement is not the only benefit stemming from the team's quinternary barrier – it also helps to increase the laser's emission wavelength. During the growth of the quantum well these layers are subjected to an *in-situ* anneal that increases their bandgap, leading to a reduction in the laser's emission wavelength. Vizbaras and his colleague Markus-Christian Amann have found that this unwanted blue shift is smaller in lasers incorporating their AlGaInAsSb barrier.

The spectral range around 3.6 μm can also be accessed with quantum cascade lasers. However, Vizbaras argues that this type of laser is inferior to ones based on GaSb in several respects: Its operating voltage and current are higher, making it far less suited to portable applications requiring batteries; room-temperature operation is far more challenging; and device growth is more complex and time consuming.

Vizbaras and Amann fabricated laser diode epistructures on GaSb substrates by MBE using a growth temperature of 550 °C. Epiwafers featuring five compressively strained, 10 nm-thick $Ga_{0.3}In_{0.7}As_{0.48}Sb_{0.52}$ quantum wells were processed into ridge waveguide lasers with cavity lengths of 1-3 mm and 30 μm ridges. These devices with uncleaved facets were mounted epi-side up on copper heatsinks.

Driven with 500 ns pulses at a 8.3 kHz repetition rate, 2 mm-long, 3.58 μm lasers produced an average output power of 29 mW per facet. Lasing was possible up to a heatsink temperature of 27 °C, limited by a loss-mechanism of unknown origin kicking in at 17 °C.

After reporting these results in a very recent edition of *Electronics Letters*, the researchers have continued to extend the wavelength of their GaSb-based lasers. "We have just demonstrated room-temperature emission at 3.73 μm with 20 percent lower threshold current densities than for the published 3.6 μm lasers," says Vizbaras. "The most recent results are being prepared for publication at the moment."

Further improvements in the performance of these lasers are possible, according to Vizbaras: "The threshold current densities are reasonably small for a proto-type laser, and further improvement should definitely lead to continuous-wave (CW) operation."

His foundation for making this claim is the progress of 3.3 μm lasers, which had pulsed threshold current densities of 5 kA/cm^2 when first fabricated in 2005 and now operate in CW mode at room temperature. "Similar progress is expected for 3.6 μm lasers."

Vizbaras points out that a hike in the differential gain of their laser should result from increasing the strain in the active region, and lower operating voltages could be realised through contact optimisation.

"Additionally, more elaborate mounting and heat-sinking should boost performance much further and eventually enable CW, room-temperature operation."

The team will now try to improve the performance of their lasers and extend their emission to 4 μm and beyond.

K. Vizbaras et al. Electron. Lett. **47** 980 (2011)

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LEDs

Kyma updates progress on AlGaN and AlN development

The firm which uses a patented III-N PVDNC process, is also seeking partnerships with bulk aluminium nitride materials developers who are interested in improving the optical properties of their materials.

Kyma Technologies, a supplier of crystalline nitride semiconductor materials, has provided an update on its progress in crystalline AlGaN and AlN materials development and to state its desire to collaborate with bulk AlN developers interested in improving the optical transparency of their materials.

Kyma has over a decade of experience in the fabrication of AlN templates which are thin films of crystalline AlN deposited on sapphire, silicon, or SiC substrates. The process uses Kyma's patented and proprietary III-N Plasma Vapour Deposition of NanoColumns (PVDNC) technology.

These products are gaining acceptance with customers engaged in blue and green LED manufacturing. The nanocolumnar nature of Kyma's PVDNC AlN templates present an excellent surface for nucleating GaN buffer layers which then can be followed by a high quality GaN LED device structure.

Recently Kyma began extending its process capabilities to develop materials which are designed to support high Al content device layer structures. Such structures are of interest for UV and high temperature and high power electronics applications.

Keith Evans, Kyma's president & CEO, stated: "While our PVDNC AlN templates are excellent substrates for manufacturing GaN-rich devices such as blue and green LEDs and AlGaN/GaN field effect transistors (FETs), we are also employing other processes to develop materials that are specifically tailored to support the manufacturing of AlN-rich devices such as mid UV LEDs for germicidal irradiation and AlN/AlGaN FETs for temperature insensitive high power electronics applications."

Towards these goals, Kyma is exploring and has made significant progress in the growth of crystalline AlN and AlGaN materials using high growth rate hydride vapour phase epitaxy (HVPE).

By adding a novel Al source to their HVPE tools, Kyma is now able to grow crystalline AlN and a broad range of AlGaN compositions. And just like GaN HVPE, the structural quality of the HVPE grown AlN and AlGaN crystals are influenced by the seed crystal that they are grown upon.

Kyma has already demonstrated the ability to deposit crystalline AlN by HVPE on a range of starting seed materials, including on AlN structures which were produced by other techniques.

Ed Preble, Kyma's CTO & VP business development, stated, "Our AlN HVPE process appears to have many of the traits of our GaN HVPE process. We are able to rapidly replicate the quality of the underlying seed and in certain cases then improve its quality as we continue to grow the crystal."

"Additionally, optical transmission measurements show that our HVPE grown AlN materials have high transparency in the 200nm to 400nm spectral region, an important feature for UV LED applications, and a noted advantage over some competing AlN crystal growth approaches," added Preble.

Taiyuan University selects Aixtron reactor for GaN blue LED

The Chinese university's first Aixtron epitaxial growth system for gallium nitride LEDs is a 3x2-inch CCS system and was chosen for its versatility and low material consumption.

Aixtron SE has a new order for an MOCVD reactor from new customer Taiyuan University of Technology, China.

The order is for one Aixtron Close Coupled Showerhead (CCS) 3x2-inch configuration

deposition system which will be used for research into GaN-based materials for high-brightness (HB) blue LEDs.

The system will be delivered in the second quarter of 2011. One of Aixtron´s local support teams in China will commission the new reactor in a new state of the art facility at the University.

Jian Liang, Professor of Taiyuan University of Technology's Material College State Laboratory, comments, "This will be our first Aixtron epitaxial growth system though we are already very familiar with this technology and know well of the reputation of this company's equipment and service. The Close Coupled Showerhead system is an ideal choice for us because it satisfies so many criteria. We are particularly interested in its versatility as well as stand-out factors such as low material consumption. These will ensure that this system is so much superior for our University research project."

Celebrating its 100th anniversary in 2002, Taiyuan University of Technology comes under the authority of the provincial government of Shanxi, China. Historically, although it was originally part of Shanxi University it did not become an independent university until much later. Today it is listed officially as one of the 'Top 100 Universities in China' according to the Chinese government.

US DOE visits Optogan to discuss gallium nitride LED lighting projects

The aim of the visit was for the US to become acquainted with Russian industry innovation and to search for possible ways to implement joint projects in energy and energy efficiency.

A US delegation headed by Department of Energy (DOE) Secretary Steven Chu visited the Optogan LED production plant in St. Petersburg to discuss possible projects in solid state lighting between Russia and the US.

USDepartment Secretary Steven Chu visits Optogan´s LED production plant in St. Petersburg.

Nobel Laureate Steven Chu is a recognised expert in the development of energy efficient technologies. The aim of the official visit of the US delegation to Russia was to become acquainted with Russian industry innovation and to search for possible ways to implement joint projects in energy and energy efficiency.

Mutual projects were discussed within the Working Group on Energy and Environment - a bilateral US-Russian presidential commission of Steven Chu and the Russian Energy Minister, Sergei Shmatko. The Working Group engaged in developing and strengthening bilateral relations between these countries and increasing their cooperation on energy efficiency.

At the Optogan plant the US delegation was shown a high-tech production of LEDs and precision equipment to create energy-efficient solid state lighting solutions. Further plans to launch the second and third stage of the production, as well as the introduction of Optogan in international markets were explained.

"The reformation of the energy system of a country cannot happen without the alignment of international experts, the exchange of information on the leading technologies and global co-operations", said Maxim Odnoblyudov, President of the Optogan Group.

"The fact, that we have the opportunity to work hand in hand with the leading scientists of energy-efficient technologies is a success for Russia and for our company. For Optogan this implies that

our company is a prime example for international collaboration to transfer the scientific achievements to society," continued Odnoblyudov.

"Solid state lighting is the energy efficient solution of the future with a convincing global potential. I strongly believe, that Optogan has a great opportunity for joint projects and cooperation with American business partners," said secretary Chu.

Steven Chu, who won the Nobel Prize in Physics in 1997, was appointed by President Obama as Secretary of Energy heading the U.S. Department of Energy (DOE). Chu dedicated his scientific career to solving energy problems, global warming and developing alternative and renewable energy. Steven Chu is member of the US National Academy of Sciences. He directed the National Laboratory in Berkeley in developing alternative and renewable energy sources. Chu graduated from the University of California Berkeley with a PhD. in Physics and received honorary degrees from 10 universities.

Osram sues Samsung and LG

The patent infringement litigation focuses on patents of Osram's white and surface mountable LED technologies, typically used in display backlighting for TV sets and monitors.

Osram has filed legal actions against Samsung group companies and LG group companies in the US and Germany as well as against an LG group company in Japan.

Based on its conviction that these companies, respectively, infringe fundamental patent rights, Osram will also file a suit against LG in China tomorrow. With this move Osram intends to enforce its patents on LED technology.

In these lawsuits Osram stresses that Samsung and LG group companies infringe its patents on white and surface mountable LEDs in the US, Germany and, as far as LG is concerned, in Japan and China. Osram intends to prevent unauthorised use of its technology and seeks orders from the courts to prevent Samsung and LG from importing and selling infringing LEDs and products containing these LEDs, such as LED-backlit TV sets and computer monitors. In addition, Osram is applying for compensation.

The legal actions focus on LEDs using technologies protected by Osram patents. These technologies relate to the electrical and thermal connection structure as well as to conversion technology, which is used, inter alia, to convert the blue light of the LED chip into white light. Typical applications of such white LEDs include, for instance, display backlighting for TV sets and monitors.

By taking royalty-bearing licenses, a variety of prominent companies around the world has recognised the value of the Osram patents on conversion technology.

"Our objective in taking legal actions against Samsung and LG group companies is to prevent unauthorised use of our valuable technology," stated Aldo Kamper, CEO of Osram Opto Semiconductors.

"We have a considerable number of patents which we developed in the course of many years of intensive research and development work. Major competitors such as Philips/Lumileds, Cree, and Nichia have acknowledged our strong IP position by entering into cross-license agreements with Osram", explained Kamper.

GT Solar receives $460.4 million order for sapphire crystallization furnaces

The firm's largest single order to date is from a Chinese based firm who is new to the LED industry.

GT Solar International has received an order for its advanced sapphire crystallisation furnaces totalling $460.4 million from a new market entrant.

The order is GT's largest single order to date, and represents a significant milestone for the company as a leader in the fast-growing LED industry. The order will be included in GT's backlog for its current Q1 FY12, which ends on July 2, 2011.

"Our customer is a well established, diversified manufacturing company located in China who is new to the LED industry. We are pleased that they have selected our advanced sapphire growth technology for their new sapphire production facility," said Tom Gutierrez, GT Solar's president and CEO.

"The market acceptance of our sapphire growth technology has been remarkable and it speaks to the confidence our customers have shown in our ability to help them build successful businesses that leverage our crystalline growth expertise and our global equipment installation and support resources," he continued.

According to Strategies Unlimited, an industry analyst firm that tracks the LED industry, revenue for high brightness LED applications will be approximately $19 billion by 2015, with general lighting applications accounting for about 25 % of this total. High brightness LEDs are primarily manufactured on sapphire wafers. This growth is driving the expansion of manufacturing capacity to meet the increased demand for high quality sapphire material.

Philips Lumileds and Future Electronics Extend Worldwide Exclusive Agreement

Philips Lumileds and Future Electronics have announced the extension of their exclusive worldwide distribution relationship. The new five-year agreement builds on the decade long relationship that has enabled the development of solid-state lighting solutions worldwide.

"Our exclusive partnership with Philips Lumileds has provided our customers with access to the world's leading portfolio of LEDs for illumination-LUXEON. Our investment in resources, training, design tools, and best-in-class supply chain capabilities has enabled us to become the service leader in the solid-state lighting industry," said Jamie Singerman, Corporate Vice-President, Future Lighting Solutions.

"Future Lighting Solutions has proven over the last decade that with LUXEON LEDs, highly trained LED solution engineers, and the core services of a global solutions provider, they are well positioned to support and enable the growing number of companies that want to enter the solid-state lighting industry," said Steve Barlow, Sr. Vice President of Sales and Marketing at Philips Lumileds.

Complete information about LUXEON LEDs, complementary infrastructure and solution approaches for illumination can be found at the Future Lighting Solutions website, www.futurelightingsolutions.com. Information about Philips Lumileds and LUXEON LEDs can be found at www.philipslumileds.com.

Cree Demonstrates Industry's First C-Band GaN HEMT MMIC High-Power Amplifier for Satellite Communications

Cree, Inc. demonstrates the industry's first GaN

HEMT MMIC high power amplifier (HPA) for satellite communication applications at the 2011 IEEE International Microwave Symposium held June 7-9 in Baltimore. The demonstration product offers dramatic performance improvements over existing commercially-available GaAs MESFET transistors or Traveling Wave Tube-based amplifiers.

"This is the first GaN MMIC to be demonstrated that offers game-changing performance for satellite communication applications due to the outstanding linear efficiency and power gains provided by our GaN HEMT technology. We anticipate our GaN products will have a large impact on how thermal management is approached and will enable reductions in both size and weight for commercial and military satellite communication systems," said Jim Milligan, Cree, director of RF.

The CMPA5585025F MMIC is a 50 ohm (Ω), 25 watt peak power two-stage GaN HEMT HPA in a multi-pin ceramic/metal package (1"x 0.38"). The instantaneous bandwidth of operation of the MMIC is 5.8 GHz to 8.4 GHz. It provides 15 watts of linear power (less than-30 dBc adjacent channel power) with 20 dB power gain. Power added efficiency is 25% at this linear operating power.

The device offers superior linear efficiency (up to 60% higher than conventional solutions) in a small footprint package facilitating reductions in transmitter size and weight with lower cost thermal management. In addition, because this device operates at higher voltages than GaAs MESFETs (e.g., 28 volts versus 12 volts), the transistors draw less current, resulting in lower power distribution losses and higher overall system efficiencies.

Samples of the CMPA5585025F are available now, and production release is targeted for the summer of 2011. For additional product information, visit www.cree.com/rf.

Osram adds low-power range LED to portfolio

The < 1 W LEDs display uniform illumination in linear and flat lighting solutions.

The new product family in the low-power range from Osram Opto Semiconductors starts with the Duris E 3. The small dimensions and wide beam angle of these new LEDs make them ideal for applications that require uniform illumination. These highly efficient LEDs can be used as replacements for conventional fluorescent lamps in T5 or T8 luminaires.

The new Duris E 3 from Osram Opto Semiconductors can be retrofitted as replacements for conventional T5 and T8 fluorescent lamps. The light has the same appearance as a continuous strip of light

Duris E 3 has been designed specifically for applications that call for uniform distribution of light, high efficiency and low procurement costs. The main areas of application are therefore lighting systems in industry, such as open-plan offices, production facilities, conference rooms and warehouses that have been equipped with T5 and T8 luminaires. "Bright LEDs are also recommended for smaller offices, shop lighting and signage", said Andreas Vogler, Product Manager SSL at Osram Opto Semiconductors. "This new LED extends our portfolio in the low-power range and offers the usual high Osram quality."

Duris E 3 offers everything that is needed for uniform light. Its small size of 3 mm x 1.4 mm means that they can be placed very close to one

another. Its beam angle of 120° ensures that in closely packed arrays the light from each LED overlaps that from its neighbour. The result is an extremely uniform distribution of light. The individual points of light can no longer be seen; instead, the impression is of a single bright strip of light. The LED covers the entire white colour spectrum with colour temperatures from 3000 K to 6500 K. At a colour temperature of 5000 K, for example, it offers a CRI of 72 and an efficiency of around 110 lm/W - perfect for use in industrial applications.

The next member of the family will be making its debut in the summer. Duris E 5 will provide a high luminous flux and package dimensions of 5.6 mm x 3 mm.

Genesis Photonics Places Multi-Unit Order for MaxBright MOCVD Systems

Veeco Instruments Inc. today announced that Taiwan based Genesis Photonics Inc. (GPI) has placed a multi-unit order for Veeco's recently released TurboDisc(R) MaxBright(TM) Multi-reactor MOCVD System.

GPI will use the systems to increase capacity for the production of high brightness light emitting diodes (HB LEDs) being driven by applications such as backlighting, lighting, displays, and automotive.

David Chung, Chairman and CEO of GPI, commented, "We have been very pleased with the production proven performance of Veeco's K465i MOCVD systems already installed in our manufacturing facility. They helped us to achieve LED brightness higher than the industry average. By now adding Veeco's new MaxBright systems, we will further lower our LED manufacturing costs, maximize our fab space, and accelerate our productivity."

William J. Miller, Ph.D., Executive Vice President, Veeco LED & Solar, added, "It is gratifying to have the MaxBright system selected by GPI, one of Taiwan's top LED manufacturers. Our customers are resonating with the message that the MaxBright system can deliver more good LEDs for less money than other tools on the market. We are particularly pleased that GPI is choosing MaxBright, which further solidifies our relationship with this important customer as they grow their position in the LED industry."

About the MaxBright

The MaxBright system is the industry's most productive, lowest cost of ownership MOCVD system available to manufacture high brightness LEDs. Available in a 2 or 4-reactor cluster architecture, the MaxBright system delivers up to a 500% productivity gain and a 2.5x increase in footprint efficiency over the industry-leading K465i system. For more information, please visit www.veeco.com/maxbright

Changelight receives 2,000th Aixtron MOCVD system

The reactors will be used to manufacture high-quality AlGaInP Red Orange Yellow (ROY) HB LED chips.

Aixtron SE has installed its 2,000th MOCVD system at LED and solar cell specialist company Changelight in China.

Bastian Marheineke, Vice President Sales at Aixtron, took the opportunity to congratulate DianMing Deng, President Changelight, personally. "We are extremely pleased to be able to share this historic occasion with such an important customer. Changelight was the first customer to use the AIX 2800G4 in China. Their AlGaInP LED epitaxial wafers and chips are amongst the best at the domestic level in terms of scale, output and sales. In 2010, multiple Aixtron G3 and G4 systems were installed at the Xiamen facility with others at the Yangzhou site."

DianMing Deng, President Changelight and Bastian Marheineke, Vice President Sales, Aixtron SE

"The vast majority of systems we sold in 2010, almost 95%, are used for the manufacture of LEDs. In the first quarter of 2011, around 90% of Aixtrons revenues were generated by sales into Asia; almost 90% of systems sold are for the manufacture of LEDs. China will undoubtedly be our biggest market in 2011," concludes Marheineke.

DianMing Deng, President Changelight, adds, "We feel deeply honoured that Aixtron supplied its 2,000th system to Changelight. Development from our initial private enterprise to the present listed company is inseparable from the great support we have enjoyed from the Aixtron team since our foundation in February 2006. With Aixtron, a leading provider of deposition equipment in the semiconductor industry, we have had an intensive relationship and cooperation over the past five years. Today, our manufacturing facilities are based exclusively on Aixtron MOCVD equipment which has been pivotal in our becoming the biggest supplier of high-quality AlGaInP Red Orange Yellow (ROY) HB LED chips in China."

"The new systems form part of our future expansion plans in Yangzhou which was opened in April 2010. Looking to the future, I see our strategic cooperation partnership with Aixtron will become deeper and broader. We send our best wishes for the company´s further success – hopefully with the delivery of the 3000th and 4000th MOCVD system in China, too."

The 2,000th system is part of a multiple tool order for 60x2-inch AIX 2800G4-R systems for advanced optoelectronics devices and will be installed and commissioned by the local Aixtron service team at the Changelight production facilities.

SPTS and Australia's Griffith University to develop SiC-on-silicon technology

The three-year collaboration aims to commercialise SiC-on-silicon as a viable semiconductor material for LED, power and MEMS devices.

SPP Process Technology Systems (SPTS), a manufacturer of plasma etch and deposition, and thermal processing equipment for the semiconductor and related industries, and Griffith University in Australia have signed a joint development agreement (JDA) targeting the commercialisation of SiC-on-silicon technology. SiC-on-silicon substrates have a wide variety of applications for the rapidly growing LED, micro-electro-mechanical systems (MEMS) and power markets.

SiC is an important substrate for growing the GaN films used to manufacture LEDs. The increased radiation hardness, mechanical strength and thermal properties of SiC also make it a suitable replacement for silicon in MEMS devices for harsh environments. In addition, SiC is used to create semiconductor devices for high power, high frequency applications where the electrical properties of SiC are significantly superior to common silicon.

Technology created by the research team at Queensland Microtechnology Facility (QMF) at the Griffith University's Queensland Micro- and Nanotechnology Centre (QMNC), has demonstrated the ability to grow crystalline SiC directly onto low cost silicon wafers. Through the JDA, SPTS will develop the thermal process and equipment expertise necessary to commercialise the technology.

Three key technologies required for SiC-on-silicon devices are SiC deposition, etch and oxidation. The QMNC has commercially orientated research into all these areas. "The JDA enables transfer of this SiC deposition process technology to device research and development activities, and provides a bridge to volume production through batch processing for up to 300mm diameter Si wafers. SPTS's strength in thermal processing makes them an attractive partner," said Alan Iacopi, Operations Director of QMNC. "This JDA is an important step in the commercialization of our SiC research efforts, especially with a partner with the global reach of SPTS" agreed Sima Dimitrijev, Project Leader and Deputy Director of QMNC.

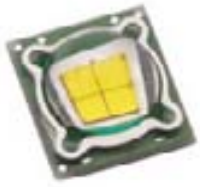
"As a market leader in providing capital equipment to the MEMS, LED and Power markets, SPTS is constantly looking at cutting-edge development opportunities. We are very pleased to have this

opportunity to work with leading researchers at Griffith University to commercialise their SiC-on-silicon technology," said William Johnson, president and CEO of SPTS. "Providing production knowledge to this collaboration and helping to develop and deliver new materials processing technology is an important business strategy. This JDA further enhances the portfolio of offerings to our served markets and will help to broaden our customer base."

Luminus launches HB-LED for general lighting

The firm's new white SSM-80 big chip LED expands its family of products for indoor lighting applications.

Luminus Devices is marketing the SSM-80 LED, a high efficacy and high brightness warm white LED for general lighting based on its Phlatlight technology.



The product is designed for indoor directional and spot lighting applications and will have an initial release in warm white colour points of 2700K, 3000K, 3500K and 4000K. At these warm white colour points the SSM-80 can achieve up to 100 LPW at 350mA, and more than 1,600 lumens at its top end rated drive condition.

"In a direct response to the demands of our general lighting customers and a rapidly growing market, the SSM-80 combines high lumens and high efficacy in a small emitting area, which enables tight beam control and provides new degrees of creativity and innovation for spot lighting applications," said Chuck DeMilo, Global Director of Product Marketing for the Lighting Business Group at Luminus Devices. "It enables lighting fixture designers to achieve light intensity levels for applications such as retail track that approach the levels of ceramic metal halide."

The SSM-80 is tested and binned at a nominal input drive condition of 1A and 12V, which makes it electrically compatible with a wide array of commercially available off-the-shelf drivers and ballasts. Other features include a thermal resistance less than 1.0°C/W and an L70 lifetime greater than 60,000 hours.

The SSM-80 is ideally suited for a variety of applications including spot lighting, narrow beam down lights and focused general lighting applications where high performance and high efficacy in a standard surface mount package are needed. The SSM-80 is available for sampling now with volume shipments starting in late summer.

Luminus and T-Opto reveal high output LED

The new SoloLux "Plug & Play" Module is ideal for high lumen general lighting applications that require a 175W metal halide source.

Luminus Devices and T-Opto, a Division of Toyota Tsusho America, are introducing the SoloLux high output LED module, a high efficacy sub-system for high lumen general lighting applications that typically utilise a 175W metal halide source.

SoloLux is designed for indoor and outdoor installations requiring many thousands of lumens such as parking area, roadway, canopy, high bay and high ceiling down lights. The patent-pending module produces up to 6,500 lumens from a single source, which reduces fixture cost and complexity when compared against alternate solutions that use arrays of low power LEDs.

"SoloLux sets a new standard for LED modules by providing the lighting community with a single source, field upgradeable solution with real optical punch," says Jim Hunter, Vice President and

General Manager for Global Commercial Markets at Luminus Devices.

"The module is based on Luminus Big Chip LED technology, which provides our lighting customers with the opportunity to develop creative and differentiated high performance fixtures. We are seeing real innovation in the marketplace with the technology, such as indirect lighting fixtures that are low glare and eliminate multi-source shadowing," he continues.

Michael Handerhan, General Manager of T-Opto, adds "Field upgradeability is a real key to the strategy behind the SoloLux. As LED performance continues to improve, fixture performance can be upgraded by replacing the chip-on-board LED with a standard screw driver. The benefits to our customers in accelerating time to market are obvious, as the SoloLux comes with integrated heat sinking and an electrical interface to standard ballasts. In addition, we have created reference designs for our customers, including custom optics, for targeted applications such as outdoor area lighting and high bay."

SoloLux is available in colour temperatures ranging from warm to cool, and is in process of attaining LM-79, UL1598 and ULIP66 accreditations.

SoloLux will be available for sampling this summer with volume availability shortly thereafter.

Aalberts aids LED, semiconductor and solar energy markets

By buying out Dutch based firm Lamers, Aalberts has the opportunity to expand its market position in the LED production and solar energy market and selling other products, systems and processes through Lamers' sales channels.

Aalberts Industries N.V. has reached an agreement with the Air Liquide group to acquire 100% of the shares of Lamers High Tech Systems B.V. (Lamers) in the Netherlands subject to antitrust clearance.

Since 1984 Lamers has been active in the development, engineering, manufacturing, assembling, testing and qualification of systems for control and distribution of high purity gases and chemicals. The systems are used in photolithography systems supplied to the semiconductor industry and MOCVD equipment supplied to the LED industry. The systems of Lamers are also used in the manufacturing process of photovoltaic systems for the solar energy industry.

The LED and solar markets are fast growing renewable energy markets, where Industrial Services strives to increase its market share. Besides this, Lamers is active in the installation of high purity distribution networks for gases and fluids, as well as hook-up activities.

Lamers generates an annual revenue of approximately €90 million with around 300 employees at its two manufacturing facilities in the Netherlands, Nijmegen and Kerkrade. The experienced management team will continue to manage Lamers on both locations together with the existing employees.

Lamers' systems are engineered in close cooperation with the customers from design to start up. Lamers delivers fully or semi-automated systems, in-house and on the customer site, using its large experience in the field of high purity tube systems, valves, fittings, sensors and flow measuring instruments.

The high purity systems are used to inject a specific mixture of gas with the exact specified temperature, pressure, humidity and purity to the different manufacturing process steps in the photolithography and MOCVD equipment. Lamers uses high-tech manufacturing processes such as (semi-) automatic welding processes of tubes systems, computer aided tube bending and the newest technology in the field of testing and qualification, such as particle- and moisture measurement, as well as helium leak testing under vacuum. This is all realised in a clean room environment.

The acquisition of Lamers is in line with Aalberts Industries' strategy of enhancing its position in the Industrial Services activity benefiting from the following features:

-Lamers will reinforce Aalberts Industries' position

as technology partner in the semiconductor market with tailor-made systems for high purity gases and chemicals. Aalberts Industries has been active in this market for many years by supplying subassemblies, vibration control systems and surface treatment of components for the semiconductor industry.

- With Lamers Aalberts Industries has the opportunity to expand its market position in the fast growing LED production and photovoltaic systems for the solar energy market, selling other products, systems and processes through the sales channels.

- By using Lamers' technology other markets can be explored, such as micro electro mechanical systems (MEMS), chemical and pharmaceutical delivery systems, markets in which Industrial Services is not yet active.

- Lamers' technology and experience of designing, engineering, manufacturing, assembling, testing and qualification of systems for control and distribution of high purity gases and fluids can also be used for other markets in which Industrial Services is already active, such as the medical and precision engineering industry.

- The technology and portfolio of high purity tube systems, valves, fittings, sensors and flow measuring instruments, used in the systems of Lamers, can be developed further using the product development know-how and sales channels of Aalberts Industries.

- By using the international network of Industrial Services, Lamers will have the opportunity to globally serve its customers, that more often need a local tailor-made service.

- Within Flow Control the Lamers systems can be sold together with the clean gas activities in laboratories, universities and research centres. Aalberts Industries has a worldwide presence in these markets.

- Besides this Lamers can use the manufacturing machining capacity within Industrial Services to develop and deliver their systems faster and more efficient.

The acquisition will be financed from credit facilities and will be realised after fulfilment of all formalities and approvals, which is expected before the end of June 2011. Lamers' results will immediately contribute to the profit per share.

Berlin to host compound semiconductor conference

Organised by the Fraunhofer Institute and the VDE Association for Electrical Technologies, Electronic & Information Technologies, the conference will address the future of compound semiconductors in micro electronics and optoelectronics.

On May 23, 2011, Andre Geim, the 2010 winner of the Nobel Prize in Physics, opened the 2011 Compound Semiconductor Week with a plenary lecture on graphene.

Here, some 450 scientists and industry representatives will discuss current research findings in the field of compound semiconductors. An example of one of the key topics of the event is how to improve energy efficiency while increasing data rates in communications systems – often referred to as "Green IT".

The conference took place in Berlin from May 22 to 26. The conference is organised by the Fraunhofer Heinrich Hertz Institute HHI, the Fraunhofer Institute for Applied Solid State Physics IAF, and the VDE Association for Electrical Technologies, Electronic & Information Technologies.

"CSW is the most important international conference for the entire spectrum of compound semiconductors. Here, participants will get an overview of what will become possible in micro electronics and optoelectronics," Oliver Ambacher, ISCS 2011 Conference Chair and head of the Fraunhofer IAF, said.

While silicon is still the most important semiconductor material, today no mobile phone, PC or car would work without additional components used in compound semiconductor technology. Compound semiconductor, in contrast to the elemental semiconductor – like silicon -, consists of at least two different types of atoms.

Compound semiconductors are used for light generation with LEDs, photonics and

communications engineering, as well as for maximum frequency electronics and power electronics. Since 2010, the CSW has combined the two most important conferences on compound semiconductors – the "International Symposium on Compound Semiconductors (ISCS)" and the "International Conference on Indium Phosphide and Related Materials (IPRM)".

"Berlin is the ideal location for hosting the CSW thanks to its broad-based research activities in this field," said Norbert Grote, Chairman of this year's IPRM and head of department at the Fraunhofer HHI. "Some 450 scientists from all over the world will come to Berlin to exchange their knowledge. This gives us the opportunity to further strengthen the location and to promote these issues."

Fraunhofer HHI and Fraunhofer IAF are both leading research institutes in the field of compound semiconductors. In Berlin, it is not only institutes and universities such as the Fraunhofer HHI, the Ferdinand Braun Institute, the Paul Drude Institut für Festkörperelektronik, the Institut für Kristallzüchtung, Humboldt- und Technische Universität, as well as the Helmholtz Zentrum, which are active in this field, but also companies like the u2t Photonics AG, a spin-off from Fraunhofer HHI. "When making a phone-call in the US, your chances of the optical components involved having been made in Berlin are pretty good," said Norbert Grote.

Nordson honoured for technology innovation with 2 awards

The firm's jet dispenser for side-view LED manufacturing won the SMT China magazine and EM Asia magazine awards.

Nordson ASYMTEK, an innovator in dispensing, coating, and jetting technologies, earned two prestigious awards for innovative technology during NEPCON China 2011.

Both the VISION Award from SMT China magazine and the Innovation Award from Electronics Manufacturing (EM) Asia magazine were presented to Nordson ASYMTEK for product excellence in the dispensing category for its jet dispenser for side-view LED manufacturing.

This was the fifth year in a row that Nordson ASYMTEK received the SMT China award and the fifth time they received the EM Asia award.

Nordson ASYMTEK's jet dispenser enables sticky silicon phosphor to be dispensed into extremely small and hard-to-reach cavities for side-view LEDs. Silicone phosphor dispensing is critical for LED colour quality.

The system uses a jet for non-contact dispensing, jetting 0.1 to 0.2mm dots through windows as small as 0.4mm into LED cavities. Unlike a needle, the jet retracts much less for silicone break-off, dispensing multiple shots faster, increasing speed and throughput. The jet's small, controlled drops of fluid reach tight cavities consistently and reliably, unlike needles which have orifices larger than the cavity windows of side-view LEDs.

The SMT China VISION Award honours achievements in China's electronics manufacturing industry. Awards are based on the creativeness and innovativeness of the product and its contribution in helping the downstream industries to reduce cost, improve quality, increase efficiency, enhance reliability, improve safety, and environmental friendliness.

The EM Asia Innovation Award recognises top performing companies in the Asian electronics industry for achieving the highest standards for products, materials, and equipment introduced and offered for sale in Asia. Entries were judged on innovation and achievement and for setting challenging objectives.

"We are honoured to receive these two awards," said Frank Wang, Nordson ASYMTEK's general manager, Greater China. "Nordson ASYMTEK has been recognised as the leader in dispensing and coating innovation and technology for over 25 years. We have grown with our customers to develop equipment and processes to enable them to produce many of the products we rely on today. Our patented jet dispensing technology for LEDs has helped our customers reduce process variation, increase yield, and reduce cost. We will continue to serve our customers throughout China and Asia with quality products and provide the very best

service and support. We thank SMT China and EM Asia for these awards."

Both awards were presented at ceremonies during NEPCON China, Shanghai, May 2011

Pantec Biosolutions Selects Oclaro Laser Diode Bars

Oclaro High-Performance Laser Diode Bars Deliver the Performance and Reliability Needed for Pantec's Revolutionary P.L.E.A.S.E. ® Laser Platform

Oclaro, Inc., a tier-one provider of optical communications and laser solutions, have announced that its 9xx nm high-power laser diode bars have been selected by Pantec Biosolutions, provider of epidermal medical applications, for use in its next generation P.L.E.A.S.E.® (Precise Laser Epidermal System) platform. This cutting-edge new laser platform represents a new era in biomedical applications by enabling an easy, painless and needle-free delivery method for drugs, as well as safe tissue ablation for skin rejuvenation.

According to Pantec, the global aesthetic market, which includes tissue ablation, is expected to grow from a $4.4 billion market in 2010 to a $7.5 billion market in 2015; while the market for transdermal drug delivery is growing rapidly and is expected to be a multi-billion dollar market by 2015. Designed for medical professionals and consumers, these new devices offer a pain-free delivery method for a variety of medical applications, such as in-vitro fertilization, vaccinations and wrinkle removal.

Oclaro worked closely with Pantec to deliver a customized quasi continuous wave (QCW) sub-assembly laser diode solution that delivered the performance and reliability needed, at a price point that will enable wide-spread adoption in the consumer space. Pantec's first Oclaro-based product, which is called the P.L.E.A.S.E.® Professional, is a tabletop system that will be used for both transdermal delivery and tissue ablation. This device will initially be sold in Europe with plans to bring the product into selected markets worldwide, starting in 2011.

"This win with Pantec is yet another example of how lasers have reached the price/performance targets that enable them to be widely used in the high-volume consumer space," said Gunnar Stolze, Worldwide Sales Director of Industrial and Consumer Lasers at Oclaro. "The combination of Pantec's P.L.E.A.S.E. platform technology with Oclaro's highly-efficient, high-volume manufacturing capabilities can deliver innovation to the consumer that revolutionizes modern day medical and cosmetic procedures such as drug delivery and tissue ablation."

"We partnered with Oclaro because it delivered the technology and reliable manufacturing excellence we needed, and also worked closely with us to design the best solution for our next generation P.L.E.A.S.E.® products," said Thomas Bragagna, CTO at Pantec Biosolutions. "As this market continues to expand, we are confident that only a world-class supplier such as Oclaro will enable us to establish a clear leadership position in a space that is poised for explosive growth in the future."

About Oclaro Laser Diode Bars

Oclaro developed a conductively cooled 9xx nm laser diode bar primarily designed for QCW pumping of miniaturized solid state lasers, which is what Pantec required for its P.L.E.A.S.E platform. Oclaro's QCW operation enabled Pantec to develop a compact laser device due to its low cooling requirements, small footprint and extremely high pulse power.

Oclaro laser diode bars feature a highly efficient two sided cooling setup of the 10x12x5mm(3) small footprint diode assembly, which allows for output peak power levels as high as 320W at 300A drive current, 5ms pulse duration and 10% duty cycle.

The Er:YAG laser systems developed by Pantec are pumped between 0.1 and 10ms pulse duration and 1-20% duty cycle, making them attractive for medical applications such as transdermal delivery of drugs from large peptides up to whole antibodies, since molecules of this mass can't penetrate passively into the dermis.

To deliver the highest level of reliability, the Oclaro high power laser diodes feature the Oclaro E2 mirror passivation process, which protects the front facet of the bar against Catastrophic Optical Damage. In addition, the Telecom grade AuSn (gold tin) hard solder makes the product suitable for demanding industrial and defense applications in CW and hard-pulse operation mode.

About the P.L.E.A.S.E. ® Platform

P.L.E.A.S.E.® is a novel transdermal delivery method for high molecular weight drugs. It creates controlled aqueous micropores through the stratum corneum into the epidermis. Due to the special features of the device the micropores do not reach the dermis, where nerves and blood vessels reside. The first device using this new platform is the P.L.E.A.S.E.® Professional, a stationary medical laser device targeted mainly for the dermatologic and aesthetic markets. An intelligent graphical user interface, together with the CE mark and the integrated class 1 laser, guarantees simple and safe use by the medical personnel or the patient, who can use the device without supervision. At a later time, this device will then be complemented by the P.L.E.A.S.E.® Private, a battery-powered handheld medical laser device targeted mainly for drug delivery.

http://www.oclaro.com.

Samsung Injects Digital Expertise into U.S. LED Lighting Market

The World's Largest Technology Company Focuses Its Consumer Electronics Proficiency at Rapidly Innovating the Lighting Industry;

Long recognized in the United States as a high-tech powerhouse, Samsung has set its sights on becoming a new leader in the U.S. lighting market as the industry shifts into the digital age. The company announced today it is making its first LED lamps available in the U.S. as the company couples its technological prowess in LED with its deep marketing knowledge in consumer electronics to launch LED lighting solutions into the mainstream professional and consumer market.

Samsung LED Co., Ltd. (www.samsungLED.com) was established globally in April 2009, channeling the company's proven expertise in the electronics and electro-mechanics fields into the production of cutting-edge LED lighting. As a leader in LED technology from chips to TV displays, Samsung already possesses some of the largest LED production facilities in the world, helping ensure quality and reliability across the entire line of products. An American center of operations has been established in Atlanta, Ga., to support the company's expansion into the U.S. market.

"The lighting industry has finally caught up with the digital revolution, with microchip technology powering lamps enabling longer lifetimes, more environmentally-friendly designs and less energy consumption," says Philip Warner, Vice President of Samsung LED America. "The Samsung brand is practically synonymous with consumer electronics. As more and more people recognize the future of home and commercial lighting lies in this amazing digital technology, we are confident Samsung will take a leading position in the market."

Samsung's initial line-up ranges from omni-directional incandescent replacements to fluorescent and PAR replacement lamps for homes and businesses. Samsung's vertically integrated supply chain allows the company to produce all aspects of LED lights, including chips, PKGs, modules, light engines and lamps. The company is also a technology leader in areas of thermal management, optics, power supplies and lighting controls.

Philip Warner, Vice President added that Samsung will put its full research and design might into developing the next generation of LED lamps. "We will not dilute our offerings with high-efficiency incandescent or even CFLs, as these are yesterday's technologies. Our focus is 100-percent on LED," he said.

LED lamps create light by running an electrical current through a microchip. They are increasingly replacing light bulbs in both indoor and outdoor settings due to their higher energy efficiency and longer lifespans compared to traditional incandescent or compact fluorescent bulbs, while providing warm pleasing light.

Cree's New Z-FET™ Silicon Carbide MOSFET

Latest Cree 1200V Z-FET device provides SiC MOSFET energy conservation to 3-10kW solar, power supply and motor drive applications

Providing power electronics design engineers with a way to increase the efficiency of high-volume power inverters for alternative energy and other power electronic applications, Cree, Inc. has extended the product range of its industry-first Z-FET™ family with a lower amperage 1200V SiC MOSFET. The new MOSFET device complements Cree's existing 1200V SiC MOSFET and features a smaller current rating that enables the device to be included in a wider range of applications at a lower price point or used in parallel to optimize system cost and performance.

The new device is designed to replace the silicon transistors (IGBTs) that are currently used in power inverter designs between 3 and 10kW. Applications include high-voltage power supplies and auxiliary power electronics circuits, especially those designed for conversion of 3-phase input power, solar power inverters, industrial motor drives, high-power DC data center power architectures, and PFC (power factor correction) circuits.

"The addition of this new switching device to our Z-FET SiC power MOSFET family gives our customers a greater range of flexibility in matching the price/performance requirements to their applications," said Dr. John Palmour, Cree co-founder and chief technology officer, Cree Power & RF. "The smaller die size provides a lower price point, yet still delivers all the benefits of silicon carbide switching performance at 1200V. It's further evidence that we're committed to establishing a comprehensive range of SiC MOSFET products that we believe will eventually replace silicon devices in many high volume power electronics applications, especially those with 1200V and higher breakdown voltage requirements."

"By using the new Z-FET SiC MOSFETs in conjunction with Cree's silicon carbide Schottky diodes to implement 'all-SiC' versions of critical high power switching circuits and power systems, power electronics design engineers can achieve levels of energy efficiency, size and weight reduction that are not possible with any commercially available silicon power devices of comparable ratings," Palmour explained.

Cree's new SiC MOSFET is rated for 12A at its operating temperature of 100°C and delivers blocking voltages up to 1200V with a typical on-state resistance (RDS(ON)) of just 160mΩ at 25°C. Unlike comparably-rated silicon switching devices, Cree's new SiC MOSFET exhibits an RDS(ON) value that remains below 200mΩ across its entire operating temperature range. This reduces switching losses in many applications by up to 50 percent, increasing overall system efficiencies up to 2 percent while operating at 2 – 3 times the switching frequencies when compared to the best silicon IGBTs. As a result of this improved efficiency, SiC devices have lower operating temperatures and fewer thermal management requirements, which combine with their ultra-low leakage current (e has been a recognized leader in SiC MOSFET process and design development for more than 20 years, demonstrating the first vertical SiC MOSFET devices; the first SiC MOSFETs at >600V; the highest announced voltage MOSFETs

ever produced (10kV); and numerous processing developments to enhance SiC MOSFET interface quality and reliability. Cree has been awarded more than 50 patents on SiC MOSFET technologies, with numerous patents pending.

Designated the CMF10120D, the new SiC MOSFET is housed in an industry-standard TO-247 package.

CMF10120D power devices are fully qualified and released for production. To locate a distributor, please visit www.cree.com/products/power_distr.asp. For more information about Cree's 1200V SiC MOSFET devices or any of Cree's 600V, 1200V and 1700V SiC Schottky diodes, visit www.cree.com/power.

For additional product and company information, please refer to www.cree.com.

Tough LED Light Bars

The CLA Series is the latest addition to PATLITE's family of high intensity LED Light Bars offering 7 light window lengths from 100mm to 1500mm, and protection ratings of IP-66 / 67 / 69K to withstand the high pressures and temperatures of steam jet cleaning

An operating temperature range from -40OC to +60OC and a uniform light pattern make it ideal for food, beverage and pharmaceutical, and a host of other applications where a cool, low-power light source is required. Where glass lensing cannot be used, the high-impact polycarbonate body reduces installation costs since there is no need for protective housings.

Wafer Bonding Report

Yole Développement announces the publication of its technology study and market research report, Permanent wafer bonding report

Historically developed for MEMS & SOI substrates, the wafer bonding technology is today becoming a key processing technology for a wide range of applications including LEDs, Power Devices, RF and Advanced Packaging.

The wafer bonding market is a very complex one crossing different wafer sizes (from 2'' to 12''), different applications (Advanced Substrates such as SOI, MEMS, LEDs, CMOS Image Sensors, Power Devices, RF Devices & Advanced Packaging) and different bonding technologies (Adhesive, Anodic, Fusion, Direct Oxide, Eutectic, Glass Frit, Metal Diffusion).

Yole Développement's report aims at giving a vision, crossing what the wafer bonding technologies will be over the 2010-2016 time line.

Market Trends

Wafer bonding is usually defined as a process that temporarily or permanently joins two wafers or substrates using a suitable process. Historically developed for MEMS and then SOI wafers, wafer bonding technology has shifted to non-mainstream IC applications over the last years. Our report aims at analyzing the market perspectives and technical trends for permanent bonding.

Wafer bonder can be also used for LEDs or Power Devices. Indeed, in a typical LED active region, spontaneous emission scatters photons in all directions. If the substrate material has a smaller band gap than the active region, approximately half of the light is absorbed in the substrate; significantly reducing device performance. So, one of the manufacturing solutions for photon loss involves bonding a wafer containing an array of devices to another wafer that provides both a reflective surface for maximum light extraction and a heat sink for thermal management. And of course, over the 5 past years, much attention has been given to this technology for 3D integration of memories for example.

Technology Trends

Yole Développement has estimated the wafer bonder to have big market growth for the next year. The growth will be driven small size wafer for LEDs and 12" wafer for 3D stacking and CIS.

Although EV Group is market leader in permanent bonding, the growth of the bonding equipment market is attracting challengers.

Yole Développement's report analyzes in details the technical & economical evolution of the permanent wafer bonding process. It gives, for example, 2010-2016 market forecasts for permanent bonding, number of equipment, an overview of the different bonding approaches and equipment players market shares and competitive information

This market & technology report also presents the trends for permanent bonding, W2W vs. C2W analysis for 3D integration. It describes the applications for wafer bonding with main characteristics, challenges

About Permanent Wafer Bonding Report:

- Authors

Dr. Eric Mounier has a PhD in microelectronics from the INPG in Grenoble. Since 1998 he is a co-founder of Yole Développement, a market research company based in France. At Yole Développement, Dr. Eric Mounier is in charge of market analysis for MEMS, equipment & material.

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For special offers and the price in dollars, please contact David Jourdan (jourdan@yole.fr or +33 472 83 01 90)

- Companies cited in the report

Acreo, AML, APM/UMC, Avago, Ayumi, Bosch, Colibrys, Dalsa, Discera, EVGroup, FhG IMS, FLIR, IBM, Icemos, IMEC, IMT, Infineon, Infineon, Invensense, KTH, Leti, Lumileds, MEMStech, Micralyne, Mitsubishi Heavy Industries, Okmetic, Omron, Osram, Qualcomm, Raytheon, RPI, Sand9, Semefab, Sensonor, Silex, SOITEC, STM, SUSS MicroTEC, Tezzaron, TI, tMt, Tohoku University, TowerJazz, Tracit, Triquint, Tronic's, TSMC, VTI, Xcom, Ziptronix

Samsung injects digital expertise into U.S. LED lighting market

The company is focusing on rapidly innovating the lighting industry and aims to take LED lighting solutions beyond U.S. early adopters.

Long recognised in the United States as a high-tech powerhouse, Samsung has set its sights on becoming a new leader in the U.S. lighting market as the industry shifts into the digital age.

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Lumiled's LUXEON A moves into volume production

With Freedom From Binning, the LUXEON A LED provides consistent quality of light from LED to LED which is something that both luminaire manufacturers and lighting designers wish to achieve.

LUXEON A, announced earlier this year, has moved into volume production and has been submitted for an Innovation Award at Lightfair 2011.

This is the second hot tested and specified LUXEON LED from Philips Lumileds this year that also delivers on the promise of Freedom From Binning.

With LUXEON A, luminaire manufacturers will
- *hold less inventory*
- *reduce testing requirements*
- *get energy saving solutions to market more quickly*

Philips Lumileds has committed to deliver illumination grade LEDs to the industry in a concerted effort to simplify and speed development of new lighting solutions and to deliver the highest quality of light for each application. Advanced manufacturing control allows the company to so accurately target a specific correlated colour temperature that each LUXEON A LED falls within one 3 step MacAdam ellipse space at actual operating conditions.

"Key to increased adoption of LEDs are ease-of-use, and confidence in the quality of light," said Steve Barlow, Sr. VP of Sales and Marketing. "Lumileds is simplifying and accelerating the design process with hot testing and Freedom From Binning. More importantly, with LUXEON A we are proving that consistent quality of light from LED to LED is something that both the luminaire manufacturer and lighting design community can count on today and into the future."

LUXEON A is featured at the company's LIGHTFAIR stand in a linear profile intended to demonstrate the consistency and quality of the emitted light. The entire LUXEON portfolio will be presented so that the lighting community can see and touch the latest LED technology that's being

implemented in solutions for homes, offices, shops, and schools.

LUXEON A is in full volume production and is available from Future Lighting Solutions.

Samsung LED to boost HB LED production with Aixtron

Following successful commissioning of the first two G5 systems in 2010 and at the beginning of this year, the company is now expanding its capabilities through Aixtron´s latest generation of AIX G5 HT MOCVD reactors.

Aixtron SE has a large multiple order for the industry standard LED production platform AIX G5 HT MOCVD Planetary Reactor from Samsung LED.

Samsung LED has been using AIX 2800G4 HT GaN MOCVD systems for several years. Following successful commissioning of the first two G5 systems in 2010 and at the beginning of this year, the company now sought to expand its capabilities through Aixtron´s latest generation of AIX G5 HT MOCVD Planetary Reactors.

The new systems will be installed within this year at Samsung's latest state-of-the-art production facility. They will be used for volume production of high brightness (HB) blue and white GaN-based LEDs for television back-light units (BLU) and LED lamps for solid-state lighting applications.

Aixtron Vice President Sales, Bastian Marheineke comments,"Having become the leading local supplier for GaN-based HB-LEDs in Korea, Samsung LED has continually expanded capacity. Once again this will be achieved by adding more reactors of choice from Aixtron. The new reactors will further ensure Samsung LED's determination to stay at the forefront of LED production for volume applications."

Formed in April 2009, Samsung LED has been recognised as one of the fastest growing LED manufacturers in the world. Today, Samsung LED is an innovator in the LED BLU module industry and is equipped with what it claims is the world's best technology. The ultra-slim BLU module minimises the thickness of all sorts of displays such as TVs, notebook PCs, monitors, DIDs, and so on. Samsung aims to become the Global Top LED company within this year.

Elec-Tech orders multiple MaxBright MOCVD tools

By adding Veeco's new multi-chamber MaxBright, Elec-Tech expect to be able to compete in a very high-production environment and drive down the cost of LEDs.

Veeco Instruments has announced that Elec-Tech International has placed a multi-unit order for Veeco's recently released TurboDisc MaxBright MOCVD System for production of high-brightness HB LEDs at its facility in Wuhu, China.

Tony Wang, Chairman of Elec-Tech commented, "As we have previously stated, our goal is to become one of the top three LED companies by output and sales revenue in China within two years, and we have an aggressive plan to achieve this goal. By adding Veeco's new multi-chamber MaxBright, we expect to be able to compete in a very high-production environment and drive down the cost of LEDs. We are excited by what we have seen with MaxBright in terms of its cost-of-ownership model, ease-of-use, and the great footprint advantage it will offer us in our fab."

Wang added, "When we selected Veeco last year as our primary equipment supplier, it was not just because of the success of the K465i, but also because of the roadmap they shared with us on the new multi-reactor MaxBright system. Also, Veeco's service and support has been excellent, so we have a lot of confidence giving them these additional orders for our capacity ramp."

William J. Miller, Executive Vice President, Veeco LED & Solar added, "Elec-Tech is moving fast to ramp capacity and gain share in the LED market. We are pleased to be able to support this ramp with our latest generation MaxBright product."

Full-colour QLED displays move closer to reality

QD Vision's quantum dot LEDs are claimed to achieve significantly higher efficiency and performance improvements over their equivalent OLED counterparts.

QD Vision, a developer of nanotechnology-based products for displays and solid state lighting, has taken major strides towards improving the efficiency and performance of its quantum dot LED (QLED) technology.

QLEDs offer all of the functional benefits of emissive display technologies, with the added advantage of simplified manufacturing processes and the potential to consume half of the power of the most efficient OLEDs.

QD Vision's red, green and blue QLEDs now meet or exceed the 1953 NSTC colour standard without using colour filters or secondary effects. The exceptional colour performance of QLEDs translates into a fundamental 30-40% luminous efficiency advantage over the best known OLED technology.

"The unique combination of extraordinary colour, high efficiency, demonstrated stability and low-cost patterning makes QLEDs the next breakthrough in electroluminescent technology for displays and solid-state lighting applications," said Seth Coe-Sullivan, QD Vision Chief Technology Officer.

QD Vision says it's deep red QLEDs now offer greater efficacy at equivalent colour than the best reported phosphorescent OLEDs, and its green and blue QLEDs match the performance of fluorescent OLEDs, but with far superior colour performance. For example, red QLEDs fabricated by QD Vision consistently achieve peak external quantum efficiencies (EQEs) of more than 18% and efficacies of more than 22 lm/W and 18 Cd/A, at 1931 CIE colour coordinates of (0.68, 0.32).

Philips unveils first LED replacement for 75W incandescent

While reducing energy consumption by 80% and lasting 25 times longer, Philips says its EnduraLED A21 17W marks another important milestone in LED lighting technology for everyday use.

Royal Philips Electronics, a manufacturer of LED lighting products, will unveil the Philips EnduraLED A21 17W light bulb at the LIGHTFAIR International tradeshow during May 17-19, 2011.

Designed to replace a 75W incandescent bulb, while reducing energy consumption by 80% and lasting 25 times longer, the Philips EnduraLED A21 17W marks another important milestone in LED lighting technology for everyday use.

"We continue to test the boundaries of LED innovation with exciting products that provide energy efficiency, ambiance and extraordinary reliability," said Ed Crawford, General Manager of Lamps for Philips Lighting North America.

"Once again we have demonstrated that consumers do not have to wait for quality alternatives to the incandescent or to sacrifice the soft white light they have become accustomed to because LED can deliver all the benefits without compromising quality."

The EnduraLED A21 17W is the latest addition to Philips' comprehensive portfolio of light-emitting diode (LED) bulbs that can efficiently replace incandescents. These include 25W and 40W equivalents, as well as the ENERGY STAR-qualified Philips EnduraLED 12.5W bulb, the world's first commercially-available 60W replacement.

The EnduraLED A21 17W, which uses the company's high-power, next-generation LUXEON LEDs, has also been developed to meet or exceed ENERGY STAR qualifications for an LED-based replacement for the 75W incandescent light bulb. Those specifications call for delivering 1100 lumens with just 17W of electricity, a colour temperature of 2700k, a colour rendering index (CRI) of 80, and a rated life of 25,000 hours. The new bulb will be submitted to ENERGY STAR in the coming months

for qualification testing.

Philips estimates that about 90 million 75W incandescent light bulbs are sold annually in the United States. Switching to this LED replacement has the potential to reduce energy use by 5,220 megawatts of electricity, a cost savings of approximately $630,000,000 annually. According to Philips estimates, switching to the EnduraLED 21 17W could also eliminate 3,255,205 million metric tons of carbon emissions annually, or the equivalent of removing nearly one million cars from the road.

As with all bulbs in the Philips LED lighting family, the new EnduraLED A21 17W has a rated life of 25 times longer than a standard incandescent bulb. Over its lifespan, the EnduraLED A21 17W could save a business or household about $160 per bulb. Available during the fourth quarter of 2011 in the US, the manufacturer's suggested retail price for consumers has not yet been finalised but is expected to be in the range of $40 - $45.

In addition to offering familiar soft white light, the Philips EnduraLED A21 17-watt fits into existing fixtures and works with standard dimmers, giving consumers a simple, long-lasting solution for the home. For those within the retail or hospitality sector, Philips says the bulb will provide a substantial return on investment, through extended bulb life and reduced energy and maintenance costs.

Ultratech to open HB-LED development facility in Taiwan

Scheduled to open in the second half of 2011, the Asia Technology Centre (ATC) will contain a class 1000 cleanroom that will aid developing cost-effective, scalable HB-LED manufacturing processes.

Ultratech, a supplier of lithography and laser-processing systems used to manufacture semiconductor devices and high-brightness LEDs (HB-LEDs), has opened the Asia Technology Centre (ATC) in Taiwan.

The integrated cleanroom provides the capability for leading-edge process development and in-depth demonstrations of Ultratech's Sapphire 100 lithography system, designed for customers in the emerging HB-LED market. To further support the company's Singapore international operations facility, announced last year, this centre will enable cost-effective, leading-edge process development that can be transferred between sites or across Ultratech's large customer base throughout the Pacific Rim. Scheduled to open in the second half of 2011, the ATC furthers Ultratech's ongoing commitment to meet its international customers' needs with advanced technology solutions at the lowest cost-of-ownership.

Ultratech Chairman and CEO Arthur W. Zafiropoulo said, "With many of our customers located in the Pacific Rim, opening our Asia Technology Centre in Taiwan enables us to work with leading companies to develop processes and lithography equipment advances to reduce the cost of manufacturing LEDs. In addition, the facility will be used to provide yield research as well as low-cost patterning solutions."

"Ultratech remains vigilant in its search for ways to provide low-cost solutions to support the significant growth in the HB-LED markets. We look forward to leveraging our Asia Technology Centre to help speed the development of cost-effective lithography processes to support our customers' product and technology roadmaps for new and emerging markets," he concluded.

Building upon the cost and performance advantages of the 1500 platform, the next-generation Sapphire 100 system provides the best operational flexibility due to the fundamental benefits of the 1X lens design and market-specific technology options for high-volume, HB-LED manufacturing. The Sapphire 100 was specifically designed to meet the wide range of lithography needs and cost advantages for the HB-LED manufacturing industry.

FZLED introduces TriAC-dimmable GU60 LED bulbs

Made to fit E26, E27, GU10, and B22 sockets, the bulbs have lifetimes of more than 35,000 hours, beam angles of 120 degrees, and utilise high-quality Samsung SMD LEDs as their lighting

source.

FZLED, maker of high-performance LED lighting products, has revealed its all new GU60 LED Bulb Series. The series comprises high-quality LED bulbs, including 7 and 9 watt models and are available with or without TriAC-dimming functionality. They fit E26, E27, GU10, and B22 sockets, making them extremely versatile. In the GU60 LED bulb series, the lens are frosted and fins are available in silver or black
to give consumers the look they desire.

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FZL-GU60-00-07TD Series

Emitting no harmful UV or IR rays and with very low heat emissions, these high-performance, energy-saving LED bulbs are an excellent lighting product to use for indoor, architectural, flood, mood, and spot lighting situations in both homes and businesses.

With the 7 watt model, consumers can choose a 3000K CCT that provides warm white light and a luminous flux (lm) of 300 or a 6000K CCT that provides a brighter cool white and lm of 400. In the 9 watt model lm reaches 400 with 3000K CCT and 500 with 6000K CCT.

Additionally, these energy-saving bulbs have lifetimes of more than 35,000 hours, beam angles of 120 degrees, and utilise high-quality Samsung SMD LEDs as their lighting source. Made to the exacting quality standards of FZLED and with an operation temperature range of -20°C to 40° C as well as an input voltage range of AC 100-264V, GU60 LED bulbs can be used in almost all situations.

FZLED's GU60 Series of TriAC-dimmable LED bulbs are currently available in Taiwan and Singapore.

With an Ra > 75 for cool white, the bulbs have a high power driver efficiency above 87%, and are CE, FCC and ETL approved.

GT Solar continue to cash in Asia

The firm has won $91 million worth of orders for its advanced sapphire furnaces from Taiwanese based Alpha Crystal Technology and Tera Xtal and the Lingyang Group based in China.

GT Solar International, a global provider of sapphire and silicon crystalline growth systems and materials for the solar, LED and other specialty markets, has received three new orders totalling $91 million for its advanced sapphire crystallisation furnaces (ASF).

Two of the orders are from customers in Taiwan, Alpha Crystal Technology, a new customer, and Tera Xtal, who last week announced a sapphire material purchase agreement with GT Solar. The third order comes from a new customer in China, the Lingyang Group.

"These new orders continue a very robust order rate for our ASF furnaces," said Tom Gutierrez, GT Solar's president and CEO. "The interest shown by new market entrants and existing sapphire producers for our ASF systems has surpassed our expectations and is a testament to the confidence customers have for our proven ability to quickly ramp to high volume, low-cost manufacturing with leading edge crystal growth technology to meet the market demand for high quality sapphire material."

GT Solar says its crystallisation process technology and global support resources offer customers a path to productive and profitable sapphire manufacturing operations with high levels of throughput and a greater return on their investment.

GT Solar to sue ARC Energy

GT Solar says that ARC and two of its employees have used trade secrets relating to GT Crystal Systems' technology for manufacturing sapphire crystals, as a means of entering the sapphire crystallisation equipment business.

GT Solar International subsidiaries, GT Crystal Systems, LLC and GT Solar Hong Kong, Limited have filed a lawsuit in the Hillsborough County Superior Court (Southern District) in New Hampshire against Advanced RenewableEnergy Company, LLC (ARC).

The firms also plan to sue Kedar Gupta, ARC's Chief Executive Officer and Chandra Khattak, an ARC employee, for the misappropriation of trade secrets relating to sapphire crystallisation processes and equipment.

The complaint alleges that ARC and the named individuals misappropriated trade secrets relating to GT Crystal Systems' technology for manufacturing sapphire crystals, as a means of entering the sapphire crystallisation equipment business. The complaint further alleges civil conspiracy, unfair competition, breach of contract and interference with contractual relations.

"We have an obligation to our shareholders to be diligent about protecting our intellectual property," said Hoil Kim, GT Solar's General Counsel. "When we believe our intellectual property has been compromised, we will take the necessary action to protect our rights."

Optogan appoints new International Sales Director

The firm has employed Ove Sörensen who previously worked at Philips Lumileds, and has considerable experience in the introduction of high power LEDs into emerging markets.

LED manufacturer Optogan has appointed Ove Sörensen as new Director Sales and Business Development EMEA for the development of the international sales network in Europe, Middle East and Africa.

Ove Sörensen, 41, will be based in Germany´s Bavarian Landshut and conducting the international business and expansion of the Optogan Group into new markets. Moreover, he will work on a worldwide distribution and trading network with Solid State Lighting (SSL) manufacturers.

Ove Sörensen is the new International Sales Director at Optogan GmbH

The products of the European LED chips and luminaire manufacturer Optogan are experiencing an uninterrupted boom in Russia. In 2010, Optogan launched its international sales activities. Due to rapidly increasing demand in global markets for LEDs "made in Germany", the Optogan Group enforced its activities by creating the new position of the Director Sales and Business Development EMEA.

"Ove Sörensen is a perfect fit to our management team. He qualifies himself due to his excellent achievements in the LED industry and broad experience in international sales, marketing and management," said Markus Zeiler, General Manager Global **Sales and Marketing of the Optogan Group.**

Before joining Optogan, Sörensen was working at Philips Lumileds, in Eindhoven, The Netherlands. At the time he joined the company in 2004, he first took over the position of Sales Manager for the regions of Great Britain, Benelux and Scandinavia. In 2007 he was appointed as Sales Director for Northern and Eastern Europe. Within this period he contributed greatly to the introduction of high power LEDs into emerging markets and expanded the

customer base for Philips Lumileds significantly.

Previously, Sörensen held senior sales and marketing positions at various companies. Among others, he succeeded as "Sales Director Government" in building up a government oriented tender business for Holland's biggest system integrator. In 2000 as the youngest ever recipient, Sörensen was awarded the coveted Top Manager of the year. He is fluent in English, German, Dutch and Norwegian.

The economist and MBA looks forward to introducing the benefits and excellent opportunities of the Optogan group to the international lighting market. "Our first priority in international Sales, is the latest generation of Chip-on-Board and customized LED modules. Apart from the advantage of our outstanding technology and competitively priced products, we are also working with our SSL customers, the leading luminaire manufacturers, to build a partner network for the Russian market."

"With Ove Sörensen, we have managed to engage an international Top Manager as Director Sales and Business Development for Optogan securing our long-term business success. Our customers appreciate the experienced and highly motivated sales team led by Ove Sörensen", said Alexey Kovsh, Executive Vice President of the Optogan Group.

Osram unveils feel-good "Brilliant-Mix" LED

The new LED concept from Osram Opto Semiconductors achieves 30 % greater luminous efficacy with a high colour rendering index.

Warm white light with a high luminous efficacy (110 lm/W) and a colour rendering index (CRI) of more than 90 are the result of the new "Brilliant-Mix" concept from Osram Opto Semiconductors. The intelligent colour mix based on powerful Oslon SSL LEDs in EQ-White and Amber covers a broad white spectrum from 2700 to 4000 K. Depending on the required luminous flux, a different number of these LEDs can be combined to produce warm white feel-good light of high quality that will set new standards in general illumination applications.

The natural warm white light, which provides realistic rendering of colours and skin tones, comes from the new "Brilliant Mix" LED concept from Osram Opto Semiconductors

This new LED concept is backed by in-depth Osram know-how in terms of the high-power Oslon SSL LED, expertise in colour mixing and control and project-specific customer support. The main applications for the new concept include high-quality lighting solutions for residential and commercial premises such as shops and offices.

The high quality of the light is based on the combination of a pleasant warm tone and very high colour rendering properties. The high CRI ensures that colours and skin tones appear in artificial light as natural as they do in normal daylight. Test colours R9 (saturated red) and R13 (skin colours) are crucial for the natural rendering of red and skin tones. With CRIs of 78 and 98 respectively they have much higher values than most conventional light sources.

The typical value for the general colour rendering index Ra (averaged sum of test colours R1 to R8) is 92 at a colour temperature of 2700 K. The luminous

efficacy is also exceptionally high at more than 110 lm/W. For a comparable colour temperature and comparable CRI that is 30 percent higher than warm white LEDs that produce white light using the principle of phosphor conversion. Even in a retrofit lamp system this concept can achieve 100 lm/W at system level.

Oslon SSL LEDs in EQ-White and Amber are used in the "Brilliant Mix" concept. Measuring just 3 mm x 3 mm, these LEDs are among the smallest in the 1 W class and can be closely clustered. This makes colour mixing easier and also improves the optical design at system level.

To make it as easy as possible for customers to select and order the appropriate LEDs we have developed a logistical module concept. Christian Neugirg, Business Development Manager SSL at Osram Opto Semiconductors explains: "Planning and implementing LED lighting systems requires an immense amount of calculation, so we are relieving our customers of this tiresome task. Customers simply have to tell us the light colour, the temperature of the board and the luminous flux they want to achieve, and our logistical module concept then works out which LEDs and how many need to be ordered to meet these requirements perfectly."

The semiconductor specialist also offers application support for selecting the correct electronic control. Lamp and luminaire manufacturers therefore have new opportunities to create LED lighting solutions with warm white light and high brightness levels. Everything is now in place for LEDs to be used more and more for general illumination purposes without having to compromise on lighting comfort.

The "Brilliant Mix" concept has already been implemented in the Parathom Pro Classic A 80 LED lamp and in the PrevaLED system from Osram. These demonstrate the high quality of light that can now be achieved with LEDs.

Avago HB-LEDs offer manufacturing simplicity

The firm's new PLCC-2 LEDs deliver superior light output for reduced LED count in signage and gaming machine backlighting, and offer tight colour uniformity for linear lighting.

Avago Technologies, a supplier of analogue interface components for communications, industrial and consumer applications, has revealed a white high-brightness LED in a robust surface-mount (SMT) package that simplifies manufacturing.

The new ASMT-UWB1 LEDs are available in a Plastic Leaded Chip Carrier (PLCC)- 2 package encapsulated in a heat-resistant silicone resin, enabling them to operate in a wide range of environmental conditions with high reliability and long operating life.

The superior light output of the ASMT-UWB1 LEDs enables reduced component count to cut overall system costs. This high-brightness performance, along with a wide 120-degree viewing angle, makes the LEDs well-suited for illuminated advertising, backlighting of vending and gaming machines, as well as for office automation, electrical appliances and industrial equipment.

Designers are choosing SMT LEDs because of their ease of assembly, compact footprint, and manufacturing flexibility, which combine to reduce overall system development costs. The ASMT-UWB1 SMT LEDs are packed in EIA-compliant tape and reels for simplified pick and place assembly. Each reel is shipped from a single intensity and tight colour bins following the ANSI C78.377-2008 colour binning structure to provide better uniformity.

The LEDs also feature a low forward voltage value, with a maximum of 3.6V. This results in low power consumption for end-applications.

Additionally, the ASMT-UWB1 is compatible with reflow soldering processes and is lead-free and RoHS compliant. It has moisture sensitivity compliant to JEDEC MSL 3 and electro-static discharge sensitivity compliant with JEDEC HBM 1000V.

In the U.S, the ASMT-UWB1 LEDs are priced at $0.21 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.

Cree LMR4 LED outshines 100W incandescents

Emitting 1000 lumens, the LMR4-1000 module provides higher quality light and efficiency, using 42 % less input power, than 26 W compact fluorescent bulbs.

Cree, an innovator in LED lighting, has revealed the new 1000 lumen LMR4 LED module, delivering 66 lumens per watt efficiency in a fully-integrated solution for downlight applications where high-quality light is essential such as commercial, retail and residential.

Featuring Cree TrueWhite Technology, the LMR4-1000 module provides higher quality light and efficiency, using 42 % less input power, than 26 watt compact fluorescent bulbs. Cree says the LMR4-1000 is also the only commercially available 2700 K LED module to deliver 1000 lumen output at more than 90 CRI, which can replace 100 watt incandescent bulbs in downlight applications.

"The LMR4-1000 has the proven technology to enable our customers to quickly and easily incorporate beautiful, energy-efficient LED lighting into the marketplace," said Scott Schwab, product line manager, Cree LED modules.

"Building on the success of Cree's LED module family, the LMR4-1000 provides high-quality light that meets the design requirements for applications such as restaurants, hotels and homes, continuing Cree's innovation in drop-in ready, integrated solutions for the LED lighting market," concluded Schwab.

The Cree LED Module LMR4-1000 integrates driver electronics, optics and primary thermal management, making the compact Cree module drop-in-ready. Designed to last 35,000 hours and dimmable to 5 %, the LMR4-1000 module is available in colour temperatures of 2700 K, 3000 K, 3500 K and 4000 K with more than 90 CRI.

The Cree LED Module LMR4 is available now with standard lead times, and sample evaluation kits are available now directly from Cree's website, www.cree.com/modules.

LED outlook remains bright upstream

IMS Research says that Veeco is inching its way towards Aixtron in the MOCVD reactor market. While Veeco was the number one provider of MOCVD tools in China and Europe, Aixtron led in Korea, Taiwan and the USA.

IMS Research's latest "Quarterly GaN LED Supply and Demand Report" says that although Q1'11 MOCVD installations were down, ending a 7-quarter streak of sequential growth, the 2011 outlook remains bright for MOCVD and other upstream equipment and materials suppliers.

Global merchant MOCVD reactor shipments fell 18% Q/Q while rising 31% Y/Y to 194 units with GaN LEDs the dominant application with a 97% share. Veeco gained a point of market share to 44% of total MOCVD reactor shipments and maintained its 44% of the GaN MOCVD market. Aixtron maintained its leadership position in both segments, losing a point of market share in total MOCVD from 53% to 52% and maintaining a 53% share of the GaN MOCVD market.

Regionally, China dominated the GaN MOCVD market as expected, accounting for a 74% share, up from 64% with Taiwan maintaining a 20% share (see Figure). 23 different companies installed tools in China with 9 companies installing in Taiwan.

San'an Optoelectronics remained the dominant customer for the second consecutive quarter, accounting for over 20% of tools installed in Q1'11. The top 3 and 7 of the top 10 MOCVD customers in Q1'11 installed tools in China. Veeco was #1 in China and Europe while Aixtron led in Korea, Taiwan and the USA.

According to IMS Research SVP Ross Young, "Looking forward, we are not seeing installations being pushed out in China. We expected to see some delays, but we have only reduced our 2011 forecast by 8 reactors from 1097 to 1089. A number of companies also provided us with their 2012 plans regardless of whether or not there are MOCVD subsidies. Other incentives and the prospect for rapid growth in LED lighting are proving powerful enough to enable continued investment in LED capacity in China in 2012."

Significant growth is expected in Q2'11 and Q4'11 resulting in the 1089 GaN MOCVD reactor unit forecast which will be up 36% Y/Y. China is expected to account for 820 tools, up 181%. China is expected to account for 75% of the 2011 MOCVD market, up from 36% in 2010. It is the only region expected to show Y/Y growth. Taiwan is expected to be the #2 region with a 16% share, down from 36% on a modest decline of 14% with Korea down 85% to 33 tools. China's Q4'11 installations alone are expected to be larger than the entire worldwide 2009 market. Each manufacturer's planned 2011 installations are included and compared with 2009 and 2010.

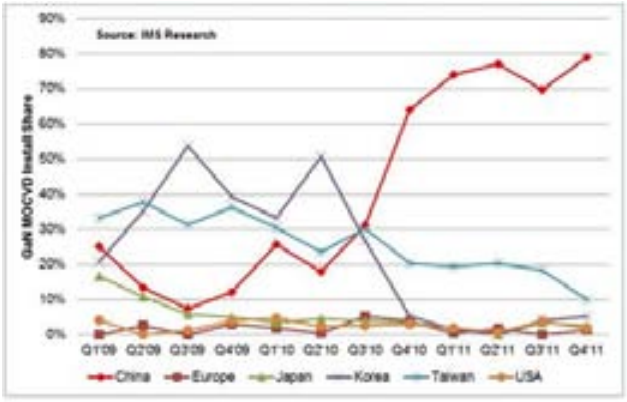


Figure. GaN MOCVD installations by Quarter

The "Quarterly GaN LED Supply and Demand Report" quantifies LED supply, demand, pricing, market size and much more. Each panel manufacturers' LED configurations and LED consumption are provided at every size, resolution and refresh rate along with their conventional and LED panel shipments and projections.

The report also tracks all other segments including lighting, automotive and signage by die size in units and revenues with market sizes projected out to 2015 in units and revenues. MOCVD shipments and share are segmented by manufacturer, region and tool type. A rolling MOCVD 4-quarter forecast is provided by LED manufacturer and MOCVD and LED supply and demand are projected out to 2015.

Veeco boosts its support efforts in Shanghai

The company has installed a new training centre which is designed to help its Chinese customers ramp up production of LEDs.

As part of its significant expansion in Asia announced last Autumn, Veeco Instruments has officially opened its new China Training Centre (CTC) in Shanghai in order to better support the rapid growth of the LED industry and the needs of its customers.

The official grand opening featured the attendance of many honoured guests, including several of Veeco's key Chinese LED customers and important local government officials.

At the ribbon-cutting ceremony, John R. Peeler, Veeco's Chief Executive Officer, commented, "China is making an enormous investment to become a world leading manufacturer of LED, both for its own domestic consumption and to export. In fact, China has stated targets to convert 30% of the domestic lighting market to LEDs by 2015. China represented nearly 30% of Veeco's 2010 revenue, or $267 million, up from $30 million in 2009, and Chinese companies will potentially represent over half of our $1 billion-plus revenue forecasted for 2011. We shipped MOCVD tools to 20 customers last year, including existing LED manufacturers, joint venture companies as well as some new start-up enterprises. We are excited to be opening our new Shanghai customer training and support centre

to support this explosive growth and strengthen our leadership position in China."

Peter Collingwood, Veeco's Senior Vice President, Sales & Service, added, "Many of our customers are building or significantly expanding factories, often in new "LED/green energy" parks. Our training centre in Shanghai was therefore developed specifically to help our Chinese customers "go faster' to ramp production of LEDs."

The CTC site, about 1700 square metres in size and housing approximately 40 Veeco employees, is equipped with three classrooms as well as Veeco's market leading TurboDisc K465i MOCVD system. Training will include TurboDisc MOCVD system introduction, epitaxial process characterisation, and more advanced hands-on training classes in hardware maintenance and trouble-shooting.

Justin Wang, General Manager, Veeco Greater China region, added, "This training centre is the first of its kind to be established for the LED industry in China. Our goal is to train hundreds of engineers to use our MOCVD tools in the next 12 months."

According to Peeler, "Veeco will invest over $30 million in 2011 to dramatically expand its Asia footprint to help customers continue to accelerate the pace of adoption of LEDs for consumer electronics and solid-state lighting, including additional new R&D/demo and process support sites in Hsinchu, Taiwan (opening in August) and Seoul, Korea (opening early 2012)."

Samsung and Evident Tech sign QD LED patent agreement

Samsung will gain access to Evident's patent portfolio for all products related to quantum dot LEDs from manufacture of the quantum dot nanomaterials to final LED production.

Evident Technologies and Samsung Electronics have entered into a comprehensive patent licensing and purchasing agreement for Evident's quantum dot LED technology.

This agreement grants Samsung worldwide access to Evident's patent portfolio for all products related to quantum dot LEDs from manufacture of the quantum dot nanomaterials to final LED production.

"We are excited that Samsung, the leader in consumer electronics, has licensed our quantum dot technology," said Clint Ballinger, CEO of Evident Technologies. "We already enjoy a terrific working relationship and look forward to the future of this technology."

Quantum dots are nanometre-sized semiconductor crystals that have great commercial promise in electronic applications from solar energy conversion to thermoelectrics to LEDs. Evident was the first company in the world to commercialise quantum dot LEDs with products launched in 2007.

Evident Technologies is currently focused on developing next-generation thermoelectric applications using their core quantum dot material technology. "Our goal is to greatly increase the performance of thermoelectric devices through our nano-material advances," says Ballinger. Thermoelectric devices can be used for solid-state heating and cooling as well as for converting waste heat into electricity directly.

Epistar honours Dow with first-ever supplier award

The firm was recognised for its supply of metalorganic precursors used in the manufacture of LEDs and for its exceptional customer support.

Dow Electronic Materials, a business unit of Dow Advanced Materials, has announced that Epistar Corporation, a world leading high brightness LED epiwafer and chip manufacturer, has awarded its first-ever Supplier Award to the Metalorganic Technologies business of Dow Electronic Materials.

As a supplier to Epistar of metalorganic precursors for the manufacture of high brightness LEDs, Dow was recognised for ensuring the supply of precursor materials, improving product quality, providing excellent material and process support for manufacturing, offering superior customer communications and achieving high customer satisfaction.

"Dow has demonstrated itself to be an exceptionally trustworthy partner over the past year that deserves more than an excellent supplier award," said BJ Lee, Chairman of Epistar, upon presenting the award. "Dow is a key, long-term supplier that we rely on for critical materials and technical service, both now and in the future. We are honoured to recognise Dow's hard work with our first annual Supplier Award acknowledging its contributions to our strong growth over the past year."

Epistar Corporation presents its first annual Supplier Award to the Metalorganic Technologies business unit of Dow Electronic Materials. Pictured from left to right are Leo Tsay, Greater China Sales & Operations Director and Joe Reiser, Global Business Director for Dow Electronic Materials and BJ Lee, Chairman and MJ Jou, President of Epistar Corporation.

The ceremony took place on March 30, 2011 in Epistar's facility in Hsinchu, Taiwan. Attending on behalf of Epistar were BJ Lee; MJ Jou, President; Jack Lin, logistics director; and Cathy Lin, procurement deputy manager.

Also attending were Derek Ma, vice director of Huga Optotech, a leading manufacturer of LED semiconductor devices dedicated to LED chips and wafer production. Accepting the award for Dow's Metalorganic Technologies business were Joe Reiser, global business director; Leo Tsay, greater China sales and operations director; and Johnny Chien, Taiwan sales manager.

"Customer satisfaction and responding to each customer's requirements is at the core of how we operate as a company," said Reiser. "It is a tremendous validation of our efforts to receive this recognition from Epistar, which acknowledges the quality of products, technical expertise and personnel we bring to every customer. We look forward to building on our cooperation with Epistar and continuing to enhance our product and service offerings to increase our support in the future."

Exceptionally high-quality materials and precise delivery of metalorganic precursors are essential to building reliable LEDs. Dow Electronic Materials is the leading supplier of precursors to the LED market, including trimethyl gallium (TMGa), which are used to create the electroluminescent films in LED chips through a chemical vapor deposition (CVD) process.

In addition to developing and supplying advanced materials for LED manufacturing, Dow Electronic Materials also offers the VAPORSTATION Central Delivery System for bulk delivery of CVD precursors to multiple reactors and other patented delivery technologies for both liquid and solid precursors.

GT Solar to supply sapphire to Tera Xtal

The firm will provide the Taiwanese firm with sapphire to produce LED epitaxial-ready wafers.

GT Solar International, a global provider of sapphire growth systems and materials for the LED and other specialty markets, has signed an agreement with leading Taiwanese LED wafer manufacturer, Tera Xtal Technology Corporation.

GT Solar will supply Tera Xtal sapphire cores for increasing their production of epitaxial-ready LED wafers.

"We are increasing our volume of epi-ready wafers to meet rising customer demand," said Steven Liu, President of Tera Xtal. "We have had a successful, long-standing relationship with Crystal Systems, now GT Solar, and have come to rely on their ability to provide us with LED sapphire material that meets our high standards for quality. We look forward to continuing our relationship with GT Solar into the future."

"We are pleased that Tera Xtal has selected GT Solar to provide them with LED sapphire material to meet their increased production needs," said Tom Gutierrez, president and CEO of GT Solar.

"Our ability to supply sapphire cores to a leading LED industry player such as Tera Xtal not only demonstrates the quality of the sapphire produced by GT's proprietary Advanced Sapphire Furnaces but also provides support to our expanding universe of equipment customers as they ramp into production over the coming year."

GT's new sapphire production facility increases the availability of high quality sapphire material for its LED and specialty market sapphire customers. Initially, material allocation will satisfy both LED and specialty market customers, but long term, as its equipment customers ramp into high volume production, GT expects that the majority of its sapphire production to be allocated to meet new specialty market growth in areas such as high energy lasers, medical devices, and applications requiring large area substrates for the aerospace and defence industries.

TV apps to dominate LED Demand through 2013

DisplaySearch says that LED lighting will take over in 2014 and the LED penetration rate in large-area backlighting is forecast to reach 70% in 2011.

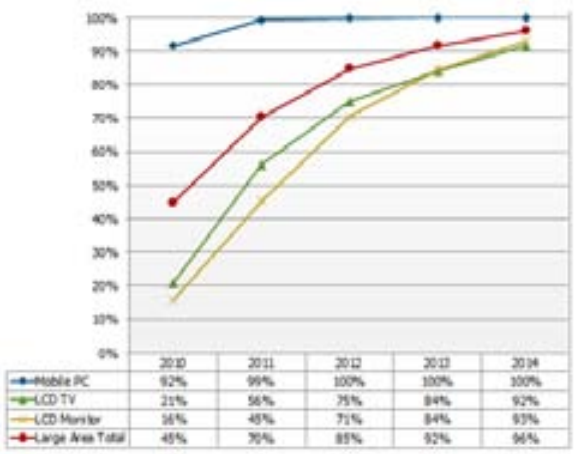
Demand for LEDs continues to rise, with TV applications forecast to dominate LED demand through 2013, accounting for nearly 50% of total LED backlight market demand.

According to the DisplaySearch Quarterly LED Supply/Demand Market Forecast Report, LED lighting will capture the lead by 2014, as demand for LEDs in LCD TV backlights falls. This drop is expected due to a decrease in the number of LED packages per set—a result of efficacy enhancements and cost reductions.

"The market for LED backlights continues to grow as manufacturers leverage the technology for large display applications like notebooks, monitors, and TVs," noted Leo Liu, Senior Analyst at DisplaySearch. "In addition, there are a growing number of emerging applications for LEDs, such as lighting, signal, and automotive applications."

Currently, LED backlights are used in all small/medium LCDs, and LED penetration in mobile PCs is nearly 100%. Penetration of LEDs in LCD monitors and LCD TVs continues to grow, while the number of LED packages per set is decreasing. After more than doubling to 12.9 in 2010, the average number of chips per set is increasing more slowly, and is expected to peak at 15.1 in 2012. This is driven by the increasing efficacy of LEDs, even as the cost per chip decreases. This virtuous cycle drives LED penetration higher in LCD backlights, as well as illumination.

Figure 1. DisplaySearch Large-Area LED Market Penetration Forecast by Application (Shipments)



Source: *Quarterly LED Supply/Demand Market Forecast Report*

The LED lighting penetration rate in 2010 was 1.4%, and is forecast to reach 9.6% in 2014. In terms of LED lighting, spotlights and LED street lights are forecast to have higher penetration in lighting due to government incentive programs like the 12th Five Year Policy in China, as well as growth in commercial applications. In addition, LED bulbs and fluorescent tubes are growing in Japan due to government incentive programs (Eco-Point) and energy consciousness.

Quarterly chip supply will nearly double from the beginning of 2010 to the end of 2011, as both existing and new suppliers ramp up MOCVD lines. In Q1'11, Samsung and LG were the top two LED suppliers in terms of 500 x 500 µm chip size. However, led by Epistar in the #3 position, Taiwan will pass Korea as the largest source of supply in 2011. The tight supply situation experienced in 2010 has turned into an oversupply, as chip production has increased while LED TV penetration did not

grow as fast as expected, reaching only 21% in 2010.

Kyma cashes in with $400k grant

The firm is one of 16 selected by North Carolina Green Business Fund to improve its plant efficiency by a very significant amount.

Kyma Technologies, a supplier of ultra-high purity crystalline GaN and AlN materials and related products and services, has won an NC Green Business Fund grant to develop a more energy efficient manufacturing facility.

The NC Green Business Fund which is managed by the North Carolina Department of Commerce. Triangle-based companies and organisations have been awarded more than $2.8 million in grants from the North Carolina Green Business Fund, state Commerce Secretary Keith Crisco announced.

Statewide, a total of 16 organisations received grants which totalled to $4.6 million; the grants are being funded through the American Recovery and Reinvestment Act.

Under this award, Kyma will receive over $400,000 to install several elements of an ultra-high energy efficiency manufacturing infrastructure. This includes installation of a geothermal heating, ventilation, and air conditioning (HVAC system); installing better insulation; implementation of high efficiency LED based solid state lighting; implementation of smart utility control sensors; and creation of an energy usage monitoring and optimisation centre.

“While we have always prided ourselves with our relatively low carbon footprint, especially compared to that of many of our competitors, NC Green’s support is going to enable us to improve our plant efficiency by a very significant amount,” said Heather Splawn, Kyma vice president of operations.

Keith Evans, Kyma’s president and CEO, added, “We are pleased to receive the support of the NC Department of Commerce’s NC Green fund. This helps us become even greener in the manufacturing of our products, which is almost poetic, because our products in turn are used by our customers used to make their products greener too.”

Kyma’s GaN and AlN materials are designed to enable their customers to make energy efficient nitride semiconductor devices such as LEDs and power switching electronics.

The market for nitride semiconductor devices is expected to surpass $65B over the long term, including over $32B in visible lighting applications and over $33B in power electronics applications.

Cree revolutionises video screen market

The firm’s two new high-contrast and water resistant HB-LEDs are suited for use both indoors and outdoors and are designed to simplify manufacturing and lower system cost.

Cree, a marketer of LED lighting, has raised performance levels for high-brightness LEDs optimised for high resolution indoor and outdoor video screens with its new water resistant and higher contrast high-brightness LEDs.

The superior contrast offered by these Cree LEDs extends the benefits of typical, black surface-mount LEDs that are used for high-definition, high-resolution LED screens and displays.

The Screen Master CLX6A-FKB delivers industry-leading intensity and far-field pattern matching for high-resolution full-colour displays in a small water resistant package. Optimised for outdoor use with both IPX6 and IPX8 ratings, this PLCC6-type LED eliminates the need for a protective cover, reducing overall systems cost and delivering higher brightness.

CLX6A-FKB

Cree says it is the industry's first water resistant, tall LED package, designed with dimensions that provide superior thermal performance and make it easier for customers to assemble.

The Screen Master CLVBA-FKA is Cree's first black-body RGB surface-mount LED, optimised to provide the highest contrast ratio for indoor video screens. It has matched red-green-blue far-field patterns, delivering a consistent viewing experience across a wide range of viewing positions and unrivalled colour vibrancy.

CLVBA-FKA

"Cree has the broadest portfolio of products optimized for the indoor and outdoor video screen market." said Mike Watson, Cree, senior director of marketing, LED components. "Two years ago, Cree introduced the first water resistant surface mount LED. With the CLX6A, Cree demonstrates our leadership again by introducing the industry's first water resistant SMD LED in an easy-to-assemble, tall package. These new products allow our customers to create superior video screens that provide the viewing public with a better, richer image."

Screen Master CLX6A and CLVBA high-brightness LEDs are commercially available now.

Telecoms

TowerJazz and DARPA unite to advance SiGe HBT development

The "GRATE" multiyear program will develop up to 500GHz devices and employ the use of grating masks combined with conventional photolithography.

Jazz Semiconductor, a fully owned U.S. subsidiary of Tower Semiconductor (operating collectively under the brand name, TowerJazz), has formed a cost-sharing collaboration with DARPA to advance its roadmap for high frequency SiGe HBT devices.

The DARPA program named "GRATE" (Gratings of Regular Arrays and Trim Exposures), will employ the use of grating masks combined with conventional photolithography to achieve very fine dimension features as an alternative to more costly lithography techniques such as immersion lithography. The grating masks will be used in combination with the standard masks used today in volume semiconductor device manufacturing.

The TowerJazz roadmap includes BiCMOS platforms which have both CMOS and BiPolar devices on a single wafer and are offered monthly in multi-project wafer (MPW) runs. The existing BiCMOS platforms are based on 350nm, 180nm and 130nm CMOS nodes, and the variants include HBT device performance at 60, 150, 200 and recently 260GHz.

In the multi-year GRATE program, TowerJazz will develop methods for implementing grating and trim exposures in its existing BiCMOS platforms in three stages: to target 200-300GHz devices, 300-400GHz devices and finally with research on 400-500GHz HBT devices.

TowerJazz has partnered with the University of California, San Diego (UCSD) for novel circuit demonstrations using the new technology platforms and for teaming on extremely high frequency test and characterization of HBT devices as well as interconnect and passive components such as microstrip lines and MIM capacitors. This high frequency data and modelling will be the basis

for mmWave design kits that enable customers to design and simulate mmWave circuits and products.

In addition, TowerJazz will bring its pure-play specialty wafer foundry approach to the program through MPW runs to allow select, early access to the technology.

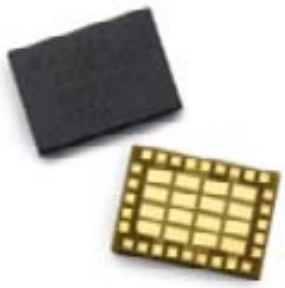
“It is exciting to work with DARPA on the use of gratings and trim exposures. Our team has demonstrated abilities to print sub-90nm features with very good depth of focus, and we are applying these methods to our SiGe BiCMOS technologies. We look forward to demonstrating novel capabilities and offering these technologies to our customers through our MPW infrastructure,” said David Howard, TowerJazz Executive Director and Primary Investigator for GRATE.

Avago provides WiMAX coexistence FEM to simplify mobile electronics

The highly-integrated, small-footprint module is claimed to be the first to deliver coexistence operation of WiMAX with other cellular and WiFi radios in the same device.

Avago Technologies, a supplier of analogue interface components for communications, industrial and consumer applications, is releasing a complete RF front-end module (FEM) for WiMAX radios in mobile handset or portable PC applications.

The new AFEM-S257 module is designed specifically for coexistence operation of WiMAX with other cellular and WiFi radios in the same device. The module features two receive ports and a single transmit port in a small 5 by 7 by 1 mm package that is ideal for space-constrained mobile applications in the 2.5 to 2.7 GHz frequency range – providing up to 25 % space savings over discrete WiMAX solutions.



The AFEM-S257 module integrates multiple high-performance technologies to reduce PCB board footprint, while simplifying design and manufacturing and shortening time to market. Using Avago’s 0.25-µm GaAs enhancement-mode pHEMT process and Film Bulk Acoustic Resonator (FBAR) filtering technologies, the module delivers superior performance across voltage and temperature levels.

FBAR technology delivers steep roll-off and low insertion loss, resulting in extended battery life and talk time and better signal quality. With high noise rejection of 35 dBc, the module enables fewer interference issues between IEEE 802.16 WiMAX and other radios. The AFEM-S257 module achieves 24 dBm of WiMAX-compliant output power, while maintaining an error vector magnitude (EVM) of 2.5 % at 16 quadrature amplitude modulation (QAM).

“The AFEM-S257 front-end module provides a complete, compact solution that can be easily and quickly designed in to mobile WiMAX applications, which is demonstrated in the top three reference designs addressing this market,” said James Wilson, senior director of marketing for wireless products at Avago. “With Avago FBAR filtering technology delivering unparalleled out-of-band rejection, the module offers the performance major smartphone makers demand.”

The AFEM-S257 has 18 % power added efficiency (PAE) and all RF ports are matched to 50 Wfor simplified design. With 3 to 5V power supply for TX path the TX gain is 34 dB. The NF is 3.5 dB from ANT to RX and has 25 dB of TX/RX isolation and RX1/RX2 isolation.

The AFEM-S257 WiMAX coexistence FEM is available in a 28-lead MCOB package and is priced at $9.50 each in 10,000 piece quantities. Samples and production quantities are available now through

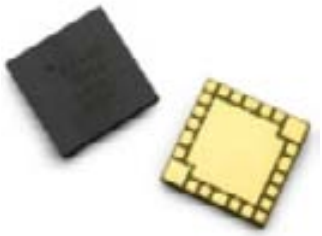
the Avago direct sales channel and via worldwide distribution partners.

Avago anchors integrated switch and GaAs LNAs for base stations

The TD-SCDMA and TD-LTE compact fully-matched products replace three discrete devices to save PCB space, whilst delivering superior noise figures, linearity and power handling performance.

Avago Technologies, a supplier of analogue interface components for communications, industrial and consumer applications, is releasing a series of high-power switch low-noise amplifier (LNA) modules dedicated for use in front-end receiver designs of TD-SCDMA and TD-LTE base transceiver station (BTS) applications.

The new small-footprint ALM-12x24 modules replace existing three-piece discrete solutions, providing significant board space savings that is especially critical for BTS designs with 8 transceiver channels in a single radio card.



The fully-matched solutions also shorten design cycle time by eliminating the need for tuning with external matching circuitry. The modules deliver best-in-class noise performance, high-gain and high linearity from a compact package.

The Avago ALM-12x24 LNA modules integrate a high-power 50W Single Pole, Double Throw (SPDT) switch, a first-stage LNA and a second-stage high-linearity amplifier in an 8-mm-by-8-mm package. Constructed with an Avago PIN diode, the SPDT switch prevents the LNA from damage by high-power signals potentially leaking over from the transmit chain in conditions where the antenna is mismatched.

The LNA and high-linearity amplifier leverage the company's proprietary 0.25 µm GaAs Enhancement-mode pHEMT process to achieve robust RF performance.

The wireless infrastructure industry must provide optimum coverage with the best signal quality in a crowded spectrum. Receiver sensitivity is the most critical requirement in a BTS receiver's design, and LNA selection greatly affects the receiver's performance. For front-end design architectures, low noise figure (NF) is a key design goal.

Another key design factor is linearity, which affects the receiver's ability to distinguish between wanted and spurious signals that are closely spaced. Output third-order intercept (OIP3) is used to specify linearity. The ALM-12124 module covers 1880-2025 MHz with 0.80 dB NF and 36.4 dBm OIP3 typical performance at 1900 MHz in receiver mode, while ALM-12224 module covers 2300-2400 MHz with 0.99 dB NF and 38.5 dBm OIP3 typical performance at 2400 MHz in receiver mode.

With 50 dB isolation between the first and second stage amplifiers, the ALM-12x24 enables external addition of an attenuator or RF filter without affecting the overall module performance. It has a high power handling capability of 47.5 dBm, low distortion silicon PIN diode technology long with a reliable MSL2a rating and lead-free package.

The ALM-12x24 switch LNA modules ship in a 24-pin MCOB package. The ALM-12124 and ALM-12224 modules are priced at $8.58 each in 10,000 piece quantities. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

Mitsubishi Electric's GaN HEMT raises the bar for PAE

With a record PAE rating of 67%, the amplifier is designed for C-band satellites and wireless communication systems.

Mitsubishi Electric has developed a GaN HEMT power amplifier for C-band satellites featuring

what it claims is the world's highest power-added efficiency (PAE) rating, 67%.

This is an increase of more than seven points compared to conventional amplifiers. The amplifier is expected to lead to smaller and lighter transmitter devices to help microwave communication satellites save power.

The device has power-saving features to help make satellites more efficient and reliable.

The new amplifier's record PAE of 67% is enabled by the world's first harmonic tuning circuit placed in front of each GaN HEMT cell on the substrate. The PAE was improved by second harmonic impedance of GaN HEMT with highly accurate input control. The harmonic tuning circuit comprises a MIM capacitor and a spiral inductor.

The module has a high output power of 107W (50.3dBm) and is 17.4 x 24.0 x 4.3 mm weighing just 7.1g. It is an internally impedance- matched GaN HEMT amplifier.

As more satellites complete their operational lifespan, the demand is increasing for new microwave communication satellites with smaller, lighter and more efficient satellite transponders. Conventional transponder devices use travelling wave tube amplifiers (TWTAs) because solid-state power amplifiers with GaAs HEMTs, which lack sufficient output power and efficiency, require an additional amplifier to gain high output power. More efficient GaN HEMT amplifiers with high output power, high-field electron velocity and high-breakdown fields are expected to replace TWTAs in communication satellites.

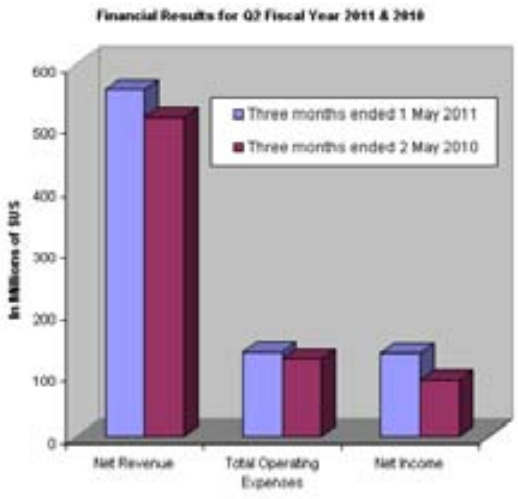
Going forward, Mitsubishi Electric intends to further enhance the efficiency and power performance of GaN HEMT amplifiers for satellites and wireless communication systems.

Avago looking up with 50% net income increase

Over the last quarter, the firm has also increased its revenue by 9% to $560 million compared to the same quarter last year.

Avago Technologies, a global supplier of analogue interface components for communications, industrial and consumer applications, has reported financial results for the second quarter of its fiscal year 2011, ended May 1, 2011.

The firm has also provided guidance for the third quarter of its fiscal year 2011.



Net revenue was $560 million, an increase of 2 % compared with the previous quarter, and up 9 % from the same quarter last year.

On a GAAP basis, gross margin was $275 million, or 49.1 % of net revenue. This compares with gross margin of $233 million, or 45.2 % of net revenue in the same quarter last year.

Operating expenses were $137 million. This compares with $125 million in the same quarter the previous year.

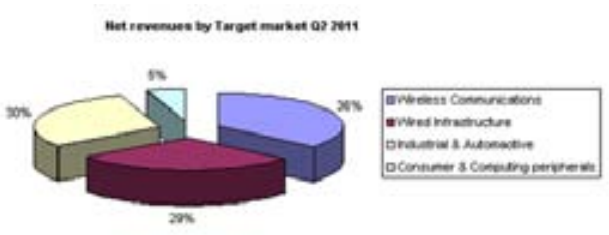
Income from operations was $138 million, compared to $108 million in the same quarter last year.

Second quarter net income was $135 million, or $0.54 per diluted share. This compares with net income of $90 million, or $0.37 per diluted share in the same quarter last year.

The Company's cash and cash equivalents balance at the end of the second quarter was $596 million, compared to $363 million at the end of the prior quarter. The increase over the previous quarter is primarily due to cash provided by operating activities of $251 million.

In addition, on March 30, 2011 the Company paid an interim cash dividend of 8 cents ($0.08) per ordinary share, totalling approximately $20 million.

The percentages of net revenues by target markets compared to the same quarter last year have hardly altered; the only difference was that wireless communications revenues increased by 1% at the expense of the wired infrastructure market.



Former senior Verizon executive joins Infinera board

Telecom industry veteran, Mark A. Wegleitner previously worked at Bell Atlantic, Bell Laboratories and AT&T. His career in telecommunications spans more than 38 years.

Infinera has appointed Mark A. Wegleitner to its board of directors. Wegleitner brings deep experience in telecommunications technology to Infinera's board of directors.

Wegleitner was most recently Senior Vice President of Technology at Verizon Communications until his retirement in July 2010. At Verizon, his responsibilities included technology assessment, network architecture, platform development and laboratory evaluation for wireline and wireless communications networks.

From 2000 to 2007, Wegleitner was CTO of Verizon Communications, responsible for wireline networks. Prior to this, he held a series of positions at Bell Atlantic, Bell Laboratories and AT&T. His career in telecommunications spans more than 38 years.

Wegleitner received a B.A. in mathematics from St. John's University, and an M.S. in electrical engineering and computer science from the University of California at Berkeley.

"I'm pleased to join Infinera's board of directors," said Wegleitner. "Infinera's innovative technology has already had a major impact on the telecom market, and I believe it is still in the early stages of its development as a force in the global industry."

"We're very pleased to welcome Mark to our board," said Infinera CEO Tom Fallon. "With his years of experience at one of the world's leading carriers, he will bring valuable insights and perspective to Infinera."

Infinera PICs handle 2 terabits of network traffic

On the busy Paris-Lyon driving route, Infinera's PICs, which incorporate InP, offer a large capacity and rapid response for data transmission.

Infinera customers are carrying more than 2 Terabits/second of live revenue-generating network traffic between Paris and Lyon for multiple customers today.

This, the firm says, demonstrates the scalability and reliability of Infinera solutions for carrying large and fast-growing volumes of traffic.

The 450 km route between Paris and Lyon is one of the busiest in Europe, standing at the crossroads between northern and southern Europe, between western Europe and eastern Europe, between traffic from Africa and the Middle East, and traffic from North American which reaches Europe via coastal ports on the English Channel.

Pan-European carrier Interoute and French operator Covage are among the service providers using Infinera networks to deliver services on this route.

Infinera network solutions are specifically designed to carry traffic in the hundreds of Gigabits and Terabit range due to the built-in scalability of the Infinera DTN system. Infinera's photonic integrated circuits (PICs) integrate more than 60 optical components onto a pair of chips, thus enabling 100Gb/s of pre-provisioned capacity on every line card today, with plans to introduce PICs with 500Gb/s of pre-provisioned capacity on Infinera's next-generation systems available next year.

Infinera's 100Gb/s PICs have demonstrated outstanding reliability in live networks, recording more than six years of field operation with no PIC failures. In addition, Infinera's Just-in-TAM guarantee ensures customers of receiving new client service modules within ten days of order, while the Infinera Management Suite enables on-demand, point-and-click turn-up of new revenue opportunity.

According to data from leading Internet exchanges in Europe, internet traffic in Europe continues to grow at double-digit rates, driven by increasing investment in network capacity in the emerging nations of Asia, Africa and the Middle East, and the increasingly pervasive use of network devices, landline-based and mobile, and the growth of applications like cloud computing and video.

Pan-European operator Interoute has built a large and growing business, meeting customer needs for network capacity across Europe using the speed and simplicity of the Infinera network. Interoute is active in 29 countries it connects with its 60,000-lit fibre-kilometre network.

"Our Infinera network is critical in helping us deliver services to customers when and where they need it very quickly and responsively. The Paris-Lyon route is one of many where we offer very large capacity and so are positioned to meet customer requests very quickly," said Matthew Finnie, Interoute's CTO.

Infinera networks also support domestic French service providers. French operator Covage has built a green field long-haul network serving 15 major cities in France with an Infinera network. Covage offers services to service providers and enterprises, with key competitive advantages including the ability to deploy services quickly, and a postage-stamp pricing model which presents customers with a simple-to-understand pricing model and the same prices for a connection whether it is 10km or 1000km.

Covage also uses this Infinera network to support its 15 local broadband networks which are delivering broadband services to French regions. "Our Infinera network has helped us launch a successful business in France, carrying large volumes of corporate and Internet traffic, and also helped us deliver services to broadband customers," said Vincent Couarraze, Director of Covage Networks.

Infinera's next-generation systems are expected to raise the bar further, offering advanced features and functionality, as well as capacity up to 25 Terabits/second. Infinera's Bandwidth Virtualisation architecture enables the flexible deployment of PIC-based network capacity to carry any available service between any points on the network without the optical impairments or constraints typical of all-optical ROADMs.

"Customers today rely on Infinera when they have large volumes of traffic on busy routes because the Infinera solution is uniquely scalable and reliable, due to the innovation of large-scale PIC technology," said Infinera Executive Vice President and Chief Strategy Officer Dave Welch. "We intend to enhance these benefits even further as we roll out our new products over the next twelve months."

Berlin to host compound semiconductor conference

Organised by the Fraunhofer Institute and the VDE Association for Electrical Technologies, Electronic & Information Technologies, the conference will address the future of compound semiconductors in micro electronics and optoelectronics.

On May 23, 2011, Andre Geim, the 2010 winner of the Nobel Prize in Physics, opened the 2011 Compound Semiconductor Week with a plenary lecture on graphene.

Here, some 450 scientists and industry representatives will discuss current research findings in the field of compound semiconductors. An example of one of the key topics of the event is how to improve energy efficiency while increasing data rates in communications systems – often referred to as "Green IT".

The conference took place in Berlin from May 22 to 26. The conference is organised by the Fraunhofer Heinrich Hertz Institute HHI, the Fraunhofer Institute for Applied Solid State Physics IAF, and the VDE Association for Electrical Technologies, Electronic & Information Technologies.

"CSW is the most important international

conference for the entire spectrum of compound semiconductors. Here, participants will get an overview of what will become possible in micro electronics and optoelectronics," Oliver Ambacher, ISCS 2011 Conference Chair and head of the Fraunhofer IAF, said.

While silicon is still the most important semiconductor material, today no mobile phone, PC or car would work without additional components used in compound semiconductor technology. Compound semiconductor, in contrast to the elemental semiconductor – like silicon -, consists of at least two different types of atoms.

Compound semiconductors are used for light generation with LEDs, photonics and communications engineering, as well as for maximum frequency electronics and power electronics. Since 2010, the CSW has combined the two most important conferences on compound semiconductors – the "International Symposium on Compound Semiconductors (ISCS)" and the "International Conference on Indium Phosphide and Related Materials (IPRM)".

"Berlin is the ideal location for hosting the CSW thanks to its broad-based research activities in this field," said Norbert Grote, Chairman of this year's IPRM and head of department at the Fraunhofer HHI. "Some 450 scientists from all over the world will come to Berlin to exchange their knowledge. This gives us the opportunity to further strengthen the location and to promote these issues."

Fraunhofer HHI and Fraunhofer IAF are both leading research institutes in the field of compound semiconductors. In Berlin, it is not only institutes and universities such as the Fraunhofer HHI, the Ferdinand Braun Institute, the Paul Drude Institut für Festkörperelektronik, the Institut für Kristallzüchtung, Humboldt- und Technische Universität, as well as the Helmholtz Zentrum, which are active in this field, but also companies like the u2t Photonics AG, a spin-off from Fraunhofer HHI. "When making a phone-call in the US, your chances of the optical components involved having been made in Berlin are pretty good," said Norbert Grote.

Skyworks reveals family of modulators for broadband

The firm's latest quadrature modulators support growing network capacity needs as mobile data traffic increases.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors, has introduced three wideband quadrature modulators for cellular infrastructure and high performance radio link applications.

Skyworks' modulators are the latest additions to its wireless infrastructure portfolio and designed to support the world's leading 3G and 4G base station providers.

These new, fixed gain quadrature modulators deliver excellent phase accuracy and amplitude balance enabling high performance for a variety of multi-carrier communication systems. In addition, Skyworks' new modulators have greater than 500 MHz 3dB modulation bandwidth, a low noise floor, and a wide operating frequency range that support multiband designs and network requirements.

According to a recent In-Stat Mobile Internet Group research report, infrastructure expenditures by mobile operators will need to scale up by more than 40 % in the coming years to meet fast approaching network demand. As a result, mobile operators will not only need to install new base stations, routers and backhaul network equipment, but will need to upgrade and expand existing infrastructure to avoid network traffic jams and preserve their highly profitable data service revenue, all of which will require increased analogue and mixed signal content.

"With the addition of these new modulators, Skyworks continues to capitalise on the network infrastructure side of the mobile Internet phenomenon," said Liam K. Griffin, Skyworks' executive vice president and general manager of high performance analogue. "Skyworks is pleased to offer our customers a multitude of high performance, cost effective solutions as they build out their networks to support the staggering increase in mobile data traffic."

The SKY73077 (for 1500 to 2700 MHz), the SKY73078 (for 500 to 1500 MHz), and the SKY73092 (for 400 to 6000 MHz), quadrature modulators contain high linearity, excellent I/Q phase accuracy and amplitude balance - making the devices ideal for use in high performance communication systems. The modulators accept two differential baseband inputs and a single-ended local oscillator, and generate a single-ended RF output.

Skyworks' new quadrature modulators are available now.

Infinera to present innovations at Light Reading conference

The InP PIC developer will discuss the digital optical networks evolution during two presentations.

Infinera will discuss important aspects of the evolution of Digital Optical Networks in two talks at Light Reading's Packet-Optical Transport Evolution Conference on Wednesday, May 18th, in New York.

Infinera Co-Founder and Chief Technology Officer Drew Perkins will discuss the evolution of Infinera's architecture to offer packet functionality as part of Infinera's integrated DWDM and OTN switching capabilities.

To address ever-growing bandwidth demand, successful next-generation networks will integrate packet, OTN switching and optical transport capabilities to deliver new network economics resulting from increased efficiency, scalability, reliability, and intelligence. Mr. Perkins will speak at a panel entitled "OTN & the Future of Packet-Optical Transport."

Infinera's Director of Solutions Marketing, Vinay Rathore, will present on the Digital ROADM in the panel on "Next Generation ROADM Architectures." Many of the features analogue ROADMs are striving to add today, such as colourless, directionless, and contentionless operation, are already implemented in the Digital ROADM and Rathore will discuss the features and future capabilities of Digital ROADMs.

The Light Reading Packet Optical Transport Evolution conference takes place at the Marriott Marquis hotel in Times Square, New York. Infinera will have a display at table # 13 and Infinera experts will be on hand to provide detailed information on Infinera technology and the Infinera product portfolio.

$10M partnership to commercialise 'green' computer chips

The collaboration will integrate optics and electronics to develop innovative "green" technology to enable faster computer chips that use significantly less power and result in the creation of 20 high-tech jobs.

APIC Corporation, a Los Angeles-based pioneer of photonics technology integrated with electronics, and the College of Nanoscale Science and Engineering (CNSE) of the University at Albany have formed a $10 million partnership.

The organisations intend to jointly develop and commercialise innovative "green" technology to enable faster computer chips that use significantly less power.

The collaboration, which integrates APIC's expertise in photonics systems and devices with CNSE's nanoelectronics resources, will result in creation of at least 20 high-tech jobs over the next 18 months, the majority at CNSE's Albany NanoTech Complex.

The APIC-CNSE partnership targets development and delivery of a new generation of modules and systems that utilise photonic integrated circuits

(PIC), which combine optical communications with silicon-based CMOS technologies. As ongoing scaling continues to shrink the bandwidth of metal wiring used to connect CMOS circuits, severely limiting speed and functionality for advanced processors and multi-core systems, optical communication, which uses light to transmit information, is seen as a serious contender to break this communications bottleneck.

These PIC systems will be particularly useful in addressing the 21st century explosion in bandwidth and computing power needs including advanced data centres, cutting-edge medical research, secure financial transactions and next-generation gaming capabilities, increasing speed by up to 60 %, while reducing power consumption by as much as 90 %.

New York State Assembly Speaker Sheldon Silver said, "The agreement reached by the APIC Corporation and UAlbany's College of Nanoscale Science and Engineering is great news for the Capital Region and further attests to the effectiveness of our public/private economic development model. This is how we will create jobs, spin-off business opportunities, spur technological advancement, and rebuild our state economy in this new millennium. I commend the APIC Corporation for its wise decision and I am confident that with the leadership of Dr. Alain Kaloyeros, Albany Nano will remain 'the place to be' for cutting-edge nanotech R&D and commercialisation."

Raj Dutt, Chairman of the Board and CEO of APIC Corporation, said, "APIC Corporation and its commercial arm PhotonIC Corp. is very excited about our partnership with the College of Nanoscale Science and Engineering, a world-class education, research, development and technology resource. Combining the unparalleled capabilities of CNSE with APIC's leading-edge photonics technology will enable advanced photonics integration with electronics and accelerate its introduction into the commercial marketplace. Budgeted at $10 million over the next 18 months, this joint program will expand both CNSE's and APIC's technical workforce in Albany, NY and Culver City, CA, and pave the way for further collaboration in the future."

CNSE Senior Vice President and Chief Executive Officer Alain E. Kaloyeros said, "The UAlbany NanoCollege is delighted to launch this partnership with APIC Corporation, which further builds on the vision, support and investment of Speaker Sheldon Silver and the New York State Assembly in establishing the NanoCollege and New York State as global hubs for nanotechnology innovation, education, and economic development and growth. This collaboration will enable APIC, a recognized leader in next-generation photonics technologies, to break new ground in the development of innovative photonics integrated circuits, and put CNSE at the leading edge of systems and interconnect research, development and commercialization, while enhancing the state-of-the-art capabilities at CNSE's Albany NanoTech Complex."

The partnership between APIC and CNSE also includes the potential for further R&D initiatives in the future, which may involve the location of additional APIC employees at CNSE's Albany NanoTech Complex.

Endwave revenues tumble by 74%

The firm has again reported income and operating losses which have tripled over the same quarter last year. It says the fall-off in legacy module product sales that began in 2010 continues to hamper its results.

Endwave Corporation, a provider of high-frequency RF solutions and semiconductor products for the telecommunications, satellite communications, electronic instruments and defence and security markets, has reported financial results for its first quarter, ended on March 31, 2011.

Revenues for the first quarter of 2011 were $1.2

million. This compares with revenues of $4.1 million in the prior quarter and $4.8 million in the first quarter of fiscal 2010.

GAAP net loss for Q1 2011 was $3.9 million, or $0.39 per share. This compares with a net loss of $2.0 million, or $0.20 per share, in the prior quarter, and a net loss of $1.3 million, or $0.13 per share, in the first quarter of fiscal 2010.

Cash, cash equivalents and investments as of March 31, 2011 were $21.2 million, compared with $23.5 million as of December 31, 2010.

“As anticipated, 2011 began as a challenging year for the company,” said John Mikulsky, Endwave’s President and Chief Executive Officer. “The fall-off in legacy module product sales that began in 2010 continues to hamper our results.”

“We believe, however, that 2011 will be a seminal year for our stockholders as a result of the pending merger transaction with GigOptix,” continued Mikulsky. “The transaction remains on schedule to close in the second quarter of 2011. Upon the close and in the years ahead, we look forward to working with the combined company as it pursues a leadership position as a high-speed, high-frequency supplier for optical and wireless communications.”

On February 7, 2011, GigOptix, announced that it signed a definitive merger agreement to acquire Endwave. The SEC has now declared effective the S-4 registration statement relating to the proposed merger transaction. Endwave stockholders must now approve the transaction in a special shareholder meeting that is scheduled for June 17. Details will be sent to those stockholders eligible to vote as of the May 12 record date.

Finisar investor files lawsuit over federal violations

The investigation, on behalf of current long term investors in common stock of Finisar, is concerned whether certain former and current Finisar employees can be held liable in connection with the alleged Securities Laws violations.

The Shareholders Foundation has announced that it is conducting an investigation for current long term investors in Finisar Corporation (Finisar), over possible breaches of fiduciary duties.

The complaint filed in the United States District Court for the Northern District of California says that the plaintiff, an investor in Finisar alleges on behalf of purchasers of Finisar common stock (NASDAQ: FNSR) during the period between December 2, 2010 and March 8, 2011, that the company violated the Securities Exchange Act of 1934. The company allegedly issued materially false and misleading statements regarding its business and financial results between December 2, 2010 and March 8, 2011.

Meanwhile an investigation on behalf of current long term investors of Finisar, including and in particular those who purchased (also) prior to December 2010 FNSR shares and presently continue to hold those shares was announced.

The investigation by a law firm on behalf of current long term investors in stock of Finisar is concerned whether certain current and/or former officers and members of Finisar board of directors and executive officers can be held liable in connection with the alleged Securities Laws violations in the lawsuit by investors who purchased FNSR stock between December 2, 2010 and March 8, 2011.

Finisar’s 12 month total revenue went from $418.55million to $629.88 from April 30, 2007 to April 30, 2010. Finisar was able to come out of a net loss of $48.91million, reported on April 30, 2007, to a net income of $14.13million reported on April 30, 2010.

Shares of Finisar (Public, NASDAQ:FNSR) traded during October 2010 were under $20 per share.

On December 1, 2010 Finisar announced record quarterly revenues and profitability for its second quarter ended October 31, 2010. Shares rose to almost $30 per share. Then on December 20, 2010, Finisar announced public offering of common stock. Finisar shares continued to increase to $43.22 on March 4, 2011.

On March 8, 2011, after the close of trading, Finisar announced its financial results for its third quarter ended January 30, 2011. Finisar said it had record revenues exceeding $1.0billion annual run-rate.

However, Finisar also disclosed that it expected adjusted earnings in the range of approximately $0.31 to $0.35 per share for the three months ending April 30, 2011. According to analysts, on average, they had been looking for profits of about $0.44 cents per share.

The company's revenue forecast for the fourth quarter of $235 million to $250 million fell short of Wall Street expectations for $258.6 million, hence the investigation.

Finisar said in its March 8 announcement that it identified a slowdown in its business in China, a 10-day shutdown for Chinese New Year, and adjustments of inventory levels by some of its telecommunications customers as reasons for the shortfall.

Finisar shares plummeted from $40.04 on March 8, 2011 to $25 on March 9, 2011 and continued to decline to $22.58 on March 15, 2011. Recently however, the company made an upturn with FNSR shares traded above $25 per share.

Finisar completes Ignis acquisition

Finisar has successfully completed the voluntary cash offer to acquire Ignis shares and plans to commence a mandatory cash offer.

Finisar Corporation has successfully completed its previously-announced voluntary public cash offer to acquire the outstanding shares of Ignis ASA, a Norwegian company whose shares are listed on the Oslo Stock Exchange, at a cash price of NOK 8 per share (approximately US $1.46).

The offer was made pursuant to an offer document dated April 7, 2011. The offer period expired on May 6, 2011, and all conditions to the completion of the offer were satisfied. Settlement with the tendering Ignis shareholders will be completed within 14 days.

The offer was accepted by holders of approximately 37.9 million shares of Ignis, representing approximately 48.1% of the outstanding shares of Ignis. These shares, combined with the 25.7 million shares held by Finisar before the offer, will bring Finisar's total ownership to approximately 80.7% of the outstanding shares.

Under the Norwegian Securities Trading Act, Finisar's ownership of more than one-third of the voting shares of Ignis triggers the requirement for Finisar to make a mandatory unconditional offer for all remaining Ignis shares.

Finisar will proceed promptly with a mandatory offer for the remaining shares at a cash offer price of NOK 8 per share. An offer document setting forth the terms of Finisar's mandatory offer will be published and distributed to the remaining Ignis shareholders as soon as possible following review and approval by the Oslo Stock Exchange, which is expected to be obtained within approximately two weeks.

SEB Enskilda is acting as Finisar's financial advisor in the transaction and as the receiving agent for both the voluntary and mandatory offers, and DLA Piper is acting as Finisar's legal advisor in the transaction.

Avago expands series of world's smallest RF amplifiers

The new positive gain slope LNA, wideband LNA, VGA and four directional detectors add to functionality of miniature chip scale package amplifiers

Avago Technologies, a supplier of analogue interface components for communications, industrial and consumer applications, has announced additions to one of the market's smallest series of RF amplifiers.

The new VMMK-3xxx amplifiers leverage Avago WaferCap chip scale packaging technology to offer an ultra-small footprint of 1.0 by 0.5 by 0.25 mm.

The amplifiers bring a host of new functionality to the existing Avago VMMK-1xxx and VMMK-2xxx families, including a positive gain slope low-noise amplifier (LNA), a wideband LNA, a variable gain amplifier (VGA), and four directional detectors.

With miniature 0402 package dimensions and no wirebonds, the VMMK-3xxx amplifiers experience almost no signal loss and minimal parasitics. The devices take up 5 % of the volume and use only 10 % of the board area of solutions using a standard SOT-343 package. In some cases, the miniature amplifiers can effectively reduce PCB area by more than 50 %.

The compact size and fully-matched surface mount design are optimised for 500 MHz to 12 GHz frequencies, making the devices ideal for a variety of radio architectures and space-constrained applications. Requiring no special tooling for assembly, the LNAs have all I/Os routed to the backside of the device wafer through via-holes, resulting in RF transitions suffering almost no signal loss and minimal parasitics.

The VMMK-3xxx LNAs and VGA can be used in UWB, WLAN, WiMAX, generic IF amp and gain block applications, while the new detectors can be used in base stations, point-to-point radios and generic power control loop detectors, as well as for monitoring power amplifier output.

Avago says this is a significant improvement over conventional plastic packages where bond-wires exhibit substantial parasitics that limit the operating frequency. The miniature amplifier family provides high gain, a high third-order intercept point (IP3) for good linearity, low noise figure (NF) and integrated 50-ohm input and output matching networks to simplify system design.

The VMMK-3xxx family includes:

* VMMK-3503: 0.5-18 GHz VGA – This broadband, wide-dynamic-range VGA features 12 dB maximum gain, 1.5 dB NF, 8 dBm IIP3 and 23 dB gain control range, and it consumes 300 mW.

* VMMK-3603: 1-6 GHz Positive Gain Slope LNA – This high-gain, self-biasing LNA features 17 dB gain, 1.5 dB NF and good linearity of 25 dBm OIP3, and it consumes 180 mW. With its positive gain slope, the LNA enables flat overall system gain.

* VMMK-3803: 3-11 GHz LNA – This high-gain, self-biasing LNA features 20 dB flat gain, 1.5 dB NF and good linearity of 0.5 dBm IIP3, and it consumes 60 mW.

* VMMK-3113: 2-6 GHz Directional Detector – This detector features 0.25 dB insertion, greater than 45 dB dynamic range, low input and output return losses (< 20 dB) and 10 dB directivity. This detector requires 1.5V with 0.18 mA for DC biasing.

* VMMK-3213: 6-18 GHz Directional Detector – This detector features 0.4 dB insertion, greater than 40 dB dynamic range, low input and output return losses (< 20 dB) and 15 dB directivity. This detector requires 1.5V with 0.18 mA for DC biasing.

* VMMK-3313: 15-33 GHz Directional Detector – This detector features 0.5 dB insertion, greater than 37 dB dynamic range, low input and output return losses (< 20 dB) and 12 dB directivity. This detector requires 1.5 V with 0.18 mA for DC biasing.

* VMMK-3413: 25-45 GHz Directional Detector – This detector features 0.8 dB insertion, greater than 35 dB dynamic range, low input and output return losses (< 20 dB) and 10 dB directivity. This detector requires 1.5 V with 0.18 mA for DC biasing.

U.S. Pricing and Availability

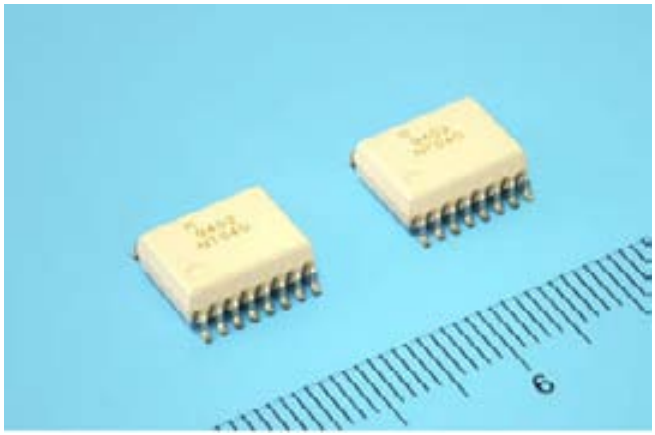
The VMMK-3xxx amplifiers are priced starting at $2.00 each in 1,000 piece quantities. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

Renesas reveals optocoupler with integrated IGBT protection

The firm's latest module which features an AlGaAs light emitting source simplifies the development of more compact inverters for industrial equipment and solar power generation systems.

Renesas Electronics is marketing a new insulated gate bipolar transistors (IGBT) drive optocoupler module, the PS9402.

Featuring an integrated IGBT protection function, the module is suited to large-current switching applications requiring high voltage tolerance.



Optocoupler with Integrated IGBT Protection Function, the "PS9402"

The PS9402 optocoupler comprises an AlGaAs LED as the light emitting element, a photodetector IC, and an IGBT protection circuit. It is designed to drive IGBTs used in inverter devices for purposes such as motor control. The use of the new optocoupler facilitates the design of IGBT peripheral circuits and enables IGBT direct drive up to the 1,200 V and 100 A class. The compact 16-pin small outline package contributes to system compactness.

An optocoupler integrates in a single package, an LED on the input side, which converts an electric signal into light, and a light receiving element on the output side, which converts light into an electric signal. It is an optical coupling device that completely isolates the input and output sides electrically by using light for signal transfer. Optocouplers are used in the inverter circuits of industrial equipment and in electric household appliances to protect the circuits between electronic devices and to shut out noise by electrically isolating the input and output blocks.

General-purpose inverters and inverters for solar power generation systems are a fundamental technology employed in recent years to reduce environmental impact by cutting carbon dioxide emissions and reducing power conversion loss to save energy. The market for these inverters is expected to continue to grow. The inverter circuit comprises a high-voltage circuit block incorporating power devices such as IGBTs or MOSFETs and a control circuit block employing components such as a microcontroller.

Optocouplers designed for use with IGBTs or MOSFETs are needed to electrically isolate the two circuit blocks. An IGBT drive coupler is typically used for the drive control of an IGBT, but a protection circuit is also needed to safeguard the IGBT. This has tended to complicate the overall system design.

The PS9402 optocoupler simplifies system design and contributes to greater compactness by integrating the protection circuit that previously had to be added as an external component.

When a short circuit occurs in the IGBT connected to the optocoupler, the collector-emitter voltage of the IGBT rises and may damage the device. The PS9402 has a function that detects a rise in collector-emitter voltage and turns off the IGBT. It also incorporates a soft turn-off function that suppresses the generation of noise when the IGBT is turned off. A fault signal is output to the microcontroller to indicate that an abnormal shut-off has occurred, and an auto-reset function performs recovery automatically once a specified time (minimum 5 microseconds) has elapsed after the fault was detected.

When the IGBT connected to the optocoupler turns off, current flow to the collector-gate capacitance (Miller current) can generate a gate voltage that causes a malfunction. The active Miller clamp circuit built into the PS9402 absorbs the Miller current, averting malfunctions by preventing the gate voltage from rising.

Renesas Electronics' exclusive BiCMOS process is employed for the light receiving IC, resulting in reduced parasitic or floating capacitance which are unwanted components generated by the internal physical structure of the chip.

It also has a, shorter delay time (tPHL and tPLH ≤ 200 ns), and reduced circuit drive current consumption (Icc ≤ 3 mA). These contribute to an increase in the precision of the inverter control circuit and reduced power consumption. They also enable greater system compactness because keeping circuit current levels low means a smaller power supply can be used for the system driven by the IGBTs.

Renesas Electronics positions the new PS9402 optocoupler as a product that can contribute to simplified development and greater compactness in inverter systems, for which the market is expected to continue to grow in future. The company plans to continue to develop new high-temperature and high-output product versions.

EMEA market expected to turn around in 2011

The EMEA optical network hardware market is forecast to make an overall gain of about 7% in 2011 as a result of a spending recovery in Western Europe, access network deployments in the Middle East and strong growth in metro WDM equipment in Eastern and Central Europe.

Market research firm Infonetics Research today has excerpts from its Optical Network Hardware in EMEA: Europe, Middle East, and Africa report.

"The optical network hardware market in EMEA saw a strong rebound in late 2010 due to a year-end spending flurry, but it wasn't strong enough to turn around the decline for the year (down 11%). We forecast an overall gain of about 7% in EMEA in 2011, as a result of a spending recovery in Western Europe; access network deployments in the Middle East, particularly the Arabian peninsula and Israel; and strong growth in metro WDM equipment in Eastern and Central Europe as carriers shift from microwave to fibre-fed access for wireless backhaul," notes Andrew Schmitt, directing analyst for optical at Infonetics Research.

The report highlights that western Europe leads optical hardware equipment spending in EMEA, with 60% in 2010. The optical hardware market in Central and Eastern Europe is growing the fastest among the EMEA regions. Also, for the full 2010 year, Alcatel-Lucent leads the EMEA optical network hardware market, with about 1/3 of the market, followed closely by Huawei. EMEA represented 30% of worldwide telecom capital expenditures (CAPEX) in 2010, and 31% of worldwide optical equipment spending

Infonetics' Optical Network Hardware in EMEA report tracks SDH (synchronous digital hierarchy) and WDM (wave division multiplexing) optical hardware for metro and long haul networks sold by vendors in the EMEA region, including Western Europe, Central and Eastern Europe, the Middle East, and Africa. The service provides vendor market share, market size, and forecasts through 2015 by country and region.

Companies tracked in the report include ADVA, Alcatel-Lucent, BTI, Canoga Perkins, Ciena, Cisco, Cyan, ECI, Ekinops, Ericsson, Fujitsu, Hitachi, Huawei, Infinera, MRV, NEC, Nokia Siemens, Nortel, Sorrento, Sycamore, Tejas, Tellabs, Transmode, Turin, Tyco, Xtera, ZTE and others.

Hittite targets the military market with 8 GHz synthesiser

The firm's latest module is suited to microwave point-to-point radios and radar applications.

Hittite Microwave Corporation, a supplier of complete MMIC based solutions for communication & military markets has introduced the HMC703LP4E, a DC to 8 GHz, very low noise fractional synthesizer ideal for driving Voltage Controlled Oscillators (VCOs) used in Microwave Point-to-Point Radios.

As Quadrature Amplitude Modulation in microwave radios moves to higher constellations, and signal bandwidths are tightening, excellent phase noise and spurious product performance is mandatory. The HMC703LP4E provides the ideal solution for the tough Error Vector Magnitude (EVM) and integrated phase noise specifications that these high data rate, frequency-efficient telecommunications systems require.

The HMC703LP4E features Frequency Shift Keying modulation as well as bi-phase modulation with data rates limited by the loop filter bandwidth (typically 100 kHz). It also features a built-in

sweeper mode that supports external or automatic triggered sweeps. The phase coherent frequency sweep mode can be used in test instrumentation, Frequency Modulated Continuous Wave sensors and automotive radars. Depending on the chosen Phase Locked-Loop bandwidth the one or two-way frequency ramp may be continuous, or in steps.

The HMC703LP4E offers superb phase noise performance of -112 dBc/Hz at an offset of 50 kHz and a VCO frequency of 8 GHz in fractional mode. Its Floor Figure of Merit is -230 dBc/Hz in fractional mode; a performance that is typically 10 dB better than the performance of its closest competitor. When tested with the HMC508LP5E VCO, the jitter corresponding to double side-band phase noise integration from 100 Hz to 100 MHz offsets is 70.7 fs. This jitter would correspond to an EVM of 0.35% at 8 GHz and a Signal-to-Noise Ratio of 49 dB.

Fractional synthesisers that set the channel step size with the fractional modulus often suffer from channel spurs. The HMC703LP4E exact frequency mode achieves exact channel frequencies with zero channel spurs, while double buffering enables strobed frequency hopping. The HMC703LP4E maximum PFD frequency is 115 MHz (in integer mode), which permits wider loop bandwidth, improved phase noise performance and faster locking/switching time. Typical in-band integer boundary spur is -60 dBc.

The HMC703LP4E maintains foot print compatibility for the main functions with its predecessor the HMC700LP4E. The HMC703LP4E is housed in a 4 x 4 mm plastic leadless surface mount package and provides excellent temperature stability over the -40 °C to +85 °C temperature range. Samples and evaluation PC boards are available from stock and can be ordered via the company's e-commerce site or via direct purchase order.

MDB awards Kopin with "Bright Lights Award"

Kopin was one of the companies to receive a CLARUS Award for technology leadership and obtaining one of the highest number of granted patents.

MDB Capital Group, Wall Street's only IP Investment Bank, has announced the winners of its 2nd annual Bright Lights Innovation Awards held during the Bright Lights Conference at Le Parker Meridien Hotel in New York City on May 10-11, 2011.

Chosen from 40 of MDB Capital Group's "Best and Brightest" small-cap companies, the award-winning companies represent IP leaders based a number of variables including, patent applications, patent novelty, quality, and impact and other factors as identified by MDB Capital's PatentVest, a proprietary IP business intelligence platform.

Kopin Corporation was one of the companies to receive a CLARUS Award for technology leadership and achieved one of the highest Tech Scores and number of patent grants.

Bright Lights is one of the only conferences with an exclusive focus on companies possessing disruptive and market changing IP, providing institutional investors a venue to discover the largely unrecognized value of embedded IP.

Bright Lights is showcasing approximately 40 public companies ranking in the 90th percentile for their respective technology leadership from more than 1,500 small-cap companies with granted U.S. patents, as rated by PatentVest.

In addition to company presentations, IP industry thought-leaders are leading Bright Lights sessions, providing insightful analysis and discussions on innovation and IP monetisation topics during this invitation-only event.

Keynote speakers include:

David Kappos, *Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office*

Paul Ryan, *CEO of Acacia Research, one of Wall Street's largest IP holders and licensing companies*

Marshall Phelps, *author, IP Hall of Fame member and former Corporate Vice President and Deputy General Counsel for Intellectual Property and Licensing at Microsoft*

John Cronin, *CEO & Founder of ipCapital Group, one of the foremost experts on IP development*

and licensing and former head of the IBM Patent Factory

Endwave's 24 GHz GaAs upconverter is multifunctioning

Based on GaAs pHEMT technology, the highly integrated MMICs are ideal for a wide range of applications, including in commercial and military transmitter systems.

Endwave Corporation, a provider of high-frequency RF devices and integrated subsystems, has added a pair of integrated frequency upconverters to its line of high-performance GaAs monolithic-microwave-integrated-circuit (MMIC) products.

The models EWU1509YF and EWU1809YF frequency upconverters operate over intermediate-frequency (IF) ranges of DC to 4 GHz and generate frequencies of 10.0 to 15.4 GHz and 17.0 to 24.0 GHz, respectively. Based on GaAs pseudomorphic HEMT technology, the highly integrated MMICs incorporate several frequency mixers, local oscillator (LO) amplifier or frequency doubler, and variable-gain RF amplifier circuitry. They are ideal for a wide range of applications, including in commercial and military transmitter systems.

The lower-frequency model EWU1509YF GaAs MMIC upconverter operates over an IF range of DC to 4 GHz with LO signals from 6.0 to 19.4 GHz at a nominal level of +2 dBm to produce RF outputs from 10.0 to 15.4 GHz. It achieves typical conversion gain of 16 dB and +19 dBm typical RF output power at 1-dB compression. RF output levels can be adjusted in level by means of a 27-dB RF gain-adjustment range.

The output third-order intercept point is typically +28 dBm at the maximum RF gain setting. Model EWU1509YF is designed for low-power applications, drawing typically only 380 mA current from a +4.5 VDC supply.

The higher-frequency model EWU1809YF GaAs MMIC upconverter accepts IF signals from DC to 4.5 GHz and LO signals from 8.5 to 12.0 GHz and nominally +2 dBm to produce RF output signals from 17.0 to 24.0 GHz with typical conversion gain of 5 dB. It generates +19 dBm typical RF output power at 1-dB compression, but allows this level to be adjusted by means of an integrated 18-dB RF gain adjustment range. The output third-order intercept point is typically +25 dBm at the maximum RF gain setting.

Both GaAs MMIC frequency upconverters feature integrated electrostatic-discharge protection bias circuitry per Human Body Model Class 1A requirements. The RoHS-compliant devices are housed in compact 5 x 5 mm, 32-lead, plastic-overmolded QFN surface-mount-technology packages and rated for operating temperatures from -55 to +85°C.

All devices are 100% DC and RF tested and visually inspected to IPC-A-610 requirements and further information about both products is available from Endwave's website.

Opto industry is speeding up the data rate

GigOptix, Opnext, Oclaro, JDSU, Sumitomo Electric, Avago, Emcore and Finisar are manufacturing products at 40Gbps or higher.

To coincide with the Optical Fibre Communication Conference and Exposition (OFC) and the National Fibre Optic Engineers Conference (NFOEC), one of the largest optoelectronics trade shows, component manufacturers released and demonstrated a host of new products in March.

According to Strategy Analytics, this activity

underscores the dramatic shift to higher data consumption. The recently published Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) viewpoint, "Compound Semiconductor Industry Review March 2011: Optoelectronics, Materials and Equipment," captures March 2011 product, technology, contract and financial announcements for optoelectronic companies such as Aixtron, Kopin, Cree, Philips Lumileds, Fujitsu, Spire Corporation and XSunX.

"Consumer and business adoption of data-intensive applications is driving changes in the entire electronics industry," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service. "The optical transport layer is the backbone of this increased demand. The industry is responding with higher data rate capacity."

Asif Anwar, a Director in the Strategy Analytics Strategic Technologies Practice, added, "We are seeing the majority of new optical networking products and components with data capability of at least 40Gbps per second, many at 100Gbps, providing faster processing."

Anadigics unveils new line of PAs for SMPS devices

The new line of power amplifiers are optimised for use with SMPS, including DC/DC converters and envelope tracking. By pairing these 2 state mode power amplifiers with SMPS, designers are able to achieve industry-leading average current consumption.

Anadigics, a provider of RF and mixed signal semiconductor products, has introduced a new series of power amplifiers (PAs), leveraging the Company's third generation High-Efficiency-at-Low-Power (HELP)technology.

The new HELP3DC AWT663x series PAs are optimised for CDMA, WCDMA/HSPA, and LTE devices that include a switched-mode power supply (SMPS), DC/DC converter, or Envelope Tracking IC to control the PA supply voltage. In this kind of design, HELP3DC PAs provide the world-class average current consumption to help extend battery life in handsets, smart phones, tablets, netbooks, and notebooks.

"Anadigics continues to raise the bar for wireless power amplifier performance with the introduction of our new HELP3DC series, optimised for devices that include DC/DC converters in their RF power management strategy," said Bruce Webber, director of marketing for wireless RF products at Anadigics. "This addition to our successful and industry-leading HELP product family provides RF designers with more options to achieve longer battery life, enabling mobile device users to experience the full potential of mobile broadband 3G and 4G services."

SMPS and DC/DC converters allow handset designers to reduce the PA supply voltage, decreasing average current consumption under selected conditions. Anadigics' HELP3DC PAs have two power modes for high efficiency across both low and high RF power levels from a single mode control input. These PAs also provide exceptionally low quiescent currents of less than 8 mA at 3.4 V.

The HELP3DC PAs are also LTE, WCDMA, HSPA, HSPA+ and CDMA/EVDO compliant. Anadigics says they have the best-in-class linearity (ACLR1) at 3.4 V and 1.8V control logic. The modules are optimised for RF designs that vary the PA supply voltage to reduce current consumption.

Using a HELP3DC series PA in combination with an external DC/DC converter gives designers additional options to reduce battery current

consumption in both high power and low power modes. Envelope tracking designs modulate the PA supply voltage to match the demands of the input RF signal. In Envelope Tracking designs, HELP3DC PAs can provide world-class performance and efficiency.

The highly integrated modules features an RF coupler, internal voltage regulation, integrated DC blocks on RF ports and come in 3 mm x 3 mm x 1 mm packages.

CS product development reflects market diversification

Strategy Analytics says some companies such as RFMD, Skyworks, Anadigics, Hittite, Analog Devices, Panasonic and NXP are expanding their product lines into defence and broadband.

Even while the handset portion of the compound semiconductor market remains the largest revenue producer, Strategy Analytics sees that leading device suppliers are diversifying their portfolios by developing additional products for infrastructure, broadband and military applications.

The recently published Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) viewpoint, "Compound Semiconductor Industry Review March 2011: Microelectronics," captures March 2011 product, financial, contract and technology announcements for microelectronic companies such as RFMD, Skyworks Solutions, Hittite Microwave, Anadigics, TriQuint Semiconductor Analogue Devices and NXP.

"The handset market continues to drive compound semiconductor volume, but rapid price erosion poses a challenge for suppliers," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service.

"The March product announcements show activity aimed at CATV, fibre, military and test and measurement markets, as companies try to capture higher margin opportunities."

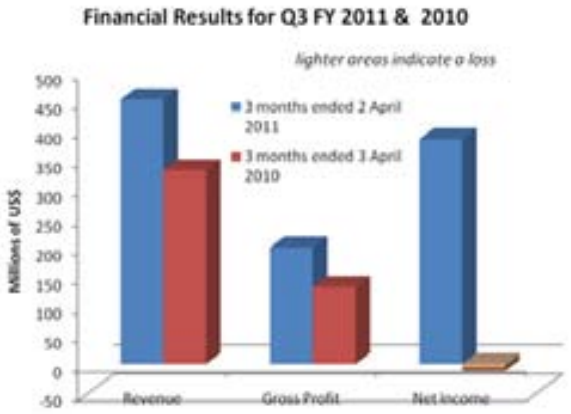
Asif Anwar, Director, Strategy Analytics Strategic Technologies Practice added, "Some companies are expanding product lines into defence and broadband, which uses new processes to diversify market penetration."

This viewpoint summarises March 2011 financial, product, contract and employment developments from major GaAs and silicon suppliers, which addresses a variety of commercial and military applications that use GaAs, GaN, Silicon SiC, and complementary metal-oxide-semiconductor (CMOS) technologies.

JDSU revenues jump by 26.8%

The company benefited this quarter from the strong mix of new products as the result of its collaborative innovations in optical communications and test and measurement businesses.

JDSU has reported results for its third fiscal quarter ended April 2, 2011.



On a GAAP basis, net revenue for the third fiscal quarter of 2011 was $454.0 million and net income was $38.6 million, or $0.16 per share. This compares to net revenue of $473.5 million and net income of $23.6 million, or $0.10 per share for the prior quarter. This represents a 26.8% increase over the same quarter last year where net revenue was $332.3 million and net loss was $(11.9) million, or $(0.05) per share.

GAAP net income for the third fiscal quarter of 2011

included a tax benefit of $34.9 million related to a release of deferred tax valuation allowance for a foreign jurisdiction. The Company determined during the quarter that it is more likely than not such deferred tax assets will be realised.

"In fiscal Q3 JDSU reported strong financial results with year over year operating income growth of nearly 150%, as our strategy to operate as a diversified technology company provides the ability to navigate fluctuations that may occur in any one business segment and continues to positively differentiate JDSU's performance," said Tom Waechter, JDSU's President and Chief Executive Officer. "We benefited again this quarter from the strong mix of new products as the result of our collaborative innovation initiative evidenced by market share gains in our optical communications and test and measurement businesses."

Business Outlook

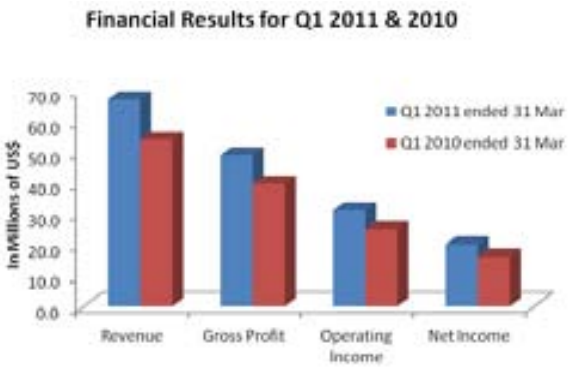
For the fourth quarter of fiscal 2011, ending July 2, 2011, the Company expects non-GAAP net revenue to be in the range of $455 to $475 million.

JDSU discussed these results and other related matters in a live webcast which is archived for replay on the company's website at www.jdsu.com/investors.

Quarterly results are rosy for Hittite

With an increase in quarterly revenues, profits and incomes over the same quarter last year, Hittite has not suffered like other RF electronics and Telecoms manufacturers.

Hittite Microwave Corporation has reported revenue for the first quarter ended March 31, 2011 of $67.2 million, representing an increase of 24.1% compared with $54.2 million for the first quarter of 2010.



This is also an increase of 2.5% compared with $65.6 million for the fourth quarter of 2010. Net income for the quarter was $20.2 million, or $0.66 per diluted share, an increase of 25.2% compared with $16.1 million, or $0.54 per diluted share, for the first quarter of 2010, and a decrease of 3.5% compared with $20.9 million, or $0.69 per diluted share, for the fourth quarter of 2010.

For the first quarter of 2011, revenue from customers in the United States was $30.0 million, or 44.6% of the company's total revenue, and revenue from customers outside the United States was $37.2 million, or 55.4% of total revenue.

Gross margin was 73.0% for the first quarter of 2011, compared with 73.4% for the first quarter of 2010 and 74.5% for the fourth quarter of 2010. Operating income for the first quarter was $31.2 million, or 46.4% of revenue. Total cash and cash equivalents at March 31, 2011 was $311.8 million, an increase of $16.3 million for the quarter.

The company expects revenue for the second quarter ending June 30, 2011 to be in the range of $67.5 million to $69.5 million and net income to be in the range of $19.8 million to $20.6 million, or $0.64 to $0.67 per diluted share.

Oclaro and JDSU must be patient

Revenue growth in the optical component industries may take some time according to the latest Bedford Report.

It is now the heart of earnings season and investors are feverishly following results from the Optical Components Industry. Shares of companies in the

sector surged in the first three months of 2011 as analysts predicted strong growth.

However, over the last month valuations have slipped following weak outlooks from many industry heavyweights. The Bedford Report examines the Optical Components Industry and provides research reports on JDS Uniphase Corporation and Oclaro.

JDS Uniphase, who saw its share price surge more than 40 % in the first quarter, is a leading provider of communications test solutions and optical products to telecom carriers, cable operators, and network equipment manufacturers. Tom Waechter, JDSU's President and Chief Executive Officer, says this is an "exciting time" as the company's innovation engine and pipeline for new products is robust.

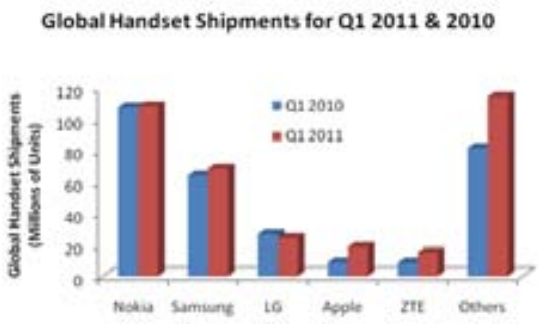
JDSU is set to report fiscal third quarter earnings after market close on Wednesday. For the third quarter ended April 2, 2011, the Company expects non-GAAP net revenue to be in the range of $440 to $460 million.

Last Thursday, Oclaro reported a fiscal third-quarter loss of 8 cents a share -- well below the profit of 6 cents a share analysts on average expected. Oclaro CEO Alain Couder says that he expects the slowdown to continue through the upcoming fiscal fourth quarter, but explains that planned new products "are expected to provide revenue growth and gross margin traction in the second half of the calendar year."

Apple leapfrogs ZTE to 4th position in handset shipments

Strategy Analytics recent report says that some brands outperformed, such as Apple and ZTE, while others underperformed, such as LG and Nokia.

According to the latest research from Strategy Analytics, global handset shipments grew 17 % annually to reach 350 million units in the first quarter of 2011. Apple captured fourth place in global handset shipments, rising from sixth position a year earlier and overtaking rival ZTE.



Alex Spektor, Senior Analyst at Strategy Analytics, said, "Global handset shipments grew 17 % annually to reach 350 million units in Q1 2011. Apple was a star performer during the quarter, as it shipped a record 18.6 million handsets, captured fourth place in global shipments and overtook rival ZTE."

Neil Mawston, Director at Strategy Analytics, added, "It was a mixed quarter for the world's major handset vendors. Some brands outperformed, such as Apple and ZTE, while others underperformed, such as LG and Nokia. LG lost ground due to sluggish feature phone volumes, while Nokia continued to struggle in 3G smartphones and the important United States market."

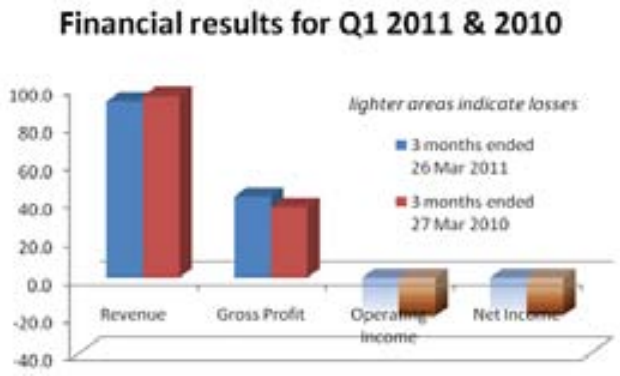
Other findings from the research included in the report "*Apple Overtakes ZTE for 4th Position in Global Handset Shipments in Q1 2011*" include Samsung shipping 68.9 million handsets worldwide during the first quarter of 2011, rising a relatively sluggish 7% from 64.3 million units a year earlier. Its global handset marketshare has dipped from 22% to 20% over the past year, due to rising competition in 2G and 3G touchphone markets.

Also, global handset shipments grew 17% annually and reached 350 million units in Q1 2011, driven by surging smartphones in mature regions and popular multi-SIM models in emerging markets. This year will be the first year ever when every quarter will exceed 300 million units.

Infinera incomes still in the red

Although revenues fell by only 3% over the same quarter last year, they also plummeted by 20% compared to the previous quarter.

Infinera Corporation, a provider of digital optical communications systems, has released financial results for the first quarter ended March 26, 2011.



GAAP revenues for the first quarter of 2011 were $92.9 million compared to $117.1 million in the fourth quarter of 2010 and $95.8 million in the first quarter of 2010. GAAP gross margins for the quarter were 46% compared to 49% in the fourth quarter of 2010 and 39% in the first quarter of 2010. GAAP net loss for the quarter was $16.4 million, or $(0.16) per share, compared to net loss of $2.7 million, or $(0.03) per share, in the fourth quarter of 2010 and net loss of $20.0 million, or $(0.21) per share, in the first quarter of 2010.

"Our first quarter results were achieved based on continuing demand for our product portfolio from our existing customers, which reflects continuing steady growth in end-user demand for bandwidth, but we saw slower new footprint activity in Q1 versus a year ago," said Tom Fallon, president and chief executive officer.

"Customers continue to show strong interest in our Photonic Integrated Circuit technology and in the field trial demonstrations of the differentiated features of our upcoming new products—our 40G transmission solution with FlexCoherent technology and our next-generation 500Gb/s PIC solution, which will support 100G transmission applications," he continued.

"It is also important to note that we are growing the number of customers who are buying a multi-product Infinera solution. This includes customers buying either a combination of long-haul and metro solutions or a combination of terrestrial and subsea solutions. At the end of Q1, we had 26 multi-platform customers out of a total of 86 customers worldwide. This is an important trend as these customers have made a more significant architectural commitment to Infinera.

"Finally, we continue to build additional features and capabilities into our ATN metro platform, and in the second quarter we will add Ethernet aggregation functionality."

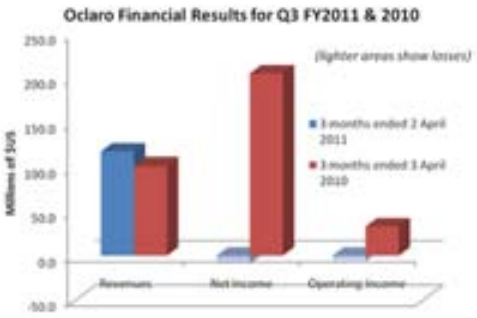
Infinera hosted a conference call for analysts and investors to discuss its first quarter results and second quarter outlook. An archived version will be available on the website for 90 days. The replay may be accessed by calling:

1-866-395-9177	(from the U.S. and Canada)
1-203-369-0501	(from outside the U.S. and Canada)

Oclaro incomes bomb in latest quarter

The firm has reported operating losses of $6.2 million and net losses of $9.4 million for its latest quarter ended 2 April 2011.

Oclaro, a provider of innovative optical communications and laser solutions, has announced the financial results for its third quarter of fiscal year 2011, which ended April 2, 2011.



"Oclaro has continued to invest in its new product

pipeline while certain telecom customers have experienced a short-term inventory correction," said Alain Couder, president and CEO of Oclaro.

"We expect the slowdown to continue through our upcoming fiscal fourth quarter. Our planned new products are expected to provide revenue growth and gross margin traction in the second half of the calendar year. We also remain confident in the second half because of the continued strong demand for broadband in the core optical market, and the increasing reliance on optical functionality throughout the network."

Revenues for Q3 FY 2011 were $116.6 million for the third quarter of fiscal 2011, compared to $120.3 million in the second quarter of fiscal 2011. GAAP gross margin was 25% for the third quarter of fiscal 2011, compared to 30% in the second quarter of fiscal 2011.

GAAP operating loss was $6.2 million for the third quarter of fiscal 2011, compared to GAAP operating income of $1.6 million in the second quarter of fiscal 2011.

Adjusted EBITDA was $1.1 million for the third quarter of fiscal 2011, compared to $10.1 million in the second quarter of fiscal 2011. GAAP net loss for the third quarter of fiscal 2011 was $9.4 million, compared to net loss of $0.2 million in the second quarter of fiscal 2011.

Cash, cash equivalents and restricted cash were $75.7 million as of April 2, 2011 compared to $78.1 million as of January 2, 2011.

For the fourth quarter of fiscal 2011, which ends July 2, 2011, Oclaro expects revenues in the range of $105 million to $115 million and adjusted EBITDA in the range of negative $6.5 million to negative $1.5 million.

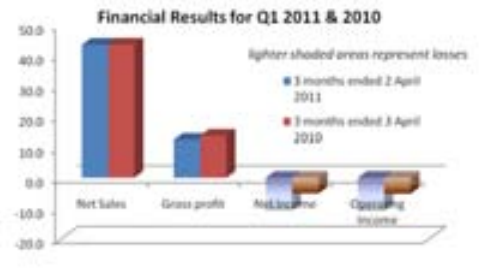
Oclaro held a conference call to discuss financial results for the third quarter of fiscal 2011. The replay may be accessed by dialling (858) 384-5517

The passcode for the replay is 4429507. A webcast of this call will also be available in the investors section of Oclaro's website at www.oclaro.com .

Anadigics revenues slide to $43.5 million

While Broadband net sales in the next quarter are expected to increase sequentially by approximately 35%, it will not be sufficient to offset the decline in Wireless sales which are expected to sequentially decrease by 25 to 30%.

Anadigics, a provider of semiconductor solutions in the broadband wireless and wireline communications markets, reported first quarter 2011 net sales of $43.5 million which were flat to the same year ago period and down 27.8% from the prior quarter.



GAAP net loss for the first quarter of 2011 was $10.7 million, or ($0.16) per share. As of April 2, 2011, cash, cash equivalents and short and long-term marketable securities totalled $104 million.

Outlook for the Second Quarter 2011

Shipments to our largest North American wireless customer will decrease during the second quarter resulting in an expected sequential decrease in Wireless net sales of approximately 25% to 30%. While Broadband net sales are expected to increase sequentially by approximately 35%, it will not be sufficient to offset the decline in Wireless sales.

As such, total Company net sales for the second quarter of 2011 are expected to decrease sequentially by approximately 15% - 19% to a range of $35 - $37 million from the first quarter revenue of $43.5 million. Net loss on a GAAP basis for the second quarter is expected to be approximately ($0.22) to ($0.23) per share, which includes a restructuring charge of $0.02 per share.

"The decrease in net sales at our largest customer is the result of programs reaching end of life and

a loss in market share related to the customer's change in chipset vendors that do not utilize our power amplifiers," commented Ron Michels, President and Chief Executive Officer.

"We remain actively engaged with this large customer and its chipset vendors on next generation platforms. Additionally, we are proactively taking steps to align our cost base with revenues over the short-term, while prudently allocating resources to further expand our technology base and product offerings going forward. New product development will be a critical area of focus as we increase the breadth of our product portfolio and enhance our commitment to innovation and technology leadership. In fact, we are already heavily engaged with all of our customers and are actively pursuing several new opportunities across both Wireless and Broadband."

"While I am disappointed in our revenue guidance for the second quarter, I want to emphasise that our foundation for future success is still intact. We have an expanding technology pipeline and strong relationships with our current customers. Together our solid balance sheet, prudent cost reductions and investment in future products will enable us to reposition Anadigics as an industry leader. Despite the significant near-term challenges that we face, I am committed to returning our company to growth and profitability and becoming more effective at everything that we do."

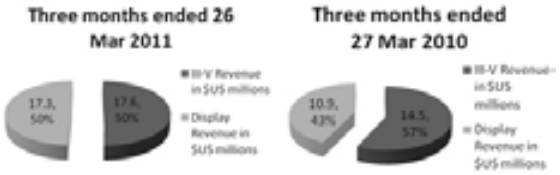
Anadigics' senior management will conduct a conference call today at 8:30 AM Eastern Time. A live audio Webcast will be available at www.anadigics.com/investors. A recording of the call will be available approximately two hours after the end of the call on the Anadigics Web site or by dialling 800-642-1687 using conference ID 60793547 (available until May 10, 2011).

III-V revenues boost Kopin's financial results

Total revenues for Q1 2011 increased 37% to a record $34.9 million much of it down to the booming smartphone market. Display revenues also grew 59% to $17.3 million, primarily as a result of higher military display sales.

Kopin Corporation, a supplier of advanced semiconductor materials and microdisplays for mobile applications, has announced financial results for the three months ended March 26, 2011.

Total revenues for the first quarter of 2011 increased 37% to a record $34.9 million, compared with $25.4 million for the same period in 2010. III-V revenue increased 21% to $17.6 million from $14.5 million for the comparable quarter last year, reflecting stronger first quarter orders from the Company's integrated circuit partners. Display revenue grew 59% to $17.3 million versus $10.9 million in the first quarter of 2010, primarily as a result of higher military display sales.



Net income for the first quarter of 2011 was $2.1 million, or $0.03 per diluted share, compared with $1.0 million, or $0.02 per diluted share, for the 2010 first quarter. Included in the 2010 results of operations was approximately $373,000 from the receipt of insurance proceeds and $686,000 from the sale of Micrel stock.

Gross margin for the first quarter of 2011 increased to 33.3% of product revenues from 26.5% of product revenues for the same period of 2010, reflecting an increase in sales of military displays and leveraging the III-V fixed costs over greater volume. R&D expense increased to $6.4 million, or 18.3% of revenues in 2011, compared with $4.3 million, or 16.9% of revenues in 2010, as a result of the Company's investments in the Golden-i product, III-V products for smartphones and the acquisition of Forth Dimension Displays (FDD).

"Kopin demonstrated strong results in the first quarter, driven by contributions from both our

III-V and display products," said Kopin President and Chief Executive Officer John C.C. Fan. "Our earnings reflect our commitment to maintaining prudent expense management, while at the same time investing strategically in research and development and capacity expansion to execute our growth strategy."

"In early April we announced the availability to select customers of Golden-i Development Kits, our revolutionary wearable, voice-activated cloud computing product, which is being developed jointly with Motorola Solutions," Fan said. "The feedback from these customers will be reflected in the Golden-i products which are scheduled for general availability in 2012. Just as many compelling applications have been created for the iPhone and Android platforms, we see significant opportunities for developers to write applications for Golden-i."

Business Outlook

"We are excited about the Company's growth prospects," Fan said. "We continue to expect III-V to grow at an annualised rate of 20-25% over the next several years, driven primarily by global smartphone demand. In our display business, as is the historic pattern, revenue from military applications fluctuates quarter to quarter but we expect strong military revenues in 2011 as we continue to supply the US Army's Thermal Weapons Sight program."

"Looking ahead, we are focused on our two main goals: extending the leadership position of our III-V products to take advantage of the expected growth in smartphones and tablets; and advancing the development schedule for Golden-i toward a planned launch in 2012," Fan continued. "We started 2011 on a very good note, with strong operating results and in excellent financial condition, with $99 million of cash and no debt."

Based on the current business environment and conversations with its customers, Kopin is affirming its full-year 2011 guidance for total revenues in the range of $130 million to $140 million.

In conjunction with its first-quarter 2011 financial results, Kopin hosted a teleconference call for investors and analysts. The call is available as an archived audio webcast on the "Investors" section of the Kopin website, www.kopin.com .

TowerJazz touts highest speed foundry SiGe technology

The 260GHz speed and low power consumption addresses the booming high-speed communications market fuelled by the explosion in video internet traffic.

TowerJazz, a specialty foundry leader, has unveiled what it claims to be the industry's highest speed foundry SiGe technology, the SBC18H3.

The technology addresses next-generation needs for high-speed interfaces in communication protocols such as Thunderbolt, optical fibre, and high-data rate wireless by improving performance while reducing noise and power consumption of key building blocks. SBC18H3 also targets applications such as automotive collision avoidance systems, millimetre-wave radar and GHz imaging.

SBC18H3 is TowerJazz's third generation 0.18 mm SiGe technology and offers transistors with 240GHz Ft and 260GHz Fmax in a cost-effective and analogue-friendly 0.18 mm node. The technology is built on the same mature integration platform used for the prior two TowerJazz SiGe processes now in high-volume production (SBC18H2 at 200GHz and SBC18HX at 155GHz).

IP of high-speed components such as TIAs, Laser Drivers, SerDes, CDRs from H2 and HX can be readily ported to the new H3 process since they are all in the same 0.18 mm node, allowing them to benefit from improved performance as well as reduced power consumption and noise.

Power consumption is dramatically reduced with H3 where, for example, a 77GHz amplifier can be made to consume three times less DC power than was possible with older technology. At the same time, noise is improved to levels that far exceed those of prior SiGe technology and are superior to numbers typically reported for more expensive III-V material systems (minimum noise figure at 20GHz is measured at less than 1dB and at 40GHz at only 2dB). This can be important in many communication systems but particularly in wireless applications, improving sensitivity of GPS systems, for example.

SBC18H3 process design Kits (PDKs) include mm-wave components important for high speed designs such as a transmission-line toolbox, p-i-n diodes for RF switching, and support for small size MIM capacitors. TowerJazz offers a monthly MPW for quick and cost-effective prototyping of designs, and leading customers have already built initial SBC18H3 prototype designs through this MPW service.

"SBC18H3 extends our leadership position in providing the highest speed SiGe foundry services," said Marco Racanelli, Senior Vice President and General Manager, RF and High Performance Analog Business Group. "The process extends the high-end of our overall portfolio of SiGe technology that currently spans from the 0.35 mm to the 0.13 mm node and is available in two of our 8-inch factories for flexibility of supply and capacity."

Handset semiconductor market revenues shoot up 15%

According to ABI Research's "Mobile Device Semiconductors Market Data" report, 2010 saw the global handset semiconductor market achieve an estimated revenue jump of about 15% compared to 2009, on a shipment growth of 13%.

According to ABI Research practice director Peter Cooney, "Consistent demand for smartphones has become the major driver behind semiconductor market growth. In view of the return on investment (ROI) and the technological barriers to entry, many semiconductor vendors are contemplating merger and acquisition strategies to align their technologies for the future."

Between the end of 2008 and the end of 2009, smartphone shipments grew about 19%, while growth over the course of 2010 surged a further 71%. That rising smartphone demand resulted in a YoY revenue growth of 34% for application processors. Among connectivity chipsets, Wi-Fi grew 62% in the same period. The top ten application processor suppliers, including Qualcomm, TI, Samsung, Apple, and Marvell, together accounted for some 85% of all revenues for the segment in 2010.

Baseband processor revenue grew approximately 11% in 2010; the top four suppliers, Qualcomm, MediaTek, TI and ST-Ericsson together earned 82% of the total. Qualcomm led the global handset baseband market in CDMA and W-CDMA segments, while MediaTek took the top position in GSM/GPRS/EDGE and TD-SCDMA segments.

Competition in handset semiconductor markets has become more intense, leading to increased M&A activity. Intel completed its acquisition of Infineon's wireless solutions business in 1Q2011. Broadcom acquired Beceem in November 2010, marking a return to the leading edge of the processor technology market. In January 2011 Qualcomm announced its intention to acquire Atheros; and Samsung announced M&A plans at CES, a sign of what's to come in the aggressively competitive world of the mobile handset.

Cooney concludes, "The total revenue delivered by handset semiconductors is set to continue growing over the next five years, driven primarily by the growing numbers of ICs supporting multiple functions in the next generations of smartphones."

RF Electronics

M/A-COM Tech extends portfolio with high power GaN HEMTs

With its new gallium nitride transistors, the firm is targeting L- and S-Band pulsed radar applications.

M/A-COM Technology Solutions is introducing a new family of GaN RF Power transistors.

The announcement was made at MTT-S 2011, one of the largest RF & Microwave Product Exhibition in the industry. This new family of products targets L- and S-Band pulsed radar applications and leverages M/A-COM Tech's rich heritage of providing both standard and custom solutions.

M/A-COM Tech's GaN on Silicon Carbide (GaN-on-SiC) products, offered as transistors and pallets,utilise a 0.5 µm HEMT process and exhibit attractive RF performance parameters with respect to power, gain, gain flatness, efficiency and ruggedness over wide-operating bandwidths. Featured benefits of M/A-COM Tech's GaN products include high breakdown voltage, superior power density, and higher and broader frequency operation than silicon.

A list of the new products is given below.

Part Number	(MHz)	Pout (W)	Frequency Pulse/Duty
MAGX-002731-030L00	2700 - 3100	30 peak	500µs / 10%
MAGX-002731-100L00	2700 - 3100	100 peak	500µs / 10%
MAGX-002731-180L00	2700 - 3100	180 peak	500µs / 10%
MAGX-003135-030L00	3100 - 3500	30 peak	500µs / 10%
MAGX-003135-180L00	3100 - 3500	180 peak	500µs / 10%
MAGX-000912-125L00	960 - 1215	125 peak	2ms / 10%
MAGX-000912-250L00	960 - 1215	250 peak	2ms / 10%
MAGX-001214-125L00	1200 - 1400	125 peak	2ms / 10%
MAGX-001214-250L00	1200 - 1400	250 peak	2ms / 10%
MAGX-001220-100L00	1200 - 2000	100 peak	500µs / 10%
MAGX-000035-030000	1 - 3500	30 average	CW
MAGX-000035-100000	1 - 3500	100 average	CW

"M/A-COM Tech leverages more than 30 years of experience in developing industry-leading high power transistors to deliver these top-quality GaN power devices," stated Chuck Bland, Chief Executive Officer of M/A-COM Tech. "Our highly versatile family of GaN products offers customers a single solution combining both the high power handling and high-voltage operation typically found in silicon LDMOS devices, but with higher frequency performance more often associated with GaAs devices. Innovative solutions for demanding applications like these are what customers have come to expect from the First Name in Microwave—M/A-COM Tech."

The latest ABI research shows increasing demand for high power, pulsed RF devices in S- and L-band air traffic control, marine, and military radar applications. "M/A-COM Technology Solutions' silicon based products have been a major force for high power, pulsed RF applications in the S- and L-Band radar market, and the extension into GaN technology positions their product line for continued market leadership", said Lance Wilson, Research Director, RF Components & Systems.

M/A-COM Tech plans to release additional products that target applications such as L-Band radar, avionics, EW, and MILCOM, as well as general purpose devices later this year.

Engineering samples for GaN transistors and pallets are available for qualified customers today from stock although the products are subject to the jurisdiction of the Export Administration Regulations.

RFMD branches out with P2P radio chipsets

The highly integrated chipsets, which employ the firm's 0.15µm gallium arsenide technology, optimise each front end component for next-generation high-capacity 3G/4G radios using complex modulation schemes.

RF Micro Devices, a designer and manufacturer of high-performance radio frequency components and compound semiconductor technologies, has expanded its product portfolio to include several point-to-point (P2P) radio chipsets targeting the growing cellular backhaul market.

The highly integrated radio chipsets combine multiple RF/microwave radio front end components and expand RFMD's product portfolio to encompass all critical RF and IF functions in the P2P radio transceiver.

The P2P radio market is growing rapidly as the proliferation of smartphones and the increasing demand for mobile data are forcing cellular operators to expand capacity in cellular backhaul networks. RFMD's highly integrated P2P radio chipsets help to satisfy operators' capacity expansion requirements by optimising each front end component for next-generation high-capacity 3G/4G radios using complex modulation schemes.

The front end components deliver industry-leading narrowband performance, enabling the realization of state-of-the-art radio performance. Additionally, the broadband nature of the front end components enables radio designers to maximize design flexibility and simplify inventory bill-of-material control.

Jeff Shealy, general manager of RFMD's Defence and Power business unit, said, "RFMD is rapidly expanding our product portfolio in support of the Point-to-Point microwave radio market. With the launch of these highly integrated radio chipsets, RFMD enables our customers to develop high-reliability, next-generation Point-to-Point radio solutions while reducing design time requirements and lowering overall bill-of-material costs."

Each new RFMD P2P radio chipset is available in a surface mount QFN package. The integrated up-converters include a LO amplifier (with integrated x2 multiplier where applicable), IQ mixer, VVA and driver amplifier in a single package. The integrated down-converters utilise 0.15µm GaAs technology to deliver industry-leading IIP3 and noise figure performance. Finally, the integrated MMIC VCOs exhibit industry-leading phase noise performance coupled with flat output power over the frequency tuning bandwidth. To complement the new radio chipsets, RFMD also offers a comprehensive portfolio of converters and gain blocks aimed at the IF section of the radio.

Samples and production quantities are available now through RFMD's online store at http://www.rfmd.com/products or through local RFMD sales channels.

RFMD raises the bar with qualified 65 V GaN1 process

The 65V gallium nitride process succeeds the firm's GaN1 process for 48V and enables miniature, 0.5kW power devices with high operating efficiency for L- and S-Band military and civilian radar applications.

RF Micro Devices, a designer and manufacturer of high-performance radio frequency components and compound semiconductor technologies has qualified its GaN1 power semiconductor process technology for 65V operation.

The high reliability power semiconductor process technology supports RFMD's GaN-based power semiconductor product designs and is also available to foundry customers through RFMD's Foundry Services business unit.

Previously, RFMD's GaN1 power semiconductor process technology had been qualified for 48V operation. The increase in operating voltage from 48V to 65V enables miniature, 0.5kW power devices with high operating efficiency for L- and S-Band military and civilian radar applications.

Bob Van Buskirk, president of RFMD's Multi-Market Products Group (MPG), said, "The qualification of our 65V GaN1 power process technology enables RFMD to target multiple higher voltage market opportunities across MPG's diversified markets while helping our foundry customers to design smaller periphery die for high power applications. RFMD continues to optimize our game-changing GaN process technology for both foundry customers and proprietary RFMD product designs, with particular emphasis on higher peak efficiency, lower power consumption and higher linearity."

RFMD's 48V GaN1 process technology is an established performance leader in the high power semiconductor industry, and RFMD's 65V GaN1 process technology moves the performance bar even higher. RFMD's 65V GaN1 process technology demonstrates a Mean-Time-to-Failure (MTTF) of 43 million hours with a channel temperature of 2000C at power densities of 10 W, a significant industry performance benchmark. The high reliability power semiconductor process is ideally suited for higher voltage operations in next generation military, radar, and public/defence mobile radio applications.

Microsemi to exhibit advanced RF power semiconductors at IMS2011

The firm will showcase its expanded power transistor family and military-grade microwave amplifiers and subsystems from newly acquired AML Communications.

Microsemi Corporation will display its family of RF components and subsystems for radar systems, defence electronics and unmanned aerial vehicle (UAV) systems at the IEEE Microwave Theory & Techniques Society's International Microwave Symposium for 2011.

Microsemi will be showing its broad line of RF power transistors, including SiC UHF static induction transistor devices that offer high peak power for Class AB systems with a 300-microsecond pulse width, and a recently announced family of GaN-on-SiC that deliver maximum performance with superior power, gain, bandwidth, drain efficiency and reliability. The company's new GaN-on-SiC devices enable the development of next-generation radar systems operating in the 2.7 GHz to 3.5 GHz frequency band.

Microsemi also will be displaying products acquired from its recent purchase of AML Communications. The company designs and manufactures a wide range of microwave low-noise and power amplifiers for military and commercial platforms operating across the 1 MHz to 40 GHz frequency range. AML's products increase the scale of Microsemi's RF component and subsystem offering and add a number of complementary technologies to the company's RF solution portfolio.

Microsemi expands S-Band RF portfolio with GaN-on-SiC devices

The firm's gallium nitride based products continue to advance power transistor technology to enable next-generation pulsed radar and other mission-critical systems.

Microsemi Corporation, has expanded its family of S-band RF power transistors to include devices that use advanced GaN-on-SiC process technology.

The company's latest high-pulsed power transistors deliver industry-leading peak power and power gain for radar systems operating in the 2.7 GHz to 3.5 GHz frequency band.

"This is a significant step in Microsemi's ongoing strategy to extend its product development and marketing initiatives to support the increasingly challenging requirements of next-generation air traffic control and other radar systems," said Charlie Leader, Microsemi vice president and general manager.

"By expanding our power transistor offering beyond traditional silicon material to use the latest compound semiconductor technologies, we take performance to the next level, create new markets for our products, and demonstrate our continuing commitment to customers in the radar systems development business."

Microsemi has leveraged its industry-leading expertise in S-band RF power transistors to create a family of GaN-on-SiC solutions that are tailored to support the requirements of next-generation systems requiring higher power, better efficiency, and wider bandwidth than is possible using conventional silicon or SiC process technologies. For applications operating in frequency bands up to 20GHz, the wide bandgap material properties of GaN-on-SiC technology enable smaller systems with improved voltage, gain, broadband performance, drain efficiency, and long-term reliability.

Microsemi's new GaN-on-SiC power transistors complement the company's extensive family of Silicon BJT, RF MOSFET (VDMOS) and RF NPN power transistors, including SiC SIT devices that provide superior performance in high-power UHF Band pulsed radar applications operating at frequencies up to 450 MHz. Microsemi also uses GaN technology for a family of Enhancement Mode GaN field-effect transistors used in satellites and other military power conversion, point-of-load, and high speed switching applications.

These devices feature drain breakdown voltage well above 350 V, enabling them to operate with a drain bias of 60 V while delivering significantly higher reliability than devices manufactured using laterally diffused metal oxide semiconductor technology. The higher drain bias improves peak power output while yielding more user-friendly impedance levels and simplified circuit-matching requirements across the full system bandwidth. Microsemi's GaN-on-SiC devices also deliver more than 13dB of power gain and cover 400 MHz of bandwidth.

Microsemi's new power transistors also reduce system size. As an example, the company's 2729GN-270 transistor replaces a conventional three-stage Si BJT transistor amplifier consisting of a driver transistor plus one output pallet with two 150W transistors. This substantially reduces system size and complexity while improving system power and efficiency.

Microsemi has released two products for each of three frequency bands:

* 2.7-2.9GHz Band for air traffic control applications (pulse format: 100 µs, 10 % ; power gain: 13 ~ 14dB typical; efficiency of 55 to 60 %)

* 2729GN-270 — 280 W power (typical)

* 2729GN-150 — 160 W power (typical)

* 2.7-3.1GHz Band for air traffic control applications (pulse format: 200 µs, 10%; power gain: 12 ~13 dB typical; efficiency of 50 to 55 %)

* 2731GN-200 — 220 W power (typical)

* 2731GN-110 — 120 W power (typical)

* 3.1-3.5GHz Band for airborne tracking applications (pulse format: 300 µs, 10% ; power gain: 11 ~ 12 dB typical; efficiency of 45 to 50 %)

* 3135GN-170 — 180 W power (typical)

* 3135GN-100 — 115 W power (typical

Sample units are available for evaluation now and additional information can be obtained by emailing GaN@Microsemi.com.

TriQuint to demonstrate key milestones in gallium nitride development

Together with customers and various US Government agencies, TriQuint is working to define the future of RF, where it believes GaN will play a key role. The firm will be showcasing its products and technologies at IMS 2011 between June 5 and 10

TriQuint Semiconductor, an RF solutions supplier and technology innovator, has announced several milestones related to its industry leading GaN developments.

"These are exciting times in the GaN development cycle and TriQuint is pushing the envelope by demonstrating key achievements in the path to broad industry consumption. We have standard products available today and continue to enhance the reliability, manufacturability and performance of our GaN process technology. We intend to set a high bar for what customers should expect of GaN technology, customer service and semiconductor

material experience," said Thomas Cordner, TriQuint Vice President.

Together with researchers from the University of Notre Dame, TriQuint put its GaN NEXT Process, which is being developed with funds from DARPA and not yet commercially available, through stringent performance tests. The results of the testing demonstrated performance twice that of recently-claimed 'best' performance by University of California Santa Barbara. The paper, entitled, "State-of-the-Art E/D GaN Technology Based on an InAlN/AlN/GaN Heterostructure" itemises Ft>240GHz compared to the UCSB claim of Ft=120GHz. The paper also details Enhancement / Depletion integration with record DC and RF performances.

TriQuint's commercial GaN foundry offering is now available on 100mm wafers in Limited Release. This release is designed for well-qualified customers with available resources prior to becoming a Full Release process. The latter will include the full complement of associated models, tools and support traditionally offered to TriQuint customers.

The firm's GaN process technology has also been certified as a Department of Defence Category 1A 'Trusted Foundry' ensuring customers that TriQuint's GaN process meets stringent product control and secure handling standards during all stages of circuit fabrication. Accreditation also creates an avenue for increased high security monolithic microwave integrated circuit (MMIC) business.

TriQuint has released several standard products based on its GaN process including:

* The T1G4005528-FS is an innovative discrete RF power transistor with exceptional performance from DC to 3.5 GHz. Ideal for narrow and wideband applications, the T1G4005528-FS is well suited for military and civilian radar, professional and military radio communications systems, test instrumentation, avionics and wideband or narrowband amplifiers.

* The T1G6001528-Q3 is a packaged GaN discrete RF power transistor offering substantial wideband coverage, high PAE, gain, and more than 18 Watts of output power and greater than 50% efficiency across an exceptionally wide bandwidth (DC to 6 GHz.). This multifaceted device can be used in professional and military radio communication systems, jammers, military and civilian radar, test instrumentation, avionics and wideband or narrowband amplifiers.

* The TGA2576 is a power amplifier that delivers 30W of saturated output power in the 2.5-6 GHz range and typically offers 30% PAE and 25dBm of small signal gain. The PA is well suited for counter-IED (C-IED) and other EW (electronic weapons) systems.

TriQuint is working on several ongoing research contracts with government agencies to further its development of GaN for broad commercial use.

These include the Defence Production Act Title III. Announced in November 2010 and granted by US Air Force Research Laboratory (AFRL), this $17.5M, multi-year contract is designed to develop manufacturing that increases yield, lowers costs and improves time-to-market cycles for defence and commercial GaN integrated circuits.

The firm is also working on an Unmanned Aerial Vehicle (UAV) Contract. Awarded by the AFRL, this program will develop new GaN modules for UAVs that will extend the range and capabilities of drone aircraft that are used for reconnaissance missions over Afghanistan, Iraq and other regions.

The DARPA 'NEXT' program announced in October 2009 and awarded by Defence Advanced Research Projects Agency (DARPA) is a $16.2M, multi-year contract funds the development of complex, high dynamic range circuits for future defense and aerospace applications.

This contract was recognised at the inaugural 2011 CS Europe Conference with a CS Europe Industry Award in the R&D category.

Skyworks affirms above market growth outlook

The firm has reiterated strong guidance ahead of this week's investor meetings with the outlook excluding the recently announced acquisitions of SiGe and Advanced Analogic Technologies.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, has announced, ahead of a non-deal road show, it is affirming its outlook for above market growth. This excludes the firm's recently announced acquisitions.

In April 2011, Skyworks guided to approximately $345 million in revenue with non-GAAP diluted earnings per share of $0.46 for the current quarter. Furthermore, during the earnings conference call, the Company indicated it was on a path to approach a $1.5 billion revenue run rate run rate with $2.00 in annualised non-GAAP diluted earnings per share in the September quarter. This growth outlook is being driven by the Company's broad customer base, diversification into new markets and increasing share gains.

"Skyworks' core business continues to outperform our addressed markets and we believe this will be clearly reflected in our performance and guidance," said Donald W. Palette, vice president and chief financial officer of Skyworks. "To be clear, our revenue and non-GAAP earnings outlook for both the June and September quarters is before we add the accretive SiGe and Advanced Analogic Technologies acquisitions."

Skyworks to showcase new lower power LNAs for 1.5 to 3.0 GHz

The LNAs based on its proprietary gallium arsenide pHEMT based process provide cost competitive solutions for wireless applications.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors, has introduced the first in a series of ultra low current, general purpose low noise amplifiers (LNAs).

These are suited to for diverse wireless applications including satellite receiver set-top boxes, Bluetooth headsets, medically prescribed hearing aids, advanced meter reading devices and 2.4 GHz wireless local area networks. These high performance LNAs deliver enhanced receiver sensitivity and wide dynamic ranges facilitating improved signal reception, increased design flexibility and reduced part counts.

"Skyworks is delighted to be expanding our product portfolio with solutions that deliver better performance and are cost competitive for a wide range of markets," said David Stasey, vice president of analogue components at Skyworks. "In addition, our new low noise amplifiers enable Skyworks to enter new markets – driving intense diversification beyond our proven front-end solutions for mobile devices."

The miniature SKY67014-396LF is an advanced pHEMT enhancement mode process LNA with an integrated active bias and on-die stability structures. It enables simple external matching and stable performance over varied temperatures.

Skyworks' enhancement mode pHEMT process allows the device to offer excellent return loss (15 dB typical), stable gain (12 db), low noise (<1 dB) and high linearity (+18 dBm OIP3) while drawing <6 ma of bias current. The SKY67014-396LF offers the designer the ability to externally adjust the supply current to further optimise the amplifier linearity performance for the chosen application. The supply voltage is applied to the RF-OUT/VDD pin through an RF choke inductor and through the VBIAS pin through an external resistor. The supply voltage is adjustable over a range of 1.5 to 5V. The LNA is

manufactured in a compact, 2 x 2 mm, 8-pin dual flat no-lead, restriction of hazardous substances compliant, surface mount technology package.

The device is the first in a series of high performance, low power LNAs targeting broadband wireless applications. Additional footprint compatible LNAs for the 100 – 700 MHz and 700 – 1500 MHz bands will be launched later this year.

Avago unveils two new GaAs LNAs for RF and microwave applications

The new LNA series debuting at IMS 2011 use Avago's proprietary 0.25 µm gallium arsenide enhancement-mode pHEMT process to deliver low noise figures and high linearity.

Avago Technologies has expanded its high-performance portfolio of RF and microwave components for cellular infrastructure applications with two new series of low-noise amplifiers (LNAs).

The company unveiled the latest additions at the 2011 International Microwave Symposium. Featuring best-in-class noise performance and high linearity, the new MGA-63xP8 LNAs and ALM-11x36 fail-safe bypass LNA modules deliver improved receiver sensitivity for base transceiver stations (BTS) and tower mounted amplifiers (TMA) applications.

The MGA-63xP8 devices and ALM-11x36 modules expand the Avago market-leading LNA portfolio for BTS applications, which leverage the company's proprietary 0.25 µm GaAs Enhancement-mode pHEMT process to deliver low noise figure and high linearity.

As opposed to a broadband approach, Avago offers series of LNAs with each device optimised for superior end performance at specific frequency operation ranges. Both new LNA series exemplify this philosophy. Reflecting the portfolio's emphasis on integration, the ALM-11x36 modules can replace large discrete and surface-mount component counts in conventional designs, shortening design cycle time and providing board space savings.

"These two new LNA series, along with the other high-performance products we have introduced leading up to IMS 2011, demonstrate our commitment to extend our leading LNA portfolio for the wireless infrastructure market and raise the bar for noise figure and overall performance," said James Wilson, senior director of marketing for wireless products at Avago. "We continue to work with our customers to develop highly-integrated solutions that streamline the design process and help them to keep up with continuously evolving cellular standards."

In addition to LNAs, the broad range of solutions in the portfolio includes Film Bulk Acoustic Resonator (FBAR) filters, gain blocks, driver amplifiers, and WaferCap amplifiers and detectors, as well as modules that integrate multiple technologies.

The high-linearity MGA-63xP8 LNA series integrates active bias circuitry and a power down function, simplifying design by eliminating the need for external discrete components to perform the same functions. The series offers high-gain performance consistent across 700-2600 MHz, with the MGA-636P8 device operating from 450-1500MHz, while the MGA-637P8 and MGA-638P8 operate from 1500-2500 MHz and 2500-4000 MHz, respectively.

The series thus supports all major cellular bands for GSM, CDMA and UMTS, as well as the next-generation LTE bands. The LNAs are housed in a common footprint miniature package measuring 2.0 by 2.0 by 0.75 mm. With a shared pin-out and layout of external matching network, the LNAs provide a common PCB layout for customers when used at different frequencies, therefore simplifying design. The performance and features of the series make them ideal to be used as second or third stage LNAs for cellular BTS radio cards, TMAs, combiners, repeaters and remote or digital radio heads.

The ALM-11x36 LNA modules are equipped with a fail-safe bypass function, which is especially critical for TMA applications to enable the LNA bidirectional bypass path during the absence of DC power supply. Their superior bypass isolation eliminates the possibility of oscillation issues, and the modules also feature low bypass insertion loss and high input and output return loss.

All matching components are fully integrated within the modules and the 50 Ω RF input and output pins are already internally AC-coupled. This makes the modules easy to use, as the only external parts required are DC supply bypass capacitors.

The series delivers optimum performance across a wide range of bands, with the ALM-11036 module covering 776-870 MHz, the ALM-11136 module covering 870-915 MHz, the ALM-11236 module covering 1710-1850 MHz and the ALM-11336 module covering 1850-1980 MHz. All the modules share the same compact 7.0 by 10.0 by 1.5 mm package and pin out configuration and are thus ideal for common platform designs.

The wireless infrastructure industry must provide optimum coverage with the best signal quality in a crowded spectrum. Receiver sensitivity is the most critical requirement in a BTS receiver's design, and LNA selection greatly affects the receiver's performance. For front-end design architectures with a bypass path, low noise figure and bypass insertion loss are the key design goals. Another key design factor is linearity, which affects the receiver's ability to distinguish between wanted and spurious signals that are closely spaced. Input third-order intercept, IIP3, is used to specify linearity.

The MGA-63xP8 LNAs ship in a surface mount 8-lead QFN package, and are priced starting at $2.69 each in 10,000 piece quantities.

The ALM-11x36 LNA modules ship in a 36-lead MCOB package. The ALM-11036 modules are priced at $6.96 each in 10,000 piece quantities.

Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

RFMD InGaP HBTs target narrowband MMIC VCO market

The 14 new narrowband indium gallium phosphide VCOs cover the 7.2 - 15.1 GHz frequency range and target the growing point-to-point radio market.

RF Micro Devices, a designer and manufacturer of high-performance radio frequency components has expanded its multi-market product portfolio to include the RFVC1831 — RFVC1844 family of MMIC voltage controlled oscillators (VCOs).

The 14 new narrowband VCOs feature RFMD's InGaP HBT technology and are optimised for the point-to-point (P2P) radio market, with cellular backhaul the leading application. The VCOs are also suited for satellite communications, test & measurement, aerospace & defence, and other defence and commercial applications.

The P2P radio market is growing rapidly, as the proliferation of smartphones and the increasing demand for mobile data are forcing cellular operators to expand capacity in cellular backhaul networks. RFMD's new narrowband MMIC VCOs satisfy operators' capacity expansion requirements by delivering industry-leading phase noise performance and minimal power consumption. The VCOs also feature monolithic construction and exhibit superior performance related to temperature, shock, and vibration.

Jeff Shealy, general manager of RFMD's Defence and Power business unit, said, "RFMD's RFVC1831 through RFVC1844 MMIC VCOs complement our existing RFUV and RFRX product families of integrated up-converters and down-converters and extend our commitment to providing the industry's most comprehensive and most technically advanced product portfolio for point-to-point microwave radio applications."

The excellent phase noise performance of RFMD's RFVC1831 - RFVC1844 MMIC VCOs enables the development of next-generation high capacity radios using complex modulation schemes. The VCOs also feature a common footprint, providing radio designers extra flexibility in designing outdoor base station units covering discrete radio bands from 6GHz to 38GHz. Finally, the VCOs feature integrated dividers that can be disabled if not required in particular applications.

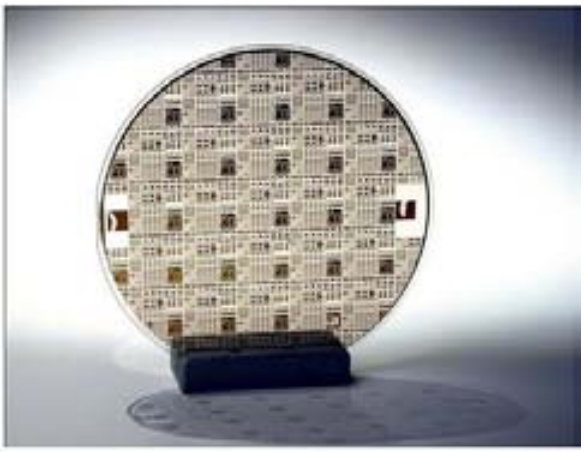
Samples and production quantities are available now through RFMD's online store at http://www.rfmd.com/products or through local RFMD sales channels. Populated evaluation boards are also available.

NXP brings GaN-on-SiC technology to the masses

NXP to offer both LDMOS and gallium nitride solutions for high-efficiency RF Power applications.

At IMS2011 this week, NXP Semiconductors is showcasing a live demo of its next-generation products based on GaN-on-SiC technology.

The GaN demo includes a 50-W wideband amplifier, the CLF1G0530-50, covering 500 to 3000 MHz; 2.1-GHz and 2.7-GHz Doherty power amplifiers for base stations; and a 100-W amplifier, the CLF1G2535-100, covering 2.5 - 3.5 GHz.



NXP has developed its high-frequency, high-power GaN process technology in collaboration with United Monolithic Semiconductors and the Fraunhofer Institute for Applied Solid State Physics. The firm is now positioned as one of the largest semiconductor company to offer both LDMOS and GaN solutions.

NXP's GaN devices are manufactured on SiC substrates for enhanced RF and thermal performance. Target end-user applications include cellular communications, wideband amplifiers, ISM, PMR, radar, avionics, RF lighting, medical, CATV and digital transmitters for cellular and broadcast.

With its high power densities, GaN has the potential to expand into applications such as high power broadcast applications, where solid-state power amplifiers (PAs) built with vacuum tubes are still the norm. While most base station PAs today are limited to specific applications, this new GaN process technology supports a roadmap towards a "universal transmitter" that can be applied in multiple systems and frequencies, simplifying transmitter production and logistics, and allowing operators to switch between frequency bands to instantly meet demands in a base station's coverage area.

"As GaN continues to gain traction, the entry of major semiconductor companies such as NXP helps to validate GaN as a 'technology of choice' for RF power semiconductors, and will help to accelerate broader adoption," said ABI Research director Lance Wilson.

"We were overwhelmed by the extraordinarily positive response to our GaN roadmap presentation at CS Europe earlier this year, from customers and

partners, as well as other semiconductor companies – in large part due to the economies of scale we're able to bring to the equation. As we release new products based on GaN, we'll also be working with our partners to build a European supply chain that optimizes costs at every step in the value chain, and continue to offer our customers choice when it comes to selecting the best alternatives – LDMOS or GaN – for high-efficiency applications," commented John Croteau, senior vice president and general manager, high performance RF, NXP Semiconductors.

Engineering samples of NXP's first GaN PAs are available immediately and are expected to be available for volume production at the end of 2011.

TriQuint introduces base station RFICs with unique integrated protections

The firm's experts will be showing new ways to lower power consumption and prevent network system ESD, RF over-drive & DC over-voltage failures at IMS 2011.

TriQuint Semiconductor, an RF solutions supplier and technology innovator, has released the first members in a new family of integrated RF products that lower power consumption while protecting mobile networks from disruption and service failures.

TriQuint's newest base transceiver station (BTS) network devices join 12 other new power and filter infrastructure solutions introduced in the first half of 2011.

"We listened to our customers in developing these products," said Vice President Brian P. Balut. "Consumer demand for smartphones and tablets means more bandwidth through the network. That leads to the requirement for greater linearity in the RF chain. At the same time, our customers want to minimise power consumption, and they want devices that withstand spikes and other stresses that may occur in the field. These two new products uniquely address all these needs."

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.*

TriQuint new base station RFICs deliver high performance that helps ensure more 'fault-free' 3G/4G network operation.

TriQuint's new base station devices, starting with the 0.25 W TQP7M9101, provides high gain and linearity with very low current consumption—just 88 mA in a typical 5 V design. The 0.5 W TQP7M9102 is also now available; it provides highly-linear performance, low current consumption and greater gain.

Setting these amplifiers apart from others now available is TriQuint's patent-pending integrated protection features that include means to guard against ESD and DC over-voltage electrical spikes.

TriQuint also integrates RF over-drive protection that reduces the chance of damage from high signal levels often seen in systems employing digital pre-distortion linearisation techniques commonly utilised to meet 3G/4G BTS system requirements.

The firm says that unlike other linear driver amplifiers available today, its TQP7M9101 module also integrates matching circuits that eliminate the need externally. These integration benefits reduce the overall BOM and provide easier-to-use solutions that are especially important when fast time-to-market is a key manufacturer strategy.

"TriQuint regularly releases new amplifier and

linear gain blocks that offer useful improvements. They appreciate that design requirements change all the time," said Alexander Kopp, RF designer, Andrew Wireless Systems / CommScope, Buchdorf, Germany. "A more linear RF signal is very important, and with very low current drain, we can reduce a system's thermal dissipation. The TriQuint team has offered us great support."

TriQuint's two new amplifiers are ideal for 3G/4G wireless infrastructure applications including base transceiver stations, repeaters, boosters, tower-mounted amplifiers (TMAs), remote radio heads, defence/aerospace and other wireless systems requiring high linearity and gain with low power consumption.

Cree ships over 10 million Watts of RF transistors and MMIC PAs

The firm has reached a milestone in shipments of its GaN-on-SiC commercial RF power transistors and high power MMIC amplifiers.

Cree, announces that, as of April 2011, the company's RF business unit has shipped commercial GaN-on-SiC RF power transistor and MMIC products with more than 10,000,000 watts of combined RF output power.

This milestone demonstrates the consistency, reliability and proven performance of Cree's GaN HEMT and GaN MMIC technology. The 10 million watt figure includes only commercial RF products and excludes an additional 1.5 million watts shipped for GaN MMIC foundry services.

Cree attained this milestone while maintaining a remarkable failure-in-time rate (FIT rate) of less than 10-per-billion device hours, which is up to 80% lower than the typical FIT rates for other RF power transistor technologies.

"We have achieved more than 1.4 billion total hours of field operation for our GaN-on-SiC devices, coupled with reliability that surpasses other high voltage silicon or GaAs technologies. This is the largest known body of fielded data accumulated by any domestic GaN supplier to date and includes not only discrete transistors but complex multi-stage GaN MMICs as well. The 10 million watt milestone is a testament to the rapid adoption of our GaN technology—not only for military applications, but for telecom base stations, wide band test equipment, civil radar and medical applications as well. If our expansion into these new market segments continues at the current rate, we have the potential to double the 10 million watt milestone by the end of calendar 2011," explained Jim Milligan, Cree, director of RF.

As one of the largest U.S. producer of GaN-on-SiC RF wafer processing technology, Cree has developed a comprehensive range of GaN HEMTs and GaN MMICs designed to enable broadband, high efficiency and reliable performance across an increasing array of RF and microwave applications.

Cree has a 25-year history of bringing creative, ground-breaking innovations to the semiconductor industry and has always been at the forefront of technology – from the earliest days of blue LEDs, to the design of the world's first SiC MOSFET and the creation of the world's first GaN-on-SiC MMIC.

Co-founder of GaAs Labs and Chairman of M/A-COM to join RFaxis Board

Respected semiconductor executive and financier John Ocampo has joined the RFaxis Board of Advisors.

RFaxis, a fabless semiconductor company focused on innovative, next-generation RF solutions for the wireless connectivity and cellular mobility markets, has announced that John Ocampo, co-founder and President of GaAs Labs LLC and Chairman of M/A-COM Technology Solutions, will join RFaxis' Board of Advisors.

"John is a well-respected semiconductor operations & technology executive and financier who brings to RFaxis a wealth of advisory experience in increasing growth trajectory, profitability and market leadership," said Mike Neshat, chairman and CEO of RFaxis. "As a private equity investor, John is very savvy with respect to business development, and he has a proven track record of success in driving

and closing major deals."

Ocampo commented, "I am very impressed with RFaxis' RF and CMOS innovations, and gratified to have the opportunity to serve on its advisory board. I look forward to helping RFaxis achieve its market and strategic objectives."

Ocampo serves as President of GaAs Labs, a semiconductor private equity fund based in California, and as Chairman of its portfolio company M/A-COM Technology Solution., a leading supplier of semiconductors, active and passive components and subassemblies for radio frequency (RF), microwave and millimetre wave applications.

Ocampo also serves on the board of directors for Ubiquiti Networks, Inc., a company that designs, manufactures and sells innovative broadband wireless solutions worldwide.

Prior to creating GaAs Labs, Ocampo co-founded Sirenza Microdevices,, a supplier of RF semiconductors and related components for the commercial communications, consumer and aerospace, defence and homeland security markets. While leading Sirenza through a successful IPO and eventual sale to RF Micro Devices he served at various times in a number of key roles, including president and CEO, CTO and chairman. Following the SMDI acquisition by RFMD, Ocampo served on the RFMD board of directors.

Prior to co-founding Sirenza, Ocampo served as general manager at Magnum Microwave, an RF component manufacturer, and as Engineering Manager at Avantek, a telecommunications engineering company later acquired by Hewlett-Packard. He holds a Bachelor of Science degree in Electrical Engineering from Santa Clara University, and currently serves on the board of trustees of Santa Clara University.

RFMD Exceeds Two Million Units of Multi-Chip Modules

RF Micro Devices, Inc., today announced that RFMD has surpassed two million units in cumulative shipments of its Multi-Chip Modules (MCMs) supporting 3G base station transceiver (BST) applications for the wireless infrastructure end market.

Bob Van Buskirk, president of RFMD's Multi-Market Products Group (MPG), said, "The shipment of over two million MCMs in such a short period of time highlights RFMD's sharp focus on product and technology leadership and the continued expansion of our product portfolio supporting the wireless infrastructure end market."

MCMs are highly integrated packages in which multiple ICs and discrete components are assembled onto one unifying substrate to form a single placement RF component. RFMD has been developing and shipping MCMs for the infrastructure industry since 2009. The Company offers a complete portfolio of MCMs to address common frequency bands, 2G/3G standards and all RF functions in the base station transceiver, including transceiver systems for new 4G LTE networks.

RFMD's MCM products reduce overall current consumption by using power down and other DC power control functions. The associated reduction in component operating temperatures improves component reliability, which is of critical importance in small remote radio heads located in difficult to access locations. The reduced current consumption also benefits manufacturers of multi-standard remote radio head platforms, allowing customers to meet new "green" wireless infrastructure network standards.

John Pelose, general manager of RFMD's Wireless Products business unit, added, "RFMD is leveraging our extensive library of single function components and industry-leading scale to deliver our customers MCM solutions promptly and efficiently. Our rapid prototyping capabilities enable our customers to improve their product cycle time and reduce time to market. Additionally, our high-volume MCM assembly and test facilities help enable advances in performance at efficient economies of scale."

Anadigics shipping volumes of multi-band PAs to Qualcomm

The new PA supports five frequency bands, enabling the multi-band Qualcomm Gobi 3000 module.

With the continued development of multi-band and multi-mode mobile devices, manufacturers are seeking new ways to help reduce board space. Anadigics says its new 5 mm x 7 mm x 1mm power amplifier (PA) offers a significant board space reduction when compared with multiple single-band 3 mm x 3 mm solutions.

Anadigics is shipping production volumes of its AWT6521 multi-mode PA for the Qualcomm Gobi 3000 module. The highly integrated AWT6521 PA supports WCDMA/ HSPA+ and CDMA/EVDO in frequency bands used by operators worldwide, providing users with more choice in carrier networks and the freedom to go without fear of losing connectivity. It also features an RF coupler and DC blocks on RF ports. With 2 shared RF inputs, 5 separate 50 Wmatched outputs, the AWT6521 also features internal voltage regulation,

The Gobi 3000 reference design is based on Qualcomm's MDM6200 and MDM6600 chipsets, both of which can provide support for HSPA+ data rates of up to 14.4 Mbps.

"The Gobi 3000 multi-mode platform provides high data rate wireless functionality to a broad spectrum of mobile devices," said Jerry Miller, vice president of business development at Anadigics. "Qualcomm's selection of our new multi-band power amplifier for the Gobi 3000 platform exemplifies the strength of our successful relationship and the performance advantages of this product. We look forward to working closely with Qualcomm to develop the next-generation mobile solutions that continue to set the standard in wireless connectivity performance."

FrequencyRange	Bands	WCDMA Efficiency
824 to 849 MHz	UMTS Bands 5 & 19	
CDMA BC 0		41% @ 28.5 dBm
880 to 915 MHz	UMTS Band 8	40% @ 28.8 dBm
1710 to 1755 MHz	UMTS Bands 3 & 4	
CDMA BC 4 & 15		41% @ 28.5 dBm
1850 to 1915 MHz	UMTS Band 2	
CDMA BC 1 & 14		40% @ 29.0 dBm
1920 to 1980 MHz	UMTS Band 1	
CDMA BC 6		39% @ 28.8 dBm

RFMD to showcase RF components At 2011 IMS

RF Micro Devices, a designer and manufacturer of high-performance RF components and semiconductor components, will showcase its broad portfolio of products and technologies for the wireless and wired broadband markets at the 2011 IEEE International Microwave Symposium (IMS).

At the symposium, RFMD will highlight its portfolio of products servicing a diverse range of end-market segments including: Broadband Transmission, Defence and Aerospace, Point-to-Point Microwave Radio, WiFi, Wireless Infrastructure, Wireless Consumer Products, WiMAX and SmartEnergy.

The RFMD products to be displayed include a variety of GaN-based products, including RFMD's high power transistors and ICs. The firm will also showcase the RFMD2080/81 IQ modulators with integrated LO oscillators, designed for Point-to-Point and other software defined radio applications. Other Point-to-Point products to be exhibited include Up/Down Converters, MMIC VCOs and other products addressing the RF and IF functions of the Point-to-Point radio transceiver.

The newly released RFSA2714 and RFSA2724

digital step attenuators and the RFSA2013 and RF2023 voltage controlled attenuators, optimised for cellular 3G/4G/LTE and WiMAX markets and RFMD's integrated multi-chip modules for wireless infrastructure applications will also be demonstrated.

Additionally, RFMD will introduce its 2011-2012 Product Selection Guide, which features specifications for over 900 products including over 90 recently released products targeting multiple end-market applications. The new 63-page guide allows customers to cross-reference and search products using end market application diagrams.

RFMD employees presenting papers, chairing sessions and hosting proceedings at the Symposium will represent the Company's Broadband Components, Defence and Power, Wireless Connectivity, Wireless Products, and Foundry Services business units.

GaAs RF device revenue to top $300 million

Strategy Analytics' latest report says that as operators deploy more base stations to handle the data increase, wireless point-to-point radios are becoming a very attractive option to backhaul the data from the edge to the core of the network.

Rapidly increasing mobile data use by consumers and businesses will fuel growth in wireless point-to-point radios.

The recently released Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) Data Model, "Wireless Point-to-Point Radio Component Demand," forecasts that wireless point-to-point radios, used to backhaul mobile data, will grow from nearly 1.4 million in 2010 to slightly more than 2 million in 2015. This growth in demand will account for $300 million of GaAs device revenue in 2015.

Strategy Analytics also forecasts that the Asia-Pacific region will account for slightly more than 50 % of wireless point-to-point radio shipments over this period. This Strategy Analytics analysis indicates strong growth for point-to-point radios above 60 GHz, but this segment will account for less than 3 % of the total radio volume. According to this Data Model, the highest volume of point-to-point radio shipments will occur in the 10-20 GHz frequency range, accounting for nearly 46 percent of shipments over the forecast period.

"The tremendous increase in mobile data consumption is rippling through many market segments," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service. "As operators deploy more base stations to handle the data increase, wireless point-to-point radios are becoming a very attractive option to backhaul the data from the edge to the core of the network."

Asif Anwar, Director in the Strategy Analytics Strategic Technologies Practice added, "Because of the frequency and performance requirements of wireless point-to-point radios, GaAs will continue to play a key role in this market segment".

The Data Model highlights dynamics in the wireless point-to-point radio market. It segments radio shipments by frequency, application and geography. The report also estimates total revenues and shipment quantity for GaAs devices.

NI to acquire RF tool designer AWR for $58 million

AWR's Microwave Office and Visual System Simulator products will strengthen NI capabilities in RF design and testing

National Instruments (NI) has signed a definitive merger agreement under which NI will acquire AWR Corporation (AWR).

AWR is a leading supplier of electronic design automation (EDA) software for designing RF and high-frequency components and systems for the semiconductor, aerospace and defence, communications and test equipment industries. Upon the closing of the transaction, AWR will continue to operate as a wholly owned NI subsidiary under the leadership of the existing management team.

The fast design cycles and increasing complexity of RF and wireless systems demand better

integration between design and test. RF system designers need to validate their simulations with actual measurements, while RF test engineers need to increase test reuse and decrease test time through more design integration. By increasing the effectiveness of the integration between AWR design tools and NI software and hardware, NI and AWR believe they can significantly improve customer productivity through increased connectivity between design, validation and production test functions.

"AWR has an exceptional team with strong RF talent and technologies that expand the NI platform into RF design, which is complementary to our capability to make measurements across the RF design flow," said James Truchard, president, CEO and cofounder of National Instruments. "We believe this combination will accelerate the deployment of RF and wireless technologies and offers a significant benefit to the customers of both companies."

Both NI and AWR deliver unique strengths that together will enable customers to more productively design and test their RF systems. The acquisition will strengthen both companies' core software brands, NI LabVIEW, AWR Microwave Office and Visual System Simulator, as well as the NI RF testing hardware platform.

The full suite of AWR design tools in combination with a complete RF testing platform from NI will give customers a platform to decrease the time to market of their RF designs. NI will also augment its current academic and university RF and communications initiatives to include AWR software tools, so educators and students can benefit from the improved teaching and learning experience for the rapid design and prototyping of RF systems.

"There is clear synergy between the customers and product offerings of both companies," said Dane Collins, CEO of AWR. "NI has a leading platform in prototyping and testing of RF systems which is complementary to AWR's RF circuit and system software design tools to the benefit of mutual customers. Together, we are better able to support and service our growing global installed base."

The aggregate purchase price to be paid at closing is approximately $58 million, which includes $7 million in cash on the AWR balance sheet. In addition, the merger agreement contains an earn-out provision, which is payable over three years. The transaction is expected to close within 30-45 days and is subject to customary closing conditions including Hart-Scott-Rodino regulatory clearance.

In this transaction, ThinkEquity LLC - A Panmure Gordon Company, acted as exclusive financial advisor to NI, and Needham and Company LLC acted as an exclusive financial advisor to AWR.

A conference call discussing the acquisition has taken place and may be replayed by calling (888) 203-1112, using confirmation code #1927872.

M/A-COM Tech restructuring continues with promotion of Jack Kennedy

Now Vice President of Sales, Kennedy's successful track record strengthens the company's ability to meet needs of a worldwide customer base.

M/A-COM Technology Solutions (M/A-COM Tech), a supplier of semiconductors, active and passive components and subassemblies for RF, microwave and millimetre wave applications, has promoted Jack Kennedy to its new Vice President of Sales.

Jack Kennedy, VP of Sales, M/A-COM Technology

Reporting to Robert Donahue, Chief Operating

Officer, in his new role, Kennedy will have responsibility for leading M/A-COM Tech's global sales organisation.

A seasoned sales and marketing leader, Kennedy was promoted from within M/A-COM Tech, where he most recently served as its Director of Global Distribution since November of 2010, and delivered significant enhancements to the efficiency and performance of this important sales channel. His previous positions at M/A-COM Tech include Strategic Account Lead, Global Account Director, Sales Manager, and Field Sales Engineer.

Jack Kennedy received his B.S. from Boston University and is currently pursuing an M.S. Degree at Northeastern University.

"I am extremely pleased to have Jack championing the sales initiatives for our company," said Bob Donahue. "Jack's understanding of our business, our products, the industry, and our customer base is comprehensive. That, combined with his inherent leadership skills and successful track record will greatly benefit M/A-COM Tech and its ability to meet the needs of its customers."

Jack Kennedy, upon accepting the position, said, "I have always felt very privileged to be part of the M/A-COM Tech team. This newest role is by far the most exciting and challenging opportunity I've had at M/A-COM Tech, and I look forward to leading our sales team to continued success and achievement."

Michael Dys joins M/A-COM Tech as Corporate Controller

The former Skyworks and Aeroflex/Micro-Metrics executive is enhancing M/A-COM Tech's finance and accounting team.

M/A-COM Technology Solutions (M/A-COM Tech), a leading supplier of high performance semiconductors and components for use in RF, microwave, and millimetre wave applications, has appointed Michael Dys as Corporate Controller.

He will report to Conrad Gagnon, Chief Financial Officer and will be responsible for all global accounting functions, budgeting and forecasting, as well as financial planning and analysis. He will also provide financial perspective to other business leaders toward optimising M/A-COM Tech's operational efficiency.

"Michael's extensive experience with substantial global players in our market space, his diverse business background, and his hands-on approach make him the ideal professional for this role," said the CFO. "His successful career to date in the microwave industry has demonstrated hands-on leadership, effective financial control and attention to the bottom line."

Dys most recently served as Controller at Aeroflex/ Micro-Metrics. He previously served as Vice President and Corporate Controller at Skyworks Solutions. He holds a Bachelor of Science Degree in Accounting and a Master's Degree in Business Administration, both from the University of Massachusetts at Lowell. He is a Certified Public Accountant in Massachusetts. In speaking about this next phase of his career, Dys commented, "I am looking forward to rolling up my sleeves to continuously improve the company's accounting processes and to implement cost-effective business solutions."

Nitronex ships 500,000th GaN RF device

The company says that expanding markets and customers, alongside an already robust U.S.-based supply chain, sets the stage for continued rapid growth.

Nitronex, a designer and manufacturer of GaN based RF solutions for high performance applications in the defence, communications, cable TV, and industrial & scientific markets, has shipped more than 500,000 production devices since introducing its first production-qualified products in 2006.

Volume production began in 2009, and shipments predominantly consisted of 10 different products to five customers with a roughly even split between domestic and international sales.

"Shipping more than 500,000 devices is a testament to the early successes we've had in military communications, jammers, and cable TV

infrastructure. We provide our customers with complete RF solutions including final, driver, and pre-driver discrete and MMIC amplifiers, product models, reliability data, and applications support," commented Charlie Shalvoy, President and CEO of Nitronex.

"We have also established a robust supply chain with U.S. manufacturing partners based on our proprietary GaN-on-Silicon technology. We believe this is more scalable than competing technologies that are based on exotic substrates. We look forward to continued growth by expanding into emerging GaN markets such as RADAR, and eventually commercial wireless infrastructure," he concluded.

Nitronex says its patented SIGANTIC GaN-on-Si process is the only production-qualified GaN process using an industry standard silicon substrate. This ensures a robust supply chain, which, combined with innovative new products, has positioned the company well for the significant growth expected in GaN markets in upcoming years.

Berlin to host compound semiconductor conference

Organised by the Fraunhofer Institute and the VDE Association for Electrical Technologies, Electronic & Information Technologies, the conference will address the future of compound semiconductors in micro electronics and optoelectronics.

On May 23, 2011, Andre Geim, the 2010 winner of the Nobel Prize in Physics, opened the 2011 Compound Semiconductor Week with a plenary lecture on graphene.

Here, some 450 scientists and industry representatives will discuss current research findings in the field of compound semiconductors. An example of one of the key topics of the event is how to improve energy efficiency while increasing data rates in communications systems – often referred to as "Green IT".

The conference took place in Berlin from May 22 to 26. The conference is organised by the Fraunhofer Heinrich Hertz Institute HHI, the Fraunhofer Institute for Applied Solid State Physics IAF, and the VDE Association for Electrical Technologies, Electronic & Information Technologies.

"CSW is the most important international conference for the entire spectrum of compound semiconductors. Here, participants will get an overview of what will become possible in micro electronics and optoelectronics," Oliver Ambacher, ISCS 2011 Conference Chair and head of the Fraunhofer IAF, said.

While silicon is still the most important semiconductor material, today no mobile phone, PC or car would work without additional components used in compound semiconductor technology. Compound semiconductor, in contrast to the elemental semiconductor – like silicon -, consists of at least two different types of atoms.

Compound semiconductors are used for light generation with LEDs, photonics and communications engineering, as well as for maximum frequency electronics and power electronics. Since 2010, the CSW has combined the two most important conferences on compound semiconductors – the "International Symposium on Compound Semiconductors (ISCS)" and the "International Conference on Indium Phosphide and Related Materials (IPRM)".

"Berlin is the ideal location for hosting the CSW thanks to its broad-based research activities in this field," said Norbert Grote, Chairman of this year's IPRM and head of department at the Fraunhofer HHI. "Some 450 scientists from all over the world will come to Berlin to exchange their knowledge. This gives us the opportunity to further strengthen the location and to promote these issues."

Fraunhofer HHI and Fraunhofer IAF are both leading research institutes in the field of compound semiconductors. In Berlin, it is not only institutes and universities such as the Fraunhofer HHI, the Ferdinand Braun Institute, the Paul Drude Institut für Festkörperelektronik, the Institut für Kristallzüchtung, Humboldt- und Technische Universität, as well as the Helmholtz Zentrum, which are active in this field, but also companies like the u2t Photonics AG, a spin-off from Fraunhofer HHI. "When making a phone-call in the US, your chances of the optical components involved having been made in Berlin are pretty

good," said Norbert Grote.

Mesuro again demonstrates first pass design success

Mesuro has shown how active harmonic load-pull and waveform engineering can produce a multi-harmonically matched MMIC PA and provide MMIC device data in one step.

Mesuro has again proved how its waveform engineering approach to power amplifier (PA) design yields major reductions in design costs and improves product time to market, through 'right-first-time' design.

Using a commercially available GaAs pHEMT, TQPED, a 0.5mm commercial foundry process from TriQuint Semiconductor, with data from characterisation performed on Mesuro's active harmonic load pull solution, the completed design produced a first pass MMIC PA with an efficiency performance of >80%.

The use of the original device measurement data meant that the designer was able to produce the design without the need for a non-linear I-Q device model. For this reason it is often necessary for the designer to rely on experimental investigations. This build and test approach is often frustrating since it can be very time consuming and does not usually allow the flexibility or the quantity of investigations to be undertaken.

The design process allowed the designer to understand accurately how component sensitivities would affect the proposed performance of the amplifier at the investigation phase prior to any expensive fabrication being undertaken. This meant that the designer could better understand the trade-offs that could be made in the impedance matches to increase the probability of a first time success after fabrication.

The ability to get close to the optimum performance first time provides designers the opportunity to hugely reduce design costs, by reducing the number of design iterations required and allows them to get a product to market quicker.

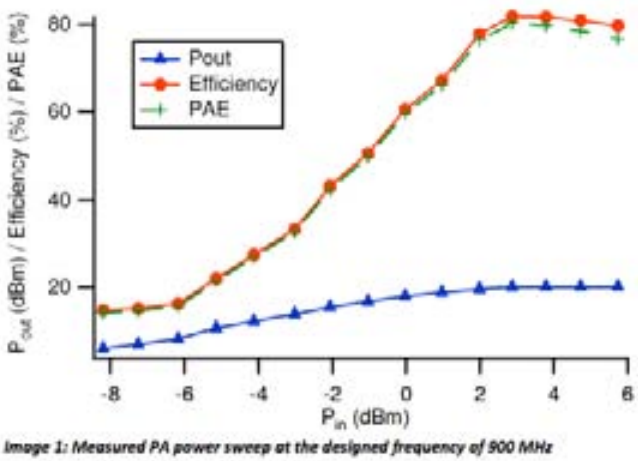


Image 1: Measured PA power sweep at the designed frequency of 900 MHz

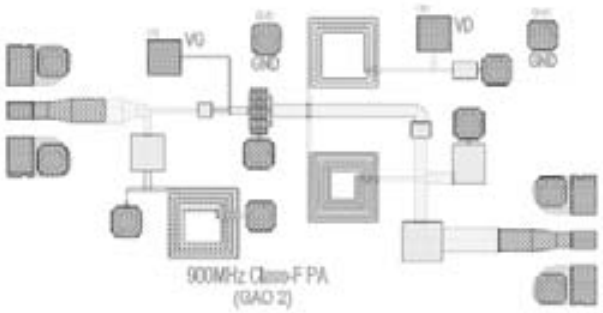


Image 2 : Layout of the 900 MHz, class-F, MMIC power amplifier

TriQuint and Agilent unite to advance wireless design flow

The firms intend to enhance PDKs, by providing a fully integrated front-to-back product design flow with customised DRC and LVS solutions.

TriQuint Semiconductor and Agilent Technologies have announced results for building next-generation RF solutions.

This includes enhanced TriQuint process design kits with support for Agilent's Advanced Design System 2011 EDA software and the development of an ADS RF Module PDK for TriQuint's RFIC/MMIC and RF Module integrated design flow.

The upgraded ADS Foundry PDKs enable both TriQuint's foundry customers and in-house design engineers to take advantage of new capabilities in ADS 2011. Specifically, the PDKs provide a fully

integrated front-to-back product design flow with customised DRC and LVS solutions. This offers the design engineer a unified suite of EDA software for schematic capture, simulation, layout, and layout verification.

"We have upgraded our PDKs utilising the new ADS 2011 capabilities in order to provide continued superior design support for our mutual customers and to our in-house product designers," said Glen Riley, vice president of TriQuint's Commercial Foundry Business Unit.

TriQuint has also expanded ADS deployment for an integrated RF Module design flow. Further collaboration between the companies led to the validation and deployment of an ADS RF Module PDK within TriQuint that integrates multi-technology IC and RF Module layout features, providing a complete electrical and physical RF Module design flow.

The integrated module design flow removes design translation errors, shortens product development cycle times and enables design optimisation for module product manufacturing yield, thus reducing overall engineering and development expenses.

"We are very pleased to announce these new developments in our collaboration with TriQuint," said Mark Pierpoint, vice president of Agilent EEsof EDA. "Our best engineers have been working together, and the improved productivity and ability to optimise today's complex MMIC/RFIC module design flow is exactly what we had hoped to achieve when we started the development of ADS 2011. It is great to see both TriQuint and their customers benefit from our joint engineering investments."

The leading electronic design automation software for RF, microwave and signal integrity applications, ADS pioneers the most innovative and commercially successful technologies, such as X-parameters and 3-D electromagnetic simulators.

ADS 2011 addresses the most challenging design complexity and integration needs of leading-edge commercial wireless and aerospace/defence companies, by enabling them to design multi-technology RF system-in-package modules and perform complex electromagnetic simulations -all with greater ease and speed.

Agilent EEsof EDA is the leading supplier of electronic design automation software for microwave, RF, high-frequency, high-speed digital, RF system, electronic system level, circuit, 3-D electromagnetic, physical design and device-modelling applications.

Wafer Bonding Report

Yole Développement announces the publication of its technology study and market research report, Permanent wafer bonding report

Historically developed for MEMS & SOI substrates, the wafer bonding technology is today becoming a key processing technology for a wide range of applications including LEDs, Power Devices, RF and Advanced Packaging.

The wafer bonding market is a very complex one crossing different wafer sizes (from 2'' to 12''), different applications (Advanced Substrates such as SOI, MEMS, LEDs, CMOS Image Sensors, Power Devices, RF Devices & Advanced Packaging) and different bonding technologies (Adhesive, Anodic, Fusion, Direct Oxide, Eutectic, Glass Frit, Metal Diffusion).

Yole Développement's report aims at giving a vision, crossing what the wafer bonding technologies will be over the 2010-2016 time line.

Market Trends

Wafer bonding is usually defined as a process that temporarily or permanently joins two wafers or substrates using a suitable process. Historically developed for MEMS and then SOI wafers, wafer bonding technology has shifted to non-mainstream IC applications over the last years. Our report aims at analyzing the market perspectives and technical trends for permanent bonding.

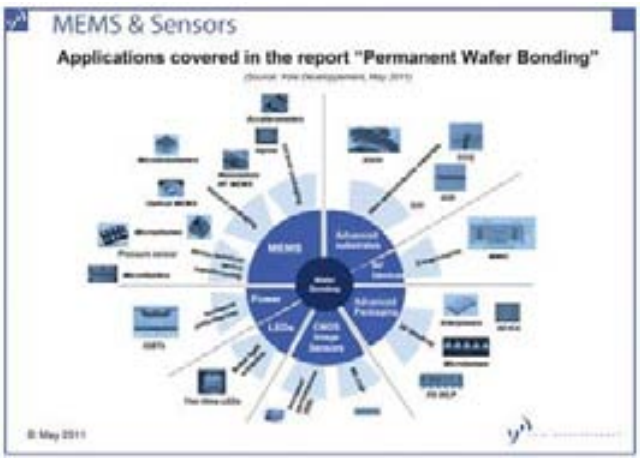
Wafer bonder can be also used for LEDs or Power Devices. Indeed, in a typical LED active region, spontaneous emission scatters photons in all directions. If the substrate material has a smaller band gap than the active region, approximately half of the light is absorbed in the substrate; significantly reducing device performance. So, one of the manufacturing solutions for photon loss involves

bonding a wafer containing an array of devices to another wafer that provides both a reflective surface for maximum light extraction and a heat sink for thermal management. And of course, over the 5 past years, much attention has been given to this technology for 3D integration of memories for example.

Technology Trends

Yole Développement has estimated the wafer bonder to have big market growth for the next year. The growth will be driven small size wafer for LEDs and 12" wafer for 3D stacking and CIS.

Although EV Group is market leader in permanent bonding, the growth of the bonding equipment market is attracting challengers.



Yole Développement's report analyzes in details the technical & economical evolution of the permanent wafer bonding process. It gives, for example, 2010-2016 market forecasts for permanent bonding, number of equipment, an overview of the different bonding approaches and equipment players market shares and competitive information

This market & technology report also presents the trends for permanent bonding, W2W vs. C2W analysis for 3D integration. It describes the applications for wafer bonding with main characteristics, challenges

About Permanent Wafer Bonding Report:

- Authors

Dr. Eric Mounier has a PhD in microelectronics from the INPG in Grenoble. Since 1998 he is a co-founder of Yole Développement, a market research company based in France. At Yole Développement, Dr. Eric Mounier is in charge of market analysis for MEMS, equipment & material.

- Catalogue price: Euros 3,990.00 (single user license) - Publication date: May 2011

For special offers and the price in dollars, please contact David Jourdan (jourdan@yole.fr or +33 472 83 01 90)

- Companies cited in the report

Acreo, AML, APM/UMC, Avago, Ayumi, Bosch, Colibrys, Dalsa, Discera, EVGroup, FhG IMS, FLIR, IBM, Icemos, IMEC, IMT, Infineon, Infineon, Invensense, KTH, Leti, Lumileds, MEMStech, Micralyne, Mitsubishi Heavy Industries, Okmetic, Omron, Osram, Qualcomm, Raytheon, RPI, Sand9, Semefab, Sensonor, Silex, SOITEC, STM, SUSS MicroTEC, Tezzaron, TI, tMt, Tohoku University, TowerJazz, Tracit, Triquint, Tronic's, TSMC, VTI, Xcom, Ziptronix

Skyworks spreads its wings with acquisition of SiGe Semiconductor

With this move Skyworks immediately expands its market which will now broaden opportunities in the smart phones, tablets, gaming consoles, notebook PCs and home automation systems markets.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, has signed a definitive agreement to purchase SiGe Semiconductor.

SiGe Semiconductor is a global supplier of RF front-end solutions that are facilitating wireless multimedia across a wide range of applications.

The acquisition of SiGe, a fabless semiconductor provider, complements Skyworks' leadership in wide area front-end solutions by adding SiGe's innovative short range, silicon-based products. As a result, Skyworks will be able to offer customers a comprehensive wireless networking product

portfolio, supporting all key operating frequencies with architectural flexibility to address a variety of high growth applications. Specifically, via this transaction, Skyworks immediately expands its addressable content opportunity within several strategic product areas including smart phones, tablets, gaming consoles, notebook PCs and home automation systems.

"Skyworks' acquisition of SiGe Semiconductor underscores our commitment to capitalize on ubiquitous wireless connectivity," said David J. Aldrich, president and chief executive officer of Skyworks. "To that end, this acquisition is highly complementary in terms of our addressed markets, sales channels, process technologies, design methodologies and baseband partnerships. At the same time, the SiGe business presents significant operational and cost synergies yielding immediate earnings accretion and long-term shareholder value creation."

"Skyworks clearly represents the best strategic and cultural fit for SiGe Semiconductor," said Sohail Khan, president and chief executive officer of SiGe Semiconductor. "Both companies have a long history of front-end innovation and a shared vision of the future of band-intensive wireless networking. Together, we can develop and deliver products of unprecedented integration and improve our customers' performance in the increasingly connected wireless world."

Skyworks will pay $210 million in cash, plus an additional $65 million if certain performance targets are met over the next 12 months. The transaction has been approved by Skyworks' and SiGe's boards of directors and is anticipated to close in June, subject to customary closing conditions, including the receipt of domestic and foreign regulatory approvals. Excluding any non-recurring acquisition related charges and amortization of acquired intangibles, Skyworks expects the acquisition to be immediately accretive to non-GAAP earnings and will finalise estimates of the transaction's financial impact, as well as the accounting for the transaction, upon deal close.

SiGe Semiconductor's diverse and comprehensive product portfolio provides the performance, range and reliability required by 802.11b/g/a/n, Bluetooth, WiMAX, GPS and ZigBee Systems. The company's innovative use of silicon-based semiconductor technologies simplifies the integration of RF signal processing for many of today's leading consumer, commercial and industrial electronics companies. Key SiGe customers include Cisco, Dell, Huawei, Hewlett-Packard, NetGear, Itron, Microsoft, Nintendo, Samsung and Sony.

M/A-COM to vigorously defend GigOptix lawsuit

The lawsuit alleges breach of contract and trade secret misappropriation allegations against M/A-COM Tech, its subsidiary Optomai, and five Optomai employees who previously worked at GigOptix.

M/A-COM Technology Solutions (M/A-COM Tech), a supplier of semiconductor solutions for RF, microwave, and millimetre wave applications, will vigorously defend a lawsuit filed by GigOptix.

The lawsuit, filed on April 26 in Santa Clara County Superior Court, requests unspecified damages and injunctive relief based on as-yet unsubstantiated breach of contract and trade secret misappropriation allegations against M/A-COM Tech, its recently-acquired subsidiary Optomai, and five Optomai employees who previously worked at GigOptix.

M/A-COM Tech is still reviewing the GigOptix complaint, but is aware of no wrongdoing on the part of M/A-COM Tech, Optomai or any of their employees in this regard, and accordingly believes that the GigOptix allegations are without merit.

"M/A-COM Tech has been pleased at the positive reaction optical networking customers have had to the Optomai acquisition, and remains committed to delivering M/A-COM Tech's full portfolio of 40/100G modulator drivers and transimpedance amplifiers to its customers," said Jihye Whang, Director of Strategic Marketing. "We anticipate a just resolution of this matter through the legal process."

No injunction has been issued by the court hearing the case to date, nor is one expected to be issued. The Optomai product line remains available for sampling and production.

Endwave revenues tumble by 74%

The firm has again reported income and operating losses which have tripled over the same quarter last year. It says the fall-off in legacy module product sales that began in 2010 continues to hamper its results.

Endwave Corporation, a provider of high-frequency RF solutions and semiconductor products for the telecommunications, satellite communications, electronic instruments and defence and security markets, has reported financial results for its first quarter, ended on March 31, 2011.

Revenues for the first quarter of 2011 were $1.2 million. This compares with revenues of $4.1 million in the prior quarter and $4.8 million in the first quarter of fiscal 2010.

GAAP net loss for Q1 2011 was $3.9 million, or $0.39 per share. This compares with a net loss of $2.0 million, or $0.20 per share, in the prior quarter, and a net loss of $1.3 million, or $0.13 per share, in the first quarter of fiscal 2010.

Cash, cash equivalents and investments as of March 31, 2011 were $21.2 million, compared with $23.5 million as of December 31, 2010.

“As anticipated, 2011 began as a challenging year for the company,” said John Mikulsky, Endwave’s President and Chief Executive Officer. “The fall-off in legacy module product sales that began in 2010 continues to hamper our results.”

“We believe, however, that 2011 will be a seminal year for our stockholders as a result of the pending merger transaction with GigOptix,” continued Mikulsky. “The transaction remains on schedule to close in the second quarter of 2011. Upon the close and in the years ahead, we look forward to working with the combined company as it pursues a leadership position as a high-speed, high-frequency supplier for optical and wireless communications.”

On February 7, 2011, GigOptix, announced that it signed a definitive merger agreement to acquire Endwave. The SEC has now declared effective the S-4 registration statement relating to the proposed merger transaction. Endwave stockholders must now approve the transaction in a special shareholder meeting that is scheduled for June 17. Details will be sent to those stockholders eligible to vote as of the May 12 record date.

Avago expands series of world’s smallest RF amplifiers

The new positive gain slope LNA, wideband LNA, VGA and four directional detectors add to functionality of miniature chip scale package amplifiers

Avago Technologies, a supplier of analogue interface components for communications, industrial and consumer applications, has announced additions to one of the market’s smallest series of RF amplifiers.

The new VMMK-3xxx amplifiers leverage Avago WaferCap chip scale packaging technology to offer an ultra-small footprint of 1.0 by 0.5 by 0.25 mm. The amplifiers bring a host of new functionality to the existing Avago VMMK-1xxx and VMMK-2xxx families, including a positive gain slope low-noise amplifier (LNA), a wideband LNA, a variable gain amplifier (VGA), and four directional detectors.

With miniature 0402 package dimensions and no wirebonds, the VMMK-3xxx amplifiers experience almost no signal loss and minimal parasitics. The devices take up 5 % of the volume and use only 10 % of the board area of solutions using a standard SOT-343 package. In some cases, the miniature amplifiers can effectively reduce PCB area by more than 50 %.

The compact size and fully-matched surface mount design are optimised for 500 MHz to 12 GHz frequencies, making the devices ideal for a variety of radio architectures and space-constrained applications. Requiring no special tooling for assembly, the LNAs have all I/Os routed to the backside of the device wafer through via-holes, resulting in RF transitions suffering almost no signal loss and minimal parasitics.

The VMMK-3xxx LNAs and VGA can be used in UWB, WLAN, WiMAX, generic IF amp and gain block applications, while the new detectors can be used in base stations, point-to-point radios and generic power control loop detectors, as well as for monitoring power amplifier output.

Avago says this is a significant improvement over conventional plastic packages where bond-wires exhibit substantial parasitics that limit the operating frequency. The miniature amplifier family provides high gain, a high third-order intercept point (IP3) for good linearity, low noise figure (NF) and integrated 50-ohm input and output matching networks to simplify system design.

The VMMK-3xxx family includes:

* VMMK-3503: 0.5-18 GHz VGA – This broadband, wide-dynamic-range VGA features 12 dB maximum gain, 1.5 dB NF, 8 dBm IIP3 and 23 dB gain control range, and it consumes 300 mW.

* VMMK-3603: 1-6 GHz Positive Gain Slope LNA – This high-gain, self-biasing LNA features 17 dB gain, 1.5 dB NF and good linearity of 25 dBm OIP3, and it consumes 180 mW. With its positive gain slope, the LNA enables flat overall system gain.

* VMMK-3803: 3-11 GHz LNA – This high-gain, self-biasing LNA features 20 dB flat gain, 1.5 dB NF and good linearity of 0.5 dBm IIP3, and it consumes 60 mW.

* VMMK-3113: 2-6 GHz Directional Detector – This detector features 0.25 dB insertion, greater than 45 dB dynamic range, low input and output return losses (< 20 dB) and 10 dB directivity. This detector requires 1.5V with 0.18 mA for DC biasing.

* VMMK-3213: 6-18 GHz Directional Detector – This detector features 0.4 dB insertion, greater than 40 dB dynamic range, low input and output return losses (< 20 dB) and 15 dB directivity. This detector requires 1.5V with 0.18 mA for DC biasing.

* VMMK-3313: 15-33 GHz Directional Detector – This detector features 0.5 dB insertion, greater than 37 dB dynamic range, low input and output return losses (< 20 dB) and 12 dB directivity. This detector requires 1.5 V with 0.18 mA for DC biasing.

* VMMK-3413: 25-45 GHz Directional Detector – This detector features 0.8 dB insertion, greater than 35 dB dynamic range, low input and output return losses (< 20 dB) and 10 dB directivity. This detector requires 1.5 V with 0.18 mA for DC biasing.

U.S. Pricing and Availability

The VMMK-3xxx amplifiers are priced starting at $2.00 each in 1,000 piece quantities. Samples and production quantities are available now through the Avago direct sales channel and via worldwide distribution partners.

Skyworks soaring with 37 % revenue increase

Revenue in the seasonally low March quarter was $325.4 million, above the Company's guidance range of $310 to $320 million, and up 37 % when compared to $238.1 million in the second fiscal quarter of 2010.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, has reported second fiscal quarter 2011 results.

Revenue in the seasonally low March quarter was $325.4 million, above the Company's guidance range of $310 to $320 million, and up 37 % when compared to $238.1 million in the second fiscal quarter of 2010.

On a GAAP basis, operating income for the second fiscal quarter of 2011 was $68.1 million and diluted earnings per share was $0.26.

"Skyworks is capitalising on consumers' skyrocketing demand to be connected anytime and anywhere via smart phones, tablets and home automation systems in addition to energy management solutions and supporting network infrastructure," said David J. Aldrich, president and chief executive officer of Skyworks.

"The growth in analogue semiconductor content associated with this increasing demand plays directly to Skyworks' technology leadership and scale. Given our momentum across these mobile connectivity applications, our diverse customer partnerships and traction in new markets, we are well positioned to demonstrably outpace industry growth during the remainder of this fiscal year, through fiscal 2012 and beyond."

Over the last quarter, the company expanded its year-over-year gross margin by 160 basis points to 43.3 % on a GAAP basis. Skyworks also secured analogue design wins with STMicroelectronics for their next generation IP television chip set and supported general dynamics with high power switching solutions for military land mobile radios.

The firm ramped production of precision analogue ICs supporting enterprise access points, cable set-top boxes and wireless video systems and captured multiple infrastructure sockets with Ericsson, Huawei and ZTE for WCDMA base station transceivers.

Skyworks also introduced a family of antenna switch modules for smart phones, tablets and datacards supporting 3G handsets and HSPA+/ LTE-enabled devices. It also announced that its modules power HTC's next generation Android-based smart phones and newest tablet offering with front-end solutions.

The company also received a Best Quality award from Samsung for excellence in overall product quality and supply-chain efficiency.

With respect to the next quarter, Donald W. Palette, vice president and chief financial officer of Skyworks said, "Based on our broad customer base, diversification into new markets and increasing share gains, we are again planning to grow faster than our addressable market in the third fiscal quarter of 2011. Specifically, we expect revenue of approximately $345 million with non-GAAP diluted earnings per share of $0.46."

Skyworks hosted a conference call with analysts to discuss its second fiscal quarter 2011 results and business outlook. A replay of the conference call will be available on Skyworks' Web site or by calling 888-203-1112 (from USA) or 719-457-0820 (from outside USA), using pass code: 1159221

Alcatel-Lucent and Powerwave benefit from smartphone revolution

Although Alcatel-Lucent is still posting net losses, it has attributed improved results to a 40 % jump in North American Sales. Powerwaves' total Americas revenue was $54.3 million or approximately 40 % of revenue.

The communications equipment industry has shown significant growth this year. As corporations become more mobile, connection solutions allowing employees to connect directly with the corporate server are growing in appeal.

Businesses are looking for faster options and equipment makers that offer these options have the opportunity to bolster their top lines. With such growth potential throughout the industry, companies are fighting harder than ever to secure their respective niches. The Bedford Report examines investing opportunities in the Communications Equipment Industry and provides research reports on Alcatel-Lucent and Powerwave Technologies.

Despite high unemployment and mediocre consumer confidence, North American smartphone and tablet sales continue to skyrocket. At the moment there is massive demand for mobile internet and telecom customers are typically looking for smooth transitions to 3G or 4G networks.

When telecom equipment-maker Alcatel-Lucent reported first quarter operating results, Chief Executive Ben Verwaaye said he is "optimistic that 3G and 4G will be a driving force for a long time to come." In the most recent quarter, Alcatel posted a net loss of €10 million ($14.6 million) compared to a loss of €515 million recorded in the year-earlier quarter. The company attributed the improved results to a 40 % jump in **North American Sales.**

In the first quarter of 2011, Powerwaves' total Americas revenue was $54.3 million or approximately 40 % of revenue, compared with $34.2 million, or approximately 30 % of revenue in the first quarter of 2010. Powerwave, a global supplier of end-to-end solutions for wireless communications networks, said last week that 3G standards accounted for approximately 36 % of total revenue and 4G standards accounted for approximately 24 % of total revenue during the first quarter of 2011.

Steve Buhaly honoured as "CFO of the Year"

Buhaly has been recognised for his leadership during TriQuint's meteoric growth during 2010.

TriQuint Semiconductor, a leading RF solutions supplier and technology innovator, announces its chief financial officer, Steve Buhaly, was named 'CFO of the Year' at The Portland Business Journal's annual awards program. Buhaly received the honour in the public company category.

"Steve Buhaly is a terrific role model for our entire organisation. In addition to ensuring high integrity and transparency in TriQuint's public reporting, Steve is a trusted business partner and a valuable voice in strategic planning. He brings common sense and a quick wit to our team," said Ralph Quinsey, President and CEO of TriQuint.

CFO of TriQuint, Steve Buhaly

Buhaly is a valuable consultant to TriQuint's business units and functional departments. His responsibilities include everything from Investor Relations, Corporate Accounting and Legal, to Information Technology, Tax and Treasury Services. Since joining the company in September 2007, he has inspired operational improvements and empowered his senior managers with skill and thoughtfulness.

TriQuint turned in record 2010 financial results, growing revenue 34% to $878.7 Million. GAAP net income for the year grew almost 12 fold. Driving improved profitability and leveraging the Company's growth is of considerable value to shareholders, and has resulted in a significantly improved stock price during Buhaly's time with the company. In its February 9th earnings release, the company guided that 2011 revenue should surpass $1 billion. TriQuint summarised its corporate goals in the recently filed Annual Report: 20% annual growth rate, 20% operating margin, 20% market share.

With no debt and $198.8 million in cash, TriQuint is poised to continue profitable growth as a leading RF provider to markets including fast growing mobile devices, networks, defence and aerospace.

CS product development reflects market diversification

Strategy Analytics says some companies such as RFMD, Skyworks, Anadigics, Hittite, Analog Devices, Panasonic and NXP are expanding their product lines into defence and broadband.

Even while the handset portion of the compound semiconductor market remains the largest revenue producer, Strategy Analytics sees that leading device suppliers are diversifying their portfolios by developing additional products for infrastructure, broadband and military applications.

The recently published Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) viewpoint, "Compound Semiconductor Industry Review March 2011: Microelectronics," captures March 2011 product, financial, contract and technology announcements for microelectronic companies such as RFMD, Skyworks Solutions, Hittite Microwave, Anadigics, TriQuint Semiconductor Analogue Devices and NXP.

"The handset market continues to drive compound semiconductor volume, but rapid price erosion poses a challenge for suppliers," noted Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor Technologies Service.

"The March product announcements show activity aimed at CATV, fibre, military and test and measurement markets, as companies try to capture higher margin opportunities."

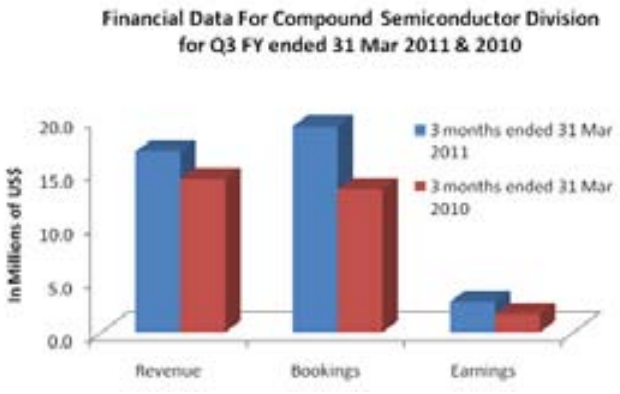
Asif Anwar, Director, Strategy Analytics Strategic Technologies Practice added, "Some companies are expanding product lines into defence and broadband, which uses new processes to diversify market penetration."

This viewpoint summarises March 2011 financial, product, contract and employment developments from major GaAs and silicon suppliers, which addresses a variety of commercial and military applications that use GaAs, GaN, Silicon SiC, and complementary metal-oxide-semiconductor (CMOS) technologies.

II-VI Compound Semi segment earnings escalate by 75%

Revenues for the quarter in the CS division increased 17.8% to $16.9 million from $14.4 million in the third quarter of the last fiscal year.

II-VI Incorporated has reported results for its third fiscal quarter ended March 31, 2011.



Bookings in the Compound Semiconductor Group for the quarter increased 41% to $19.3 million compared to $13.4 million in the third quarter of the last fiscal year.

Revenues for the quarter in the division increased 17.8% to $16.9 million from $14.4 million in the third quarter of the last fiscal year.

Earnings in the CS division increased by a whopping 74.9% over the same quarter last year, from $1.6 million to $2.9 million.

On January 4, 2010, the Company completed its acquisition of Photop Technologies (Photop). Company results include Photop's results for the three and nine months ended March 31, 2011. On December 6, 2010, the Company completed its acquisition of Max Levy Autograph (MLA). Results for the quarter ended March 31, 2011 include the operating results of MLA since the acquisition date.

Bookings for the quarter increased 30% to a record $142.9 million compared to $110 million in the third quarter of last fiscal year. Included in bookings for the three months ended March 31, 2011 were approximately $36.8 million of bookings attributable to Photop. Bookings are defined as customer orders

received that are expected to be converted into revenues during the next 12 months.

Revenues for the quarter increased 33% to a record $130 million from $97.5 million in the third quarter of last fiscal year. Included in revenues for the three months ended March 31, 2011 were approximately $32.4 million of revenues attributable to Photop.

Net earnings attributed to II-VI Incorporated for the quarter were $23.1 million or $0.72 per share-diluted, compared with net earnings of $10.3 million or $0.33 per share-diluted, in the third quarter of last fiscal year.

Francis J. Kramer, president and chief executive officer said, "We achieved record bookings and revenues in the third fiscal quarter as strong positive momentum continued across almost all markets. Bookings increased 30%, revenues were up 33% and earnings more than doubled from the year-ago quarter. Orders in the Infrared Optics segment and at Photop were particularly strong - up 38% and 39%, respectively, from the year-ago quarter and 12% and 24%, respectively, from the quarter ended December 31, 2010. Our backlog stands at $176.5 million, an increase of 23% from March 31, 2010 and 9% from December 31, 2010. Earnings of $0.72 per share-diluted primarily resulted from increases in sales volume and operating efficiencies. The effective tax rate for the quarter was lower to reflect the increased profit contribution from our foreign operations; revenues outside of the U.S. accounted for over 60% of our total revenues for the quarter."

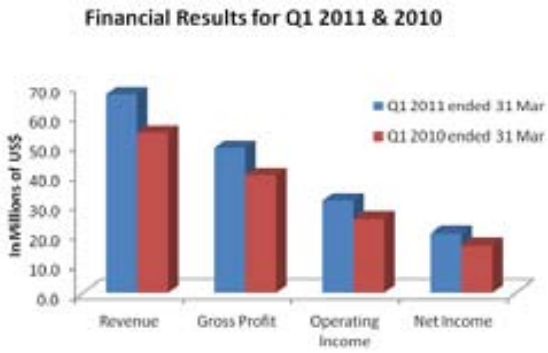
Kramer continued, "Quarterly EBITDA performance and cash flow generation continue to strengthen. EBITDA for the quarter increased 63% from the same period last fiscal year and 9% from the December 31, 2010 period. During the quarter, we made strategic capital investments of $14 million, after which our cash balance still increased $9 million. Robust market momentum, strong operating performance and a record order backlog are causing us to increase our guidance for the fourth quarter and fiscal year."

Kramer concluded, "We are in the process of preparing the II-VI Incorporated operating plan for fiscal year 2012. We see continuing strength in industrial markets as global economies rebound. Near-infrared market growth appears positive overall, with ongoing strength in China. We are monitoring U.S. military spending to assess the effects any changes may have on our military businesses. We expect to introduce guidance for fiscal year 2012 in June 2011."

Quarterly results are rosy for Hittite

With an increase in quarterly revenues, profits and incomes over the same quarter last year, Hittite has not suffered like other RF electronics and Telecoms manufacturers.

Hittite Microwave Corporation has reported revenue for the first quarter ended March 31, 2011 of $67.2 million, representing an increase of 24.1% compared with $54.2 million for the first quarter of 2010.



This is also an increase of 2.5% compared with $65.6 million for the fourth quarter of 2010. Net income for the quarter was $20.2 million, or $0.66 per diluted share, an increase of 25.2% compared with $16.1 million, or $0.54 per diluted share, for the first quarter of 2010, and a decrease of 3.5% compared with $20.9 million, or $0.69 per diluted share, for the fourth quarter of 2010.

For the first quarter of 2011, revenue from customers in the United States was $30.0 million, or 44.6% of the company's total revenue, and revenue from customers outside the United States was $37.2 million, or 55.4% of total revenue.

Gross margin was 73.0% for the first quarter of 2011, compared with 73.4% for the first quarter of 2010 and 74.5% for the fourth quarter of 2010. Operating income for the first quarter was $31.2

million, or 46.4% of revenue. Total cash and cash equivalents at March 31, 2011 was $311.8 million, an increase of $16.3 million for the quarter.

The company expects revenue for the second quarter ending June 30, 2011 to be in the range of $67.5 million to $69.5 million and net income to be in the range of $19.8 million to $20.6 million, or $0.64 to $0.67 per diluted share.

The company hosted a conference call to discuss its financial results. A telephonic replay of the call will be available for one week after the live call by dialling (303) 590-3030 with access code 4430193.

A webcast replay is also available by visiting the Investors page at www.hittite.com.

TriQuint revenues strong with 24% increase

The firm reported quarterly revenues of $224.3 million, mainly driven by strong demand in the smartphone market.

TriQuint Semiconductor, an RF solutions supplier and technology innovator, has announced its financial results for the quarter ended April 2, 2011.

Commenting on the results for the quarter ended April 2, 2011, Ralph Quinsey, President and Chief Executive Officer, stated, “Driven by strong demand in the smartphone market, we enjoyed 24% revenue growth and 47% growth in non-GAAP earnings year over year in the first quarter. Looking ahead, I expect continued solid traction in mobile devices, strength in high performance optical amplifiers and good progress in the cable market.”

Revenue for the first quarter of 2011 was $224.3 million, up 24% from the first quarter of 2010 and down 11% sequentially. Mobile Devices grew 41% year over year while Networks grew 6% year over year.

Gross margin for the first quarter of 2011 was 39.0%, up from 37.9% in the first quarter of 2010 and flat sequentially.

Operating expenses for the first quarter of 2011 were $67.1 million, or 30% of revenue, up from $55.3 million in the first quarter of 2010 and $61.6 million in the previous quarter. Net income for the first quarter of 2011 was $12.4 million, or $0.07 per diluted share.

The Company believes second quarter revenue will be between $230 million and $240 million. Litigation expense is expected to be approximately $7 million. Second quarter non-GAAP net income is expected to be between $0.16 and $0.18 per share. The Company is 86% booked to the midpoint of revenue guidance.

In the last quarter, TriQuint was awarded by Compound Semiconductor Magazine for its R&D efforts. The company was also recipient of the ZTE Supplier of the Year Award and was recognised by China Electronic News top 10 brand and EE Times Annual Creativity in Electronics finalist for Company of the Year.

Since the end of the last quarter, TriQuint has Introduced new single and dual band WLAN Power Amplifiers that augment the Texas Instruments WiLink 6.0 and WiLink 7.0 solutions to support strong market demand for WiFi connectivity. It has also launched three new cable products expanding the transport portfolio.

Lasers

Compound Semiconductor Technologies clinches deal with China

With its new laser chips made for use in industrial, communications and defence applications, the firm is set to double its turnover to £5m within the next three years.

Compound Semiconductor Technologies Global Limited (CST), the Scotland-headquartered manufacturer of optoelectronics devices, has secured a six-figure supply agreement with one of China's emerging tele and data communications developers.

The company's recent successes, which sees the High Blantyre-based company develop and manufacture customised laser chips for use in industrial, communications and defence applications, is set to double the company's turnover to £5m within the next three years.

The news comes as CST also reaches a production milestone, with the company having manufactured two million high performance laser chips since acquiring its new manufacturing premises in 2010.

Neil Martin, chief executive officer of CST, said, "We have been making considerable headway in the Chinese market for some time and have now reached a key milestone, which underscores the significant investment we've made in developing our own proprietary modular process technology platforms. This commitment now sees CST firmly at the forefront of this global market."

"Chinese companies are increasingly looking to develop their own operations beyond pure manufacturing. Even though these markets have been traditionally high volume low cost, we have achieved considerable success in working with such companies to incorporate their custom-built CST laser technologies into their products."

"The development of our own modular technology platforms has allowed us to remain both competitive and agile. From a practical perspective, it means we don't need to go back to R&D team every time a new requirement comes along, which accelerates time to market for our customers."

The optoelectronics sector is experiencing rapid growth, with significant demand coming from the data and telecommunications sectors.

Jeffrey Sercel Receives Entrepreneur of the Year from NHHTC

Jeffrey Sercel, Founder and CTO of JP Sercel Associates, Inc (JPSA) was selected as a New Hampshire High Technology Council (NHHTC) Entrepreneur of the Year for 2011. Sercel was recognized for the pioneering work of JPSA, which he started in 1994, which has grown into an internationally recognized supplier of laser systems.

The award was based on the Applicant, Type of Business, Current Activity, Innovative Approaches, and Future Plans for the business. Jeffrey Sercel was one of three finalists chosen to present their cutting edge companies in audio/visual presentations to members of the NHHTC and on stage to the public on May 9th, 2011. Sercel is one of only two people to have won the award twice.

After receiving the award, Jeffrey Sercel said, "It's great to receive this award and be a part of this special event that recognizes the best Entrepreneurs in NH. This award not only symbolizes my dedication and hard work to build JPSA into the company it is today, but the persistence of the entire JPSA team who have made the company a quality manufacturer of laser micromachining products."

Sercel began his career in 1983 as a laser engineer at the first excimer laser Applications Lab and development facility in North America, Tachisto Inc. After receiving his Bachelor of Science degree in engineering physics from the University of Arizona, he devoted more than 25 years to become an expert in excimer, DPSS and ultrafast industrial laser technology.

Osram laser diode provides precise 3D imaging

The 3D camera by FOTONIC using Osram's 845nm LD is designed for industrial applications such as gauging fluid levels and grading objects according to size or shape. The light is hardly visible to the human eye, and yet is well within the sensibility range of the camera chip.

A fast laser diode of Osram Opto Semiconductors provides light for the new 3D camera from Swedish manufacturer FOTONIC. The component has been developed specially for 3D cameras like the FOTONIC C70. It facilitates range finding for moving object with good depth resolution at video rate.

The object and camera for each pixel. Fast and powerful light sources like the new pulsed laser diode of Osram Opto facilitates particularly precise range finding 3D camera FOTONIC C70 produces relief images which yield the distance between

Osram's new infrared laser diode provides high optical power of about 0.5 W, even when in continuous wave operation. With a wavelength of about 845 nm, the light is hardly visible to the human eye, and yet it is well within the sensibility range of the camera chip.

Three-dimensional cameras superimpose a two-dimensional picture with information on the range and surface profile of an object. Industrial applications for such systems are, for example, the gauging of fluid levels or the grading of objects according to size or shape. Three-dimensional sensors also provide reliable stereoscopic information, e.g. for the control of robot arms.

The FOTONIC C70 camera is based on a CMOS sensor and it makes use of the principle of time-of-flight measurement. A laser diode, which is integrated into the camera, transmits a light pulse which the target reflects back. Each of the 120x160 pixels of the camera chip records the distance to the object by measuring a respective phase shift compared to the emitted light pulse.

The precision of this distance measurement and the range of the sensor increases with the modulating frequency of the light source. Due to their fast switching times of only a few nanoseconds, laser diodes are particularly well suited for this application. The laser diode, developed for this kind of 3D cameras is modulated with 44 MHz. Within the range of 0.1 to 7 m, the camera measures distances with an accuracy of 3 up to 30 mm.

For Osram Opto, it is the first application of a laser diode in a 3D sensor of this type. Rickard Åström of FOTONIC is convinced of the laser's performance and comments, "Together with Osram we've managed to increase the performance of our FOTONIC C70 Camera. We plan to use this component in future generations of our camera."

Jörg Heerlein, marketing manager for pulsed laser diodes at Osram Opto Semiconductors, predicts a growing market for such applications: "In industry,

three-dimensional sensor technology is on the advance. This technology is becoming interesting for the consumer market and also the automobile sector. To name a few applications, it is used for touch screens, or in sensors for accident avoidance systems in automobiles. We therefore designed this new laser diode especially for 3D sensor technology."

The sturdy metal package of the component meets the demands for industrial applications. Osram Opto will present the laser together with the FOTONIC C70 3D camera at the Measurement Fair Sensor+Test 2011 in Nuremberg at the beginning of June.

Intense unveils QC mini stacks maximising temperature performance

The designs can be produced for standard wavelengths of 808nm and 940nm. Custom wavelengths, including multicolour options are also available.

Intense Ltd., a developer of next generation semiconductor lasers, systems and solutions, has revealed its next generation of Hermes 650W Mini Stacks at Laser World of Photonics in Munich, Hall 1, Booth #400 (IMM Photonics).

The Mini Stack is an ultra-compact QCW stack offering maximum brightness at high operating temperatures. It incorporates new, high power 808nm laser bars designed for extending performance across a broad range of operating temperatures. A high brightness stack, it has an emission area of only 2.8mm x 2.8mm and generates an optical output in excess of 8 kW/cm2 operating with ~300µs pulses.

Hermes stack

The 650W Mini Stack is designed for handheld DPSS laser systems, which require a reduced footprint/weight ratio, and improved battery life and system performance under harsh conditions.

The Mini Stack has been fully qualified to military standard MIL-STD-810F, including storage temperature cycle (-57°C to 75°C), mechanical shock (>20K shots at 1000G), and more than 250k shots of continuous operation. The design can be produced for standard wavelengths of 808nm and 940nm. Custom wavelengths, including multicolour options, are available on request.

"The Mini Stack offers more than 50% higher optical power density than common 2kW stacks that use standard bar technology," stated Kevin Laughlin, Chief Commercial Officer, Intense Ltd. "The new bar designs offer improved performance over a wider range of operating temperatures. This, combined with a compact footprint and small emission area, makes the Mini Stack ideal for high power end pumping of DPSS laser sources."

The standard 650W Mini Stack supports operating temperatures from -40°C to 70°C. The new, high temperature versions of Intense's QCW bars and stacks, now meet output specifications at operating temperatures as high as 130°C. Power levels and emission areas can be custom designed for OEM requirements.

"The Mini Stack's ultra compact form factor and high optical power density offer a real opportunity to reduce size and cost," continued Laughlin. "They can dramatically improve system operating efficiency for solid state laser manufacturers currently using flash lamps or standard diode bar pump technology. As a direct result of our latest development efforts, Intense is now in the position to provide these stacks in combination with a whole new generation of laser bars designed to operate under the most challenging environmental conditions."

The entire Hermes product line will be on display at Laser World of Photonics, including the QCW bars the provide up to 400W of output power, and the QCW 1kW, 2kW, and 3KW stacks with 1kW, 2kW, and 3kW of output power, respectively. All Hermes bars and stacked arrays incorporate Intense's patented Quantum Well Intermixing (QWI) technology. This increases the brightness and

reliability of the lasers while dramatically reducing instances of catastrophic optical damage (COMD). These bars and stacks are assembled using AuSn hard solder and designed for a wide range of aerospace, defence and industrial applications.

The Hermes 650W Mini Stacks are available now in both standard and high temperature versions. Pricing is based on quantities ordered. Other wavelengths and configuration, including multicolour options, are available on request.

Intense introduces next generation InGaAs 793nm lasers

The multi-emitter pump modules deliver up to 20W light output power and are designed to replace existing diode pumped solid-state (DPSS) technology in medical and industrial applications.

Intense Ltd., a developer of next generation semiconductor lasers, systems and solutions, is releasing prototype versions of its next generation Series 8000 InGaAs 793nm High Power Pump Laser Diode Module.

The new multi-emitter pump module delivers 20W of output power from a 105 mm core fibre, 0.15 or 0.22 Numerical Aperture. It is designed to meet growing demand for laser pumps in the field of eye-safe, Thulium-doped fibre laser systems. The pump module is used in defence and aerospace applications, such as LIDAR and direct infrared countermeasures, and to replace existing diode pumped solid-state (DPSS) technology in medical and industrial applications.

The Series 8000 793nm standard Mini-Fibre Packages (MFP) provide a robust and cost effective solution for applications with power requirements in the 4 to 5W range. The same high power chip technology used in Intense's 793nm MFP's is now available in new multi-emitter packages designed to yield a maximum optical pump power of up to 20W. The building block 4 to 5W laser diodes can also be supplied in free space configuration on C-mount with a FAC-lens, or on isolation sub-mounts.

"Over the years, we have continuously improved our industry leading 793nm laser diode technology," stated Berthold Schmidt, CEO, Intense Ltd. "The multi-emitter modules with the next generation of 793nm chips are an important extension of the 793nm MFP product line that incorporates a single laser diode and yield of about 4.5W fibre coupled output power."

The Series 8000 793nm Pump Laser Diode Module is based on Intense's next generation 793nm single emitter chips, which incorporate improved asymmetric waveguide design with narrow beam divergence and Intense's patented Quantum Well Intermixing (QWI) technology to maximise power and reliability.

The entire Hermes product line will be on display at Laser World of Photonics, including the QCW bars the provide up to 400W of output power, and the QCW 1kW, 2kW, and 3KW stacks with 1kW, 2kW, and 3kW of output power, respectively.

All Hermes bars and stacked arrays incorporate Intense's patented QWI technology. This increases the brightness and reliability of the lasers while dramatically reducing instances of catastrophic optical damage (COMD). These bars and stacks are assembled using AuSn hard solder and designed for a wide range of aerospace, defence and industrial applications.

The Series 8000 793nm Pump Laser Diode Module prototypes are available on a limited basis to key OEM partners in preparation for a full product launch in 2012.

Berlin to host compound semiconductor conference

Organised by the Fraunhofer Institute and the VDE Association for Electrical Technologies, Electronic & Information Technologies, the conference will address the future of compound semiconductors in micro electronics and optoelectronics.

On May 23, 2011, Andre Geim, the 2010 winner of the Nobel Prize in Physics, opened the 2011 Compound Semiconductor Week with a plenary lecture on graphene.

Here, some 450 scientists and industry representatives will discuss current research findings in the field of compound semiconductors. An example of one of the key topics of the event is how to improve energy efficiency while increasing data rates in communications systems – often referred to as "Green IT".

The conference took place in Berlin from May 22 to 26. The conference is organised by the Fraunhofer Heinrich Hertz Institute HHI, the Fraunhofer Institute for Applied Solid State Physics IAF, and the VDE Association for Electrical Technologies, Electronic & Information Technologies.

"CSW is the most important international conference for the entire spectrum of compound semiconductors. Here, participants will get an overview of what will become possible in micro electronics and optoelectronics," Oliver Ambacher, ISCS 2011 Conference Chair and head of the Fraunhofer IAF, said.

While silicon is still the most important semiconductor material, today no mobile phone, PC or car would work without additional components used in compound semiconductor technology. Compound semiconductor, in contrast to the elemental semiconductor – like silicon -, consists of at least two different types of atoms.

Compound semiconductors are used for light generation with LEDs, photonics and communications engineering, as well as for maximum frequency electronics and power electronics. Since 2010, the CSW has combined the two most important conferences on compound semiconductors – the "International Symposium on Compound Semiconductors (ISCS)" and the "International Conference on Indium Phosphide and Related Materials (IPRM)".

"Berlin is the ideal location for hosting the CSW thanks to its broad-based research activities in this field," said Norbert Grote, Chairman of this year's IPRM and head of department at the Fraunhofer HHI. "Some 450 scientists from all over the world will come to Berlin to exchange their knowledge. This gives us the opportunity to further strengthen the location and to promote these issues."

Fraunhofer HHI and Fraunhofer IAF are both leading research institutes in the field of compound semiconductors. In Berlin, it is not only institutes and universities such as the Fraunhofer HHI, the Ferdinand Braun Institute, the Paul Drude Institut für Festkörperelektronik, the Institut für Kristallzüchtung, Humboldt- und Technische Universität, as well as the Helmholtz Zentrum, which are active in this field, but also companies like the u2t Photonics AG, a spin-off from Fraunhofer HHI. "When making a phone-call in the US, your chances of the optical components involved having been made in Berlin are pretty good," said Norbert Grote.

VI Systems 850 nm VCSEL transmits record 25 Gbit/s

This milestone proves the applicability of advanced VCSELs for low cost high-speed optical data transmission over 100 metre distances.

Scientists at the Georgia Institute of Technology in Atlanta, GA have demonstrated a plastic optical fibre (POF) data link using a VI Systems ultrahigh-speed 850 nm VCSEL to transmit data at 25 Gbit/s over a distance of 100 metres.

POFs are more typically used at lower data rates from 50 MBit/s to 1 Gbit/s in automotive and home network applications and with light near 650 nm.

The error-free transmission (defined as a bit error ratio <10^{-12}) used an 80 µm-diameter core POF and reached coupling tolerances as high as ~35 µm.

This is another important milestone proving the applicability of advanced VCSELs for low cost high-speed optical data transmission over 100 metre distances.

Optical data transmission of up to 40 Gbit/s has been realised with high speed photodetectors and transimpendance amplifiers by VI Systems. The V40-850C chip is available in a 250 x 250 µm single die size or as 1x4-channel or 1x12-channel chip array.

The target applications are proprietary optical links and active optical cables at 40 Gbit/s and 100 Gbit/s, Fibre Channel at 14 Gbit/s and 28 Gbit/s, and Infiniband FDR (14 Gbit/s) and EDR (26 Gbit/s) applications.

Product samples are available now.

Oclaro introduces new high-power laser diodes

Designed for the materials processing market, the new parts are ideal for DPSS pumping and direct diode applications. They include 60W at 880nm and 120W at 910 to 1070nm, both on a passive cooler.

Oclaro, a provider of optical communications and laser products, has further strengthened two of its leading high-power laser diode product families by delivering next generation parts that feature improved performance, reliability and industry-leading cost competitiveness.

The new parts are ideal for DPSS pumping and direct diode applications and include 60W at 880nm as well as 120W at 910 to 1070nm, both on a passive cooler, and will be showcased at LASER World of PHOTONICS in Munich this week in the Oclaro booth #469, Hall C1 in the New Munich Trade Fair Centre.

“Oclaro has the technology, packaging and manufacturing expertise to continually drive innovations in power and efficiency for our existing product families,” said Bernd Meyer, Leader, High Power Laser Business for Oclaro. “We are now expanding the capabilities of our OPC family by delivering higher performance across a wider wavelength range and brightness — and we’ve also developed a new family member for the BPM/BLM mini-cooler series that represents the smallest footprint and highest CW power level of any competitive solution.”

The new BLM component, the BLM9xx/10xx is claimed to represent the industry’s smallest footprint and highest power conductively cooled product. This laser diode delivers up to 120W at the 910 to 1070nm wavelength range and replaces micro-channel coolers in horizontal configurations for DPSS pumping and direct diode applications.

To ensure easy integration, the new BLM9xx/10xx replaces soldering or wire bonding with mechanical electrical connection and mounting.

The OPC880, the new OPC family member is a 60W CW low filling factor bar at the 875nm to 890nm wavelength range and will be used in Oclaro’s own Prosario collimated modules, fibre coupled packages and will also be available as a passively cooled bar to Oclaro customers. By expanding the wavelength range of the existing OPC family, the new OPC880 enables Oclaro to enter the new and growing 880nm neodymium-YAG and neodymium-vanadate pumping market.

Researchers conjure up nanocavity super efficient laser

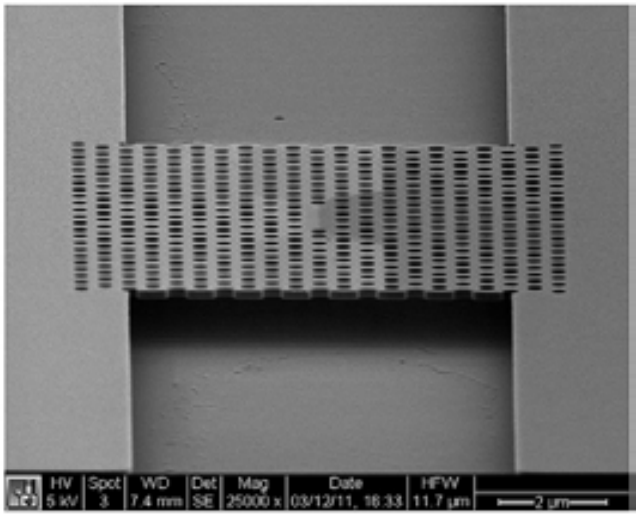
The GaAs/InAs laser is suited to optical communication systems and could herald a new era in low-energy data interconnects that communicate with light as well as electrons.

In the push towards ever-smaller and ever-faster data transmission technology, a team of Stanford electrical engineers has produced a nanoscale laser that they claim is much faster and vastly more energy efficient than anything available today.

To the Silicon Valley mantra of “faster, smaller” semiconductors, you can now add “more efficient.” The electrical data interconnections inside the

computers of America's massive datacentres consume huge amounts of electricity, and there is a technological drive afoot to reduce that consumption.

To that end, Stanford researchers have unveiled a tiny, highly efficient semiconductor laser that could herald a new era in low-energy data interconnects that communicate with light as well as electrons.



The wafer's holes 'act like a hall of mirrors to reflect photons back toward the center of the laser,' said Jelena Vuckovic, an associate professor of electrical engineering. (Courtesy of Jelena Vuckovic : Wafer with holes)

"Today's electrical data transmission circuits require a lot of energy to transmit a bit of information and are, relatively speaking, slow," said Jelena Vuckovic, an associate professor of electrical engineering at Stanford working on the new generation of nanoscale lasers.

She and her team, including Stanford graduate students Bryan Ellis and Gary Shambat, in collaboration with the research groups of James Harris at Stanford and Eugene Haller at the University of California-Berkeley, introduced their laser in a paper just published in *Nature Photonics*.

Vuckovic is working on a type of data transmitter known as a photonic-crystal laser. These lasers are particularly promising, not just for their speed and size, but because they operate at low thresholds and don't use much energy.

"We've produced a nanoscale optical data transmitter, a laser that uses 1,000 times less energy and is 10 times faster than the very best laser technologies in commercial use today," said the professor. "Better yet, we believe we can improve upon those numbers."

While others have created low-threshold lasers, Vuckovic said, the most promising have required a second laser to inject them with the energy they need to work, known as "pumping", hardly an ideal solution.

"We really needed a laser pumped with electricity, not light," she said. The only available electrically pumped photonic-crystal laser was inefficient and difficult to fabricate, making it commercially impractical. Now, for the first time, Vuckovic says they have demonstrated an electrically pumped laser that is both easy to manufacture and delivers dramatically reduced energy consumption.

To create the laser, the researchers use MBE to grow GaAs layers on a GaAs substrate and intermix the layers with three thin layers of InAs. A cross-section reveals that the InAs appears are quantum dots within the wafer.

When done, the wafer resembles a nanophotonic deck of cards, a mere 220 nm thick.

Next, the engineers "dope" two discrete areas on top of the wafer with ions. On one side, the researchers seed ions of silicon, and on the other they implant ions of beryllium.

These two regions are faintly visible on the surface, widening toward each other, approaching but never quite meeting at the centre of the wafer. These ion-infused regions help focus the current flow to a very precise area at the core of the wafer where light is emitted, improving the performance of the laser.

Finally, with the basic wafer fabricated, the researchers have yet one more trick up their engineering sleeves. They finish by etching a precise honeycomb pattern of circular holes through the wafer.

The size and positioning of these holes is critical to the success of the laser. If the holes are too small or too large, spaced too closely or too far apart, the laser will not perform optimally and in some cases,

it won't perform at all.

"These holes are almost perfectly round with smooth interior walls and are very important to the laser's function. They act like a hall of mirrors to reflect photons back toward the centre of the laser," said Vuckovic.

Here, in the heart of the wafer, the photons are concentrated and amplified into a tiny ball of light, a laser which can be modulated up to 100 billion times per second, 10 times the best data transmitters now in use. Thus the light becomes binary data – light on, 1; light off, 0.

At one end of a semiconductor circuit is a laser transmitter beaming out 1s and 0s as blasts of light. At the other end is a receiver that turns those blasts of light back into electrical impulses. All that is needed is a way to connect the two.

To do this, the researchers heat and stretch a thin fibreoptic filament, hundreds of times thinner than a human hair. The light from the laser travels along the fibre to the next junction in the circuit.

All this happens in a layer so thin hundreds of these nanophotonic transmitters could be arranged on a single layer, and many layers could then be stacked into a single chip.

Before Vuckovic's laser interconnect becomes commonplace, however, certain questions will need to be resolved. The new laser operates at relatively cold temperatures, 150 degrees Kelvin and below – about 190 degrees below zero Fahrenheit – but Vuckovic is confident and pressing forward.

"With improvements in processing," she said, "we can produce a laser that operates at room temperature while maintaining energy efficiency at about 1,000 times less than today's commercial technologies. We can see a light on the horizon."

Kovic's engineering research was made possible by funding from Stanford Graduate Fellowships, the Interconnect Focus Centre and the Air Force Office of Scientific Research.

Further details of this work have been published in the paper "Ultralow-threshold electrically pumped quantum-dot photonic-crystal nanocavity laser" by Bryan Ellis *et al,* in Nature Photonics 5, 297– 300, (2011). doi:10.1038/nphoton.2011.51

VCSEL slashes power consumption in atomic clock

The GaAs based VCSEL operating at a wavelength of 894 nm operates at only 2 mW, and consumes over a thousand times less power than the conventional light source used in atomic clocks, a rubidium-based atomic vapour lamp.

A matchbook-sized atomic clock 100 times smaller than its commercial predecessors has been created by a team of researchers at Symmetricom Inc. Draper Laboratory and Sandia National Laboratories.

The portable Chip Scale Atomic Clock (CSAC), only about 1.5 inches on a side and less than a half-inch in depth, also requires 100 times less power than its predecessors; instead of 10 W, it uses only 100 mW.

"It's the difference between lugging around a device powered by a car battery and one powered by two AA batteries," said Sandia lead investigator Darwin Serkland.

Darwin Serkland measures the wavelength of the VCSEL. The image on the monitor (left) shows a bright circle of light emitted from a 894 nm VCSEL needed to drive the atomic clock. The objects that look like black baseball bats are tiny wire needles carrying milliampere currents. The round white plastic containers on Serkland's workbench each contain about 5,000

VCSELs fabricated from one-quarter of a 3-inch diameter GaAs wafer. Each wafer is designed differently to yield a unique type of laser. (Photo by Randy Motoya)

Despite common implications of the word "atomic," the clock does not use radioactivity as an energy source. Instead, where an old-fashioned alarm clock uses a spring-powered series of gears to tick off seconds, a CSAC counts the frequency of electromagnetic waves emitted by caesium atoms struck by a tiny laser beam to determine the passage of time.

The clock is suited for use by miners far underground or divers engaged in deep-sea explorations, who would normally not receive GPS signals which are blocked by natural barriers. It enables them to plan precise operations with remote colleagues who also have atomic clocks, because their timing would deviate from each other by less than one millionth of a second in a day.

A CSAC timekeeper would also be invaluable to experts using electromagnetic interference to prevent telephone signals from detonating improvised explosive devices, or IEDs. Again, where GPS signals were blocked, a CSAC timekeeper would still function.

On a nationwide scale, relay stations for cross-country phone and data lines, which routinely break up messages into packets of information and send them by a variety of routes before reconstituting them correctly at the end of their voyages, would continue functioning during GPS outages.

The clock's many uses, both military and commercial, are why the Defence Advanced Research Projects Agency (DARPA) funded the work from 2001 until the CSA Clock hit the commercial market in January.

"Because few DARPA technologies make it to full industrial commercialisation for dual-use applications, this is a very big deal," said Gil Herrera, director of Sandia's Microsystems and Engineering Sciences Application (MESA) centre. "CSAC now is a product with a data sheet and a price."

Caesium atoms are housed in a container the size of a grain of rice developed by Cambridge, Mass.-based Draper Lab. The caesium atoms are interrogated by a light beam from a VCSEL, contributed by Sandia. Symmetricom, a leading atomic clock manufacturer, designed the electronic circuits and assembled the components into a complete functioning clock at its Beverly, Mass., location.

"The work between the three organisations was never 'thrown over the wall,'" said Sandia manager Charles Sullivan, using an expression that has come to mean complete separation of effort. "There was tight integration from beginning to end of the project."

Nevertheless, the reduced power consumption that was key to creating the smaller unit required, in addition to a completely new architecture, a VCSEL rather than the previous tool of choice, a rubidium-based atomic vapour lamp.

"It took a few watts to excite the rubidium lamp into a plasma-like state," Serkland said. "Use of the VCSEL reduced that power consumption by more than a thousand times to just two milliwatts." Serkland's success in attaining this huge power reduction caused some in the clock business to refer to him as "the VCSEL wizard."

The way the clock keeps time may best be imagined by considering two tuning forks. If the forks vary only slightly in size, a series of regular beats are produced when both forks vibrate. The same principle works in the new clock.

The VCSEL, in addition to being efficient, inexpensive, stable and low-power, is able to produce a very fine, single-frequency beam. The laser frequency, at 335 THz (894.6 nms), is midway between two hyperfine emission levels of the caesium atom, separated in terms of energy like the two differently sized tuning forks.

One level is 4.6 GHz above and the other 4.6 GHz below the laser frequency. (Hyperfine lines are the energy signatures of atoms.) A tiny microwave generator sends an oscillating frequency that alternates adding and subtracting energy from the incoming laser carrier frequency. Thus, the laser's single beam produces two waves at both hyperfine emission energies. When they interact, the emitted waves produce (like two tuning forks of different sizes) a series of 'beats' through a process known

as interference.

A photodiode monitors the slight increase in light transmission through the caesium vapour cell when the microwave oscillator is tuned to resonance. According to the international definition of the second (since 1967) the clock indicates that one second has elapsed after counting exactly 4,596,315,885 cycles (nearly 4.6 gigacycles) of the microwave oscillator signal.

Because magnetism has an influence on caesium atoms, they are shielded from Earth's magnetic field by two layers of steel sheathing.

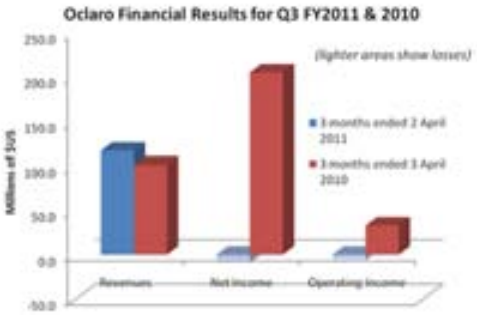
While this sounds cumbersome, atomic clocks are simpler to maintain than timepieces of a century ago, when a pendulum clock in Paris was the source of the world's exact time. Kept in a room that was temperature- and humidity-controlled, not only would a change of one degree affect the pendulum's swing, but the difficulty of bringing accurate time to the U.S. was extreme: one synchronised a portable clock in Paris and then had to transport it across the ocean by ship, during which time the mechanical clock would inevitably drift from the time of the Paris clock.

Sandia is developing a follow-on technology for DARPA: a trapped-ion-based clock. It will improve timing accuracy at similar size, weight and power to the CSAC. Researchers are currently working on the first compact prototype.

Oclaro incomes bomb in latest quarter

The firm has reported operating losses of $6.2 million and net losses of $9.4 million for its latest quarter ended 2 April 2011.

Oclaro, a provider of innovative optical communications and laser solutions, has announced the financial results for its third quarter of fiscal year 2011, which ended April 2, 2011.



"Oclaro has continued to invest in its new product pipeline while certain telecom customers have experienced a short-term inventory correction," said Alain Couder, president and CEO of Oclaro.

"We expect the slowdown to continue through our upcoming fiscal fourth quarter. Our planned new products are expected to provide revenue growth and gross margin traction in the second half of the calendar year. We also remain confident in the second half because of the continued strong demand for broadband in the core optical market, and the increasing reliance on optical functionality throughout the network."

Revenues for Q3 FY 2011 were $116.6 million for the third quarter of fiscal 2011, compared to $120.3 million in the second quarter of fiscal 2011. GAAP gross margin was 25% for the third quarter of fiscal 2011, compared to 30% in the second quarter of fiscal 2011.

GAAP operating loss was $6.2 million for the third quarter of fiscal 2011, compared to GAAP operating income of $1.6 million in the second quarter of fiscal 2011.

Adjusted EBITDA was $1.1 million for the third quarter of fiscal 2011, compared to $10.1 million in the second quarter of fiscal 2011. GAAP net loss for the third quarter of fiscal 2011 was $9.4 million, compared to net loss of $0.2 million in the second quarter of fiscal 2011.

Cash, cash equivalents and restricted cash were $75.7 million as of April 2, 2011 compared to $78.1 million as of January 2, 2011.

For the fourth quarter of fiscal 2011, which ends July 2, 2011, Oclaro expects revenues in the range of $105 million to $115 million and adjusted EBITDA in the range of negative $6.5 million to negative

$1.5 million.

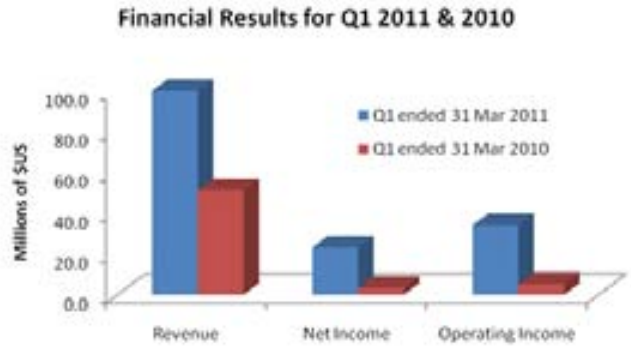
Oclaro held a conference call to discuss financial results for the third quarter of fiscal 2011. The replay may be accessed by dialling (858) 384-5517

The passcode for the replay is 4429507. A webcast of this call will also be available in the investors section of Oclaro's website at www.oclaro.com .

IPG quarterly revenues rocket by 95%

The firm has reported strong quarterly sales of $100, much of it thanks to high demand for high power and pulsed lasers.

IPG Photonics Corporation has reported financial results for the first quarter of 2011 ended March 31, 2011.



"IPG's growth momentum continued through the first quarter of 2011," said Valentin Gapontsev, IPG Photonics' Chief Executive Officer. "This was another outstanding quarter of revenue growth as sales increased 95% to $100 million. Although growth is compared to the first quarter of 2010 when we were still feeling the effects of the global economic downturn, demand was strong in what is typically a seasonally slow quarter. We reported year-over-year sales increases in all geographies and product lines. We also achieved gross margins of 54% and grew earnings per diluted share to $0.47 from $0.07 in the first quarter of 2010."

"Sales for materials processing applications were up more than 100% year over year, driven primarily by purchases for marking, welding and cutting," continued Gapontsev. "Demand for high power and pulsed lasers continued to drive our product sales. Also, the growing number of OEM customers contributed to the sales increase in materials processing. Advanced applications and telecom sales were up 76% and 73%, respectively, and medical increased by 10% from last year. Geographically, sales increased in every region, with China and Europe the strongest performers with sales up 234% and 120%, respectively."

"IPG generated $13.8 million in cash from operations and ended the quarter with $160.6 million in cash, an increase of $12.8 million sequentially," said Gapontsev. "Capital expenditures for the first quarter of 2011 totalled $11.3 million as we invested in additional capacity, application development and sales facilities abroad."

Business Outlook and Financial Guidance

"IPG's order flow remains strong," said Gapontsev. "It has become clear that our fiber lasers are now well accepted in many applications, especially in materials processing, as potential customers recognize our brand and the value our products provide. In addition, we are seeing customers, especially OEMs, order products in significantly greater quantities. Given the leverage in our business model, our sales performance should result in impressive profitability for the year."

IPG Photonics expects revenues in the range of $102 million to $110 million for the second quarter of 2011. The Company anticipates earnings per diluted share in the range of $0.50 to $0.59 based on 48,690,000 common shares, which includes 47,099,000 basic common shares outstanding and 1,591,000 potentially dilutive options at March 31, 2011.

Daylight to throw light on expanded Aries mid-IR lasers

Daylight Solutions, a manufacturer of advanced molecular detection, spectroscopic, and high-power illumination solutions based on quantum cascade and other technologies, has expanded its Aries Series of high-power, multi-wavelength mid-IR lasers.

Earlier this year Daylight introduced the first in the

product line, the Aries-100 air-cooled 2 W laser. The Aries commercial product line has now been expanded to include the Aries-200, -400, and -700 products.

The modularity of the Aries family of products can now provide the end user with customisable performance in wavelength and power. Our customers can now choose to populate one, two, four, or seven laser "sockets" with any wavelength and power that Daylight offers. Populating all seven sockets in the Aries-700 can provide over 10 W of cw, air-cooled mid-IR laser power.

"The flexibility and performance of the Aries product family is beyond anything available on the market to date," says Michael Radunsky, Product Marketing Manager for Daylight Solutions' scientific products. "These turn-key systems can be configured for high power at a single wavelength or to deliver up to seven different wavelengths simultaneously and collinearly."

The Aries-100 is CDRH approved and is ready for lab use. The higher models in the series are OEM laser systems that are ready for integration. Radunsky continues, "The SPIE Defence, Security, and Sensing Symposia and Exhibition is an excellent venue for the announcement of this new product line, as the Aries series serves this community well. These lasers are already finding applications in stand-off detection, free space communication, infrared countermeasures, thermal imaging, and scene generation."

Wavelengths ranging from 2 to 13 µm are available in the Aries products. The higher models in the series are also highly ruggedized. Standard performance includes operation within an ambient temperature range of 15 to 40 °C. However, they can also be specified to operate over a much wider range of operating temperatures, ranging from -40 to +70 °C.

Aries has also been tested for shake and vibration resistance. Optical fibre delivery is also available as an option. "Releasing an additional three models simultaneously for the Aries series is a good accomplishment for our team," states Paul Larson, President of Daylight Solutions. "The flexibility of these models enable applications in multiple markets."

Solar

First Solar reaches 4 GW manufacturing milestone

The firm's has so far produced enough cadmium telluride solar modules to power almost 2 million households with electricity. The firm has also started manufacturing modules in Germany ahead of schedule.

First Solar says it has manufactured 4 GW of thin-film photovoltaic CdTe solar modules since beginning commercial production in 2002.

A 4GW generation capacity is enough solar electricity to power around two million households, displacing more than 2.5 million metric tons of CO2 emissions a year--the equivalent of taking 500,000 cars off the road.

The company also announced that its second factory at Frankfurt an der Oder, Germany, has begun producing solar modules one month ahead of schedule. The four new production lines are still expected to ramp to full production during the third quarter of 2011, bringing annual capacity at the two Frankfurt factories to more than 500 MW.

First Solar, which is one of the world's leading producers of PV solar modules, also has manufacturing sites in Perrysburg, Ohio and Kulim, Malaysia, as well as new plants under construction in Mesa, Arizona and Vietnam. It recently completed the production ramp of its two newest plants in Malaysia.

First Solar CdTe PV modules receive UK MCS certification

The firm's cadmium telluride series 3 modules comply with the MCS rigorous international standards to ensure that end-customers in the UK have assurance of excellent quality.

First Solar has confirmed that its innovative, thin-film solar photovoltaic (PV) modules have received accreditation under the U.K. Microgeneration Certification Scheme (MCS), opening the door to the use of its modules in systems that benefit from the United Kingdom's feed-in tariff.

The MCS accreditation is an internationally recognised quality assurance scheme which validates the quality and reliability of approved products that satisfy rigorous standards. Product certification involves type testing of products and an assessment of the manufacturing processes, materials, procedures, and staff training.

"The MCS is a key prerequisite to serving the U.K. market," said TK Kallenbach, head of First Solar's Components Business Group. "Installers and products that carry the MCS mark provide end-customers with assurance that their PV systems comply with rigorous international standards."

The MCS accreditation applies to First Solar's Series 3 CdTe modules FS-370 to FS-385.

Solyndra installs its largest ever installation for Delhaize

The 3MW system for the supermarket based in Belgium consists of over 17,000 copper indium gallium diselenide (CIGS) solar modules covering 34,000 square metres of roof space.

Solyndra International AG, a manufacturer of CIGS cylindrical photovoltaic (PV) systems for commercial rooftops, has completed a 3MW rooftop solar system of a Delhaize distribution centre in Zellik, a Belgian suburb.

World's largest Solyndra installation to-date, a 3MW Delhaize warehouse rooftop in Belgium. More than 17,000 Solyndra panels were used in the installation

The project was completed by solar integrator U|S|E AG, a Solyndra Platinum Solution Provider based in Reutlingen, Germany, with its Belgium subsidiary Enerdeal. Delhaize, an international supermarket chain with over 2,800 stores worldwide, and 805 stores in Belgium and Luxembourg, is a winner of the Platinum Leadership in Energy and Environmental Design certification from the U.S. Green Building Council. The Belgian multi-national has committed to reducing its CO2 emissions by 20% by 2020, and rooftop solar is a part of its strategy.

"Having worked with Solyndra on previous installations, the choice of supplier was an easy one," said Denis Knoops, Senior Vice President Business & Concept Development & New Business Opportunities of Delhaize Belgium. "The innovative panel design allows us to maximise the installed capacity, reducing our CO2 emissions by 600 tons annually on these distribution centre roofs alone. We have a strong commitment to achieving environmental goals, and Solyndra ensures those goals become a reality."

Non-recourse financing included assistance from the Export-Import Bank of the United States (Ex-Im Bank) and KBC Bank NV. KBC provided lower-cost, non-recourse project financing with the loan

guaranteed by Ex-Im Bank under its Renewable Express program. Ex-Im's streamlined Renewable Express process for rooftop PV financings resulted in approval for the Delhaize project in just a few weeks.

The Zellik installation consists of more than 17,000 Solyndra CIGS solar modules covering 34,000 square metres of roof space and generates an annual yield of approximately 2,400 MWh, enough to power more than 700 households.

"We are very happy with the outcome of this project that was completed hand-in-hand with Solyndra," said Arnold Berens, CEO of U|S|E. "Their simple, non-penetrating, flat-mounting system allows for the maximum level of roof coverage. This helps companies like ours carry out quick and simple installations, reducing costs while maximising yields per square metre - a solution that keeps both building owners and their insurers happy."

Timothy Kim, in the Renewable Energy and Environmental Finance group of Ex-Im Bank said, "The Delhaize project represents a significant milestone for Ex-Im Bank and its Renewable Express Program. Ultimately, this deal demonstrates Ex-Im Bank's commitment to U.S. exporters such as Solyndra, as well as to foreign companies that wish to purchase high quality U.S. goods. Ex-Im Bank thanks Solyndra and KBC Bank for their dedication and support, a strong collaborative effort which drove this deal to the finish line."

"I want to thank the Export-Import Bank of the U.S. for its constructive role in delivering the guarantees for this transaction," said Dirk Mampaey, senior general manager, KBC Corporate Banking. "I am confident that our 'KBC Renewable Energy Team' will be able to leverage the additional acquired know-how and experience from this particular project in future renewable energy investment projects to the benefit of Solyndra and other U.S. exporters."

Supermarkets and distribution centres are typically some of today's largest flat-roofed commercial buildings, making them ideal for the installation of solar panels. Solyndra's innovative solar module design allows the panels to be oriented in any direction with minimal effect on the levels of generated energy.

Using CIGS and thin film technology, the modules generate electricity from direct, diffuse and reflected sunlight. USE added a white Sure-Weld thermoplastic polyolefin roof membrane from Carlisle SynTec to simultaneously maximise reflected light capture and further reduce costs through building cooling.

"We are very happy to be able to help Delhaize to realise the economic and environmental potential of their rooftops," comments Clemens Jargon, Solyndra's president of EMEA. "This installation bears testimony to our desire and ability to engage with large scale distributed energy projects at a time when more and more corporations are seeing the hidden value in their fixed rooftop assets. Solyndra technology allows them to meet their environmental goals and delivers great results to their bottom line."

Franzen to use Odersun CIS integrated solar façades

The two firms will use their combined experience to expand the use of photovoltaics in façade construction and solar installation.

Odersun, a manufacturer of customer specific CIS solar modules and the FranzenGroup, planner and constructor of façade and solar systems, will be cooperating in the sector of integrated building photovoltaics.

Together, they are to further promote the integration of solar components in curtain wall type, rear-ventilated façades. Franzen Ingenieur- und Montagebau GmbH offers comprehensive consulting services for the planning of solar-integrated façades as early as in the planning and design phase. Architects, specialist planners and builders are accompanied from design through to implementation of modern, energy-efficient photovoltaic façades. Odersun manufactures made to order CIS modules used in existing façade systems as well as according to individual specifications.

"Franzen combines, when it comes to the handling of our new types of solar components, a decisive, and until now rare, combination of skills, namely experience in façade construction and in the design

of solar systems"

The FranzenGroup works in the field of open system curtain wall façades and has the necessary cross-discipline know-how to meet the challenge of integrating photovoltaics in building façades. With over 40 years in the façade business and long-term involvement in the solar sector, Franzen combines, under one roof, all the necessary skills for both aesthetic and functional installation and layout of fully integrated façade systems. Unnecessary interfaces with other trades are no longer applicable.

"Franzen combines, when it comes to the handling of our new types of solar components, a decisive, and until now rare, combination of skills, namely experience in façade construction and in the design of solar systems," explains Hein van der Zeeuw, CEO of Odersun AG. "The constructional and artistic integration of solar in buildings can only be successful when the necessary systems and the decisive experience and competence in planning and installation are combined with suitable materials."

The cooperation between Odersun and Franzen forms another important link in the chain between manufacturer, system supplier and planning and installation.

"As a classical installation company, we were one of the first businesses to turn to the integrated use of solar energy in buildings. It was clear to us that there was a dynamic movement toward the incorporation of new technologies for sustainable energy supply within the building, a movement for which we wanted to be prepared," says Dipl.-Ing. Jürgen Krämer, a managing director at FranzenGroup.

"We have more than 40 years experience in installation and have been active in the solar sector since 2005. With the new components from Odersun, we can now combine both skills and offer solar façades, which also meet the requirements of aesthetic integration."

PowerFLEX thin-film module is awarded IEC and UL certifications

The Most Efficient Flexible Solar Module

The flexible module PowerFLEX BIPV from Global Solar Energy, a provider of flexible thin-film solar cells based on CIGS technology, has been awarded the IEC 61730 and 61646 as well as UL 1703 certifications.

The flexible thin-film module fulfils the strict requirements of safety, reliability and durability set by two independent test laboratories, the International Electrotechnical Commission (IEC) and Underwriters Laboratories (UL).

Its low weight of just 3.5 kg/m2 of module area makes the PowerFLEX BIPV particularly suited for industrial flat roofs, which are often not strong enough to bear the weight of thick-film photovoltaic installations. With 12.6% efficiency in relation to the aperture area, the solar module is the most efficient flexible module in the market to date.

The successful certification confirms that the flexible thin-film modules from Global Solar Energy are able to guarantee safe electric and mechanical operation for the duration of their entire expected lifetime, and that they are suitable for permanent open-air use. They also meet the requirements of the Prototype Building Regulation (MBO) laid down by the Conference of Ministers of Construction, a working group for urban development, construction and housing of the responsible Ministers and Senators from the 16 German Federal States.

"The UL and IEC certifications represent another milestone in the rapid development of Global Solar Energy. We are already planning several installations in the US and Europe," explains Jeff Britt, President and Chief Executive Officer of the US company with a German subsidiary in Berlin-Adlershof.

"Due to its high efficiency and low volume of materials, the new module can be offered at an extremely competitive price, which will help property owners to reach a quick return on their investment and achieve profitability."

The PowerFLEX module is rolled onto and adhered to the roof membrane, requiring no mounting hardware. The roof membrane is not perforated, and no additional wind load is created. The look of the building is not altered. The PowerFLEX module has a large format (5.75m x 0.5m) and a high power density (300W). It is around 50% more efficient than flexible silicone solar cells.

OPEL Solar to propose name change to OPEL Technologies

The name change should provide more focus and a clear framework for the two distinct divisions of the Company. OPEL Solar has its HCPV and solar tracker technologies, and ODIS possesses the GaAs POET technology.

OPEL Solar International has announced that proxy materials were recently mailed to shareholders with respect to the Annual and Special Meeting of shareholders to be held in Toronto on June 21, 2011 (the Meeting") and PDF copies of the said material has been filed on SEDAR (www.sedar.com).

In addition to the usual matters to be determined at the Meeting, including the appointment of auditors and election of directors, shareholders will be asked to consider a special resolution authorizing, subject to regulatory approval, the proposed change in the name of the Company to 'OPEL Technologies Inc.'

The Name Change provides more focus and a clear framework for the two distinct divisions of the Company. OPEL Solar has its HCPV and solar tracker technologies, and ODIS has the extraordinary GaAs POET technology. With each division having such significant technologies in their own right, the Company and its shareholders are best served to take a name that is more descriptive to encompass the broadening universe that is OPEL today.

Shareholders will also be asked, at the meeting, to approve Amendments to the Company's Stock Option Plan in order to increase the Number of Shares Reserved for Issuances under the Option Plan.

The Directors have approved these matters, as they believe they are in the best interests of the shareholders. Management's focus is on its efforts to grow the Company to its next level of success, to build on the strong foundation already in place, to provide increased brand recognition and to increase investor awareness, which should eventually yield added shareholder value. The Company's business outlook continues to be extremely positive, and shareholders will be presented with an update on the Company at the Meeting.

Sofradir's MCT detectors to power Sentinel-5-Precursor space mission

Over the last 12 years, Sofradir has optimised the design of the focal plane array (FPA) used in its detectors and is presently offering two versions of packaging, one with an active cooler and one with passive cooling in the satellite.

Sofradir, a developer and manufacturer of advanced infrared detectors for military, space and industrial applications, has been awarded the contract to provide shortwave infrared (SWIR) arrays for the TROPOMI/S5 - (Sentinel 5 Precursor) mission, as part of the Global Monitoring for Environment and Security (GMES) space initiative. GMES is a joint undertaking of the European Commission and the European Space Agency (ESA).

Under the contract, Sofradir will deliver to SSTL (UK), a worldwide supplier of satellite and space equipment, off-the-shelf 1000x256 SWIR arrays, based on its MCT/HgCdTe technology. Selecting an off-the-shelf model that has proven its performance and reliability has eliminated the need for Sofradir to go through a preliminary design phase, which can involve extensive screening and qualification. This translates into an 18-month saving in delivery time of the flight models. As a result, all deliveries will be completed within 24 months.

"This new contract shows that Sofradir has the right infrared products for the space community," said Philippe Bensussan, chairman and CEO at Sofradir. "Repeat orders of our off-the-shelf space-qualified MCT detectors allow us to offer IR products to our space customers at affordable prices with short lead

times and minimal risk."

The Sentinel-5-Precursor mission, scheduled for launch in 2014, is intended to fill a time gap between Envisat, an earlier generation of earth observation satellites for climate and environment monitoring, and Sentinel 5, which will be on-board the Post-EPS satellite scheduled for launch around 2019.

ESA funded the original development of the 1000x256 SWIR array for the Spectra mission in 1999. Since then, Sofradir has optimised the design of the focal plane array (FPA) and is presently offering two versions of packaging. One has the FPA integrated in a dewar with an active cooler. The second has the FPA in a hermetic package without cooling system, to be implemented with passive cooling in the satellite.

The SWIR with hermetic package without cooling system was selected because it offered some major advantages in reliability and power consumption. Unlike an active cooler that has moving mechanical parts that can shorten the overall life of the detector, passive cooling significantly increases reliability as it is dependent on the FPA only.

Sofradir FPAs are known for their outstanding reliability in harsh environments. For example, Sofradir IR detectors aboard the spaceborne observation satellite Helios IIA have been operating continuously since the 2004 launch. The fully hermetic package with optimised thermal interface minimises the cooling requirement. Other technological advances at Sofradir have enabled it to produce SWIR detectors that exhibit very high performance at relatively high temperatures (140K, -133°C), which means that they also consume less power.

Sofradir is increasingly being selected to participate in satellite and space missions for earth mapping, environment and disaster monitoring, meteorology and planet exploration. Its MCT IR detectors are in orbit in French military earth observation satellites, Helios IIA and IIB. Sofradir's IR detectors are also being used on ESA's Venus Express satellite (launched in 2005) and the French MoD SPIRALE satellites.

All of the detectors are still exhibiting nominal performance. Other space activities include the Japanese space agency (JAXA) SGLI/G-COM (Second Generation GLI/Global Change Observation Mission), where Sofradir's IR detectors are in Flight Model Phase.

In 2010, Sofradir delivered 26 detectors for space programs. Development teams at Sofradir are also working on a 1000x1000 SWIR array partially funded by ESA. This detector has been earmarked as a candidate for several ESA-led projects in the future.

CIGS to emerge as the major technology by 2020

Despite caution in the overall PV industry, the thin film market is expected to experience an overwhelming growth in coming years with CIGS coming out on top in the next 9 years.

Reportlinker.com is now marketing the report, "Thin - Film Photovoltaic (PV) Cells Market Analysis to 2020 - CIGS (Copper Indium Gallium Diselenide) to Emerge as the Major Technology by 2020."

The report provides key data, information and analysis on the current status and future outlook of Global Thin film industry. The global thin film PV market, despite caution in the overall PV industry, is expected to experience an overwhelming growth in coming years.

By 2020, the industry is set to transform itself to become the face of Solar PV industry. The study also addresses thin-film module production, production capacity, and competition among the industry players (as per technologies) along with the focus on development of emerging technologies in the thin film arena.

The report entails comprehensive analysis of top 5 countries. The strongest growth for thin film is anticipated to be in Europe and the US in the short to medium term. Asian countries like China, Japan, and India are also expected to speed up their escalation in the medium term. Germany however will remain strongest and the most important market for thin film PV industry.

Ruukki first to offer fully-integrated CIGS solar panel facade

The firm says that its solar power system is unique because it is fully integrated into the facade of the building, both functionally and visually

Ruukki says it is the first company to have developed a photovoltaic system that has been fully integrated into a facade to convert sun rays into energy. The solar power system does not depend on the sun's warmth, only its radiation. The electricity generated is used either to meet the building's own needs or is fed into the electric grid.

The PV modules are based on CIGS thin-film technology, commonly used in solar cells.

The solar panel facade has been designed for application in buildings of a high architectural standard that comply with increasingly stricter environmental regulations. Developed and patented by Ruukki, the system is fully integrated into the facade and is the most cost-effective way on the market to make a fully-glazed facade that generates energy from the sun.

The system enables power to be produced even in areas with no direct sun rays since the technology can also utilise sun rays in cloudy weather. In snowy areas and next to water, the system increases output from reflected rays.

"The solar panel facade is Ruukki's response to the need to produce energy from renewable energy sources. The main message of the product is sustainable development and ecology, which are combined with Ruukki's newest technological innovations and the latest technology available," says Jouni Metsamaki, SVP, Building Components, at Ruukki.

In the facade of an average-sized office building in Finland, for example, Ruukki's solar panel facade can produce 18,000 kWh of electricity a year. This is enough to meet the annual needs of a medium-sized, electrically-heated small-family home. Output and capacity can easily be increased according to the area available and capacity requirement.

"The unique concept in Ruukki's solar power system is that it is fully integrated into the facade of the building, both functionally and visually. The almost completely black fully-glazed facade enables solutions of a high architectural standard," says architect Laura Paunila at Ruukki. No visible fastenings have been used and thanks to their even colouring, the PV modules based on thin-film technology are aesthetically pleasing, unlike, for example, panels of crystalline silicon.

A sun panel facade is ideal not only for office and commercial construction, but also for residential and commercial construction. The system does not limit choice of base materials or type of building and the facade can be installed in newbuild and renovation construction and on different bases.

A solar panel facade is the easiest and most effortless way for a building to generate electricity. The system is based on modular solar power or PV panels, which have been made from glazed PV modules and Ruukki's steel rainscreen panel system. The modules are almost black in colour. They can be combined with Ruukki's other facade products and are part of the Ruukki Design Palette range of facade products, which allow the size and shape of the other components in the facade to be freely defined.

A solar panel facade has a similar structure to Ruukki's Liberta rainscreen panel facade and is installed just like an ordinary Ruukki facade. The facade has been pre-designed and delivery includes all the components and supplies required at the site. Also the cabling system has been pre-designed. On-site installation is both fast and easy.

Aalberts aids LED, semiconductor and solar energy market

By buying out Dutch based firm Lamers, Aalberts has the opportunity to expand its market position in the LED production and solar energy market and selling other products, systems and processes through Lamers' sales channels.

Aalberts Industries N.V. has reached an agreement with the Air Liquide group to acquire 100% of the shares of Lamers High Tech Systems B.V. (Lamers) in the Netherlands subject to antitrust clearance.

Since 1984 Lamers has been active in the development, engineering, manufacturing, assembling, testing and qualification of systems for control and distribution of high purity gases and chemicals. The systems are used in photolithography systems supplied to the semiconductor industry and MOCVD equipment supplied to the LED industry. The systems of Lamers are also used in the manufacturing process of photovoltaic systems for the solar energy industry.

The LED and solar markets are fast growing renewable energy markets, where Industrial Services strives to increase its market share. Besides this, Lamers is active in the installation of high purity distribution networks for gases and fluids, as well as hook-up activities.

Lamers generates an annual revenue of approximately €90 million with around 300 employees at its two manufacturing facilities in the Netherlands, Nijmegen and Kerkrade. The experienced management team will continue to manage Lamers on both locations together with the existing employees.

Lamers' systems are engineered in close cooperation with the customers from design to start up. Lamers delivers fully or semi-automated systems, in-house and on the customer site, using its large experience in the field of high purity tube systems, valves, fittings, sensors and flow measuring instruments.

The high purity systems are used to inject a specific mixture of gas with the exact specified temperature, pressure, humidity and purity to the different manufacturing process steps in the photolithography and MOCVD equipment. Lamers uses high-tech manufacturing processes such as (semi-) automatic welding processes of tubes systems, computer aided tube bending and the newest technology in the field of testing and qualification, such as particle- and moisture measurement, as well as helium leak testing under vacuum. This is all realised in a clean room environment.

The acquisition of Lamers is in line with Aalberts Industries' strategy of enhancing its position in the Industrial Services activity benefiting from the following features:

-Lamers will reinforce Aalberts Industries' position as technology partner in the semiconductor market with tailor-made systems for high purity gases and chemicals. Aalberts Industries has been active in this market for many years by supplying subassemblies, vibration control systems and surface treatment of components for the semiconductor industry.

- With Lamers Aalberts Industries has the opportunity to expand its market position in the fast growing LED production and photovoltaic systems for the solar energy market, selling other products, systems and processes through the sales channels.

- By using Lamers' technology other markets can be explored, such as micro electro mechanical systems (MEMS), chemical and pharmaceutical delivery systems, markets in which Industrial Services is not yet active.

- Lamers' technology and experience of designing, engineering, manufacturing, assembling, testing and qualification of systems for control and distribution of high purity gases and fluids can also be used for other markets in which Industrial Services is already active, such as the medical and precision engineering industry.

- The technology and portfolio of high purity tube systems, valves, fittings, sensors and flow measuring instruments, used in the systems of Lamers, can be developed further using the product development know-how and sales channels of Aalberts Industries.

- By using the international network of Industrial Services, Lamers will have the opportunity to globally serve its customers, that more often need a local tailor-made service.

- Within Flow Control the Lamers systems can be sold together with the clean gas activities in laboratories, universities and research centres. Aalberts Industries has a worldwide presence in these markets.

- Besides this Lamers can use the manufacturing machining capacity within Industrial Services to develop and deliver their systems faster and more efficient.

The acquisition will be financed from credit facilities and will be realised after fulfilment of all formalities and approvals, which is expected before the end of June 2011. Lamers' results will immediately contribute to the profit per share.

Phoenix Solar inaugurates two CdTe solar parks

With a total peak power of 18 MW, the Jocksdorf and Preschen solar parks in Germany will save around 10,000 tons of carbon dioxide a year.

Phoenix Solar AG, a German based photovoltaic (PV) system integrator, celebrated the inauguration of two solar parks in Jocksdorf and Preschen, together with its financing partner KGAL GmbH & Co. KG, on 20 May 2011.

The solar parks are located on a former military airbase and will supply green electricity to more than 4,300 four-person households in future. Both solar parks employ First Solar CdTe thin-film modules.

The Jocksdorf park employs 55,360 modules of the FS275 and 50,092 units of the FS277.

The Preschen facility houses 129,600 FS-277 modules.

A large number of guests from politics and the business community took part in the ceremony.

In her opening speech, Anita Tack, Brandenburg's Environment Minister, underlined how important the expansion of renewable energies for Germany's future is. She commented, "Today Brandenburg is already sourcing 15.6 % of its primary energy requirements from renewable energies. This brings annual savings on CO2 to almost 10 million tons. Brandenburg is viewed as a role model for an ambitious energy and climate protection policy, and has made it possible to convince entrepreneurs, investors and scientists to translate their ideas into reality here in particular. In the meantime, a branch of industry has successfully developed on this basis, with more than 12,000 jobs, 3,000 of which are in the photovoltaic sector alone."

In other speeches, District Administrator Harald Altekrüger, Eberhard Müller, the Mayor, Klaus Wolf of KGAL and Ralph Schneider of Phoenix Solar AG underscored the special features of both projects and gave an insight into the development, construction, expected electricity yields and the significance of the solar parks for the region.

KGAL commissioned Phoenix Solar AG with building the solar parks and has incorporated them into a fund for institutional investors. "We have been realising projects with Phoenix Solar for our investors for many years now. With both these projects as well, we relied on the experience and professionalism of our partner Phoenix Solar and have successfully added to our investment portfolio in the field of renewable energies", explained Klaus Wolf, member of KGAL's Board of Directors.

Phoenix Solar was responsible for the turnkey construction of both power plants in the capacity of

EPC contractor. As the solar power plants had to be built on a military conversion site of just under 60 hectares (approximately 150 acres), Phoenix Solar first task was to remove all munition remains before it could start with the installation.

“We are proud of being able to revitalise a conversion site in Brandenburg and put it to sustainable use through our solar parks. We will continue our work in the region, thereby making an active contribution to climate protection”, stated Ralph Schneider, Executive Vice President of Solar Energy Investments at Phoenix Solar. At the end of the operating lives of the solar parks, now fixed for 20 years, the conversion of the site will enable it to be used for urban development.

The solar parks were already taken into operation in 2010.

The Jocksdorf power plant was built in 22 weeks and the solar park in Preschen in 12 weeks. Both power plants, which are situated on a former military airbase, are separated by a runway which is 3 km long and therefore belong to different neighbouring municipalities. Favourable irradiation of an annual average 1,050 kW hours per square metre makes this region in the east of Germany ideal for the construction of PV power plants. The solar parks save around 10,000 tons of carbon dioxide a year.

Berlin to host compound semiconductor conference

Organised by the Fraunhofer Institute and the VDE Association for Electrical Technologies, Electronic & Information Technologies, the conference will address the future of compound semiconductors in micro electronics and optoelectronics.

On May 23, 2011, Andre Geim, the 2010 winner of the Nobel Prize in Physics, opened the 2011 Compound Semiconductor Week with a plenary lecture on graphene.

Here, some 450 scientists and industry representatives will discuss current research findings in the field of compound semiconductors. An example of one of the key topics of the event is how to improve energy efficiency while increasing data rates in communications systems – often referred to as “Green IT”.

The conference took place in Berlin from May 22 to 26. The conference was organised by the Fraunhofer Heinrich Hertz Institute HHI, the Fraunhofer Institute for Applied Solid State Physics IAF, and the VDE Association for Electrical Technologies, Electronic & Information Technologies.

“CSW is the most important international conference for the entire spectrum of compound semiconductors. Here, participants will get an overview of what will become possible in micro electronics and optoelectronics,” Oliver Ambacher, ISCS 2011 Conference Chair and head of the Fraunhofer IAF, said.

While silicon is still the most important semiconductor material, today no mobile phone, PC or car would work without additional components used in compound semiconductor technology. Compound semiconductor, in contrast to the elemental semiconductor – like silicon -, consists of at least two different types of atoms.

Compound semiconductors are used for light generation with LEDs, photonics and communications engineering, as well as for maximum frequency electronics and power electronics. Since 2010, the CSW has combined the two most important conferences on compound semiconductors – the “International Symposium on Compound Semiconductors (ISCS)” and the “International Conference on Indium Phosphide and Related Materials (IPRM)”.

“Berlin is the ideal location for hosting the CSW thanks to its broad-based research activities in this field,” said Norbert Grote, Chairman of this year’s IPRM and head of department at the Fraunhofer HHI. “Some 450 scientists from all over the world will come to Berlin to exchange their knowledge. This gives us the opportunity to further strengthen the location and to promote these issues.”

Fraunhofer HHI and Fraunhofer IAF are both leading research institutes in the field of compound semiconductors. In Berlin, it is not only institutes and universities such as the Fraunhofer HHI, the Ferdinand Braun Institute, the Paul Drude Institut für Festkörperelektronik, the Institut für

Kristallzüchtung, Humboldt- und Technische Universität, as well as the Helmholtz Zentrum, which are active in this field, but also companies like the u2t Photonics AG, a spin-off from Fraunhofer HHI. “When making a phone-call in the US, your chances of the optical components involved having been made in Berlin are pretty good,” said Norbert Grote.

CIS firm Sulfurcell is reborn as Soltecture

The new name ‘Soltecture’ is intended to get to the heart of the firm’s core competencies and stands for superior performance in solar, technology, and architecture.

On the ten-year anniversary of its founding, CIS thin-film pioneer Sulfurcell will be renamed Soltecture.

The Berlin-based company’s new name is intended to reflect the excellence of the company’s integrated solar solutions.

New company name Soltecture on headquarters in Berlin, Germany

CEO and Founder Nikolaus Meyer explains:

“The renaming is a logical step that takes the evolution of our company into account. The new name ‘Soltecture’ gets to the heart of our core competencies and stands for superior performance in solar, technology, and architecture. With the renaming we are signalling and underlining the development of the company from module manufacturer to a provider of optimum integrated PV system solutions.”

Soltecture (Sulfurcell) can look back on a ten-year history of success in CIS thin-film technology. Soltecture has been a pioneer in the PV thin-film space since its founding and continues its technological leadership today. From the early module market introduction of thin-film modules based on CIS semiconductors in 2005 and the ramp-up of three fabrication lines to recent record efficiencies of 13.0 % with innovative CIGSe technology, Soltecture stands for excellence in thin-film.

Soltecture has received multiple awards for its cutting-edge research and product development. In 2010 Eurosolar awarded the company the badge of the German Solarprize and the Germany-wide initiative “Land of Ideas” recognised Soltecture (Sulfurcell) as an exemplary and sustainable company. Furthermore, the UK’s Guardian newspaper listed Soltecture among the “hottest 100 clean technology companies in Europe” in the years 2009 and 2010.

Soltecture claims to achieve worldwide peak results with CIS solar modules based on CIGSe semiconductors. The company unveiled the new high-efficiency modules to the public at the end of 2010. TÜV Rheinland officially confirmed the output of 94 W or 12.6 % aperture efficiency. Only weeks later 13.0 % has already been achieved and industrial mass production of the new products has begun. During continuing shift operation (24/7) within just three months of the start of production, a yield of over 80% has been achieved. More than 4 out of 5 high efficiency solar modules produced are meeting the required specifications.

The rapid increase in yields in Soltecture’s state-of-the-art mass production and the marginal deviance in module power (90W +/- 3W) confirm process stability, which is widely recognised as an extraordinary challenge in thin-film module production.

In the coming 10-16 months, Soltecture aims to increase module-efficiency to more than 14% and production yields to over 90%. Based on successful quality control and on the background of series production readiness, the sales and distribution of the new modules have already begun.

Since the end of 2008, Soltecture has begun work on second generation technology, which deploys a CIS layer based on selenium instead of sulphur (indicated by the abbreviation CIGSe instead of CIGS). In the laboratory this technology has been proven to yield the highest efficiencies in the thin-film space.

CIGS- and CIGSe modules are produced with the same equipment in Soltecture's 35MW production plant in Berlin, Germany. Only for the CIGSe coating process, new specially developed equipment is being used. Yearly production capacity for the product line CIGS is 20MW; the capacity for CIGSe is currently being expanded from 5MW to 15MW.

Soltecture's research and development work as well as its highly flexible production line in Berlin provides the ideal framework for the development and production of the thin-film products of the future.

In ten years Soltecture has evolved from a leading manufacturer of high-performance thin-film modules to a provider of integrated system solutions. Soltecure offers standardised solutions for intelligent integration of their high-performance and optically aesthetic thin-film modules for construction challenges such as roofs, factories, and modern facades.

"With their engineering expertise and years of experience in solar technology our engineers constantly develop new PV solutions that are perfectly adjusted for solar architecture," explains Henrik Kruepper, Executive Director and Chief Sales Officer at Soltecture. "We offer our clients solar integration from one source and that makes us successful in the market."

These developments have been made possible by the trust of international investors. In recent years, renowned international investors including Intel Capital, Climate Change Capital, and the Vattenfall Europe- and GdF Suez-supported BEU Fund have provided Soltecture with growth financing amounting to more than €110 million.

In the newest financing round on January 2011 investors led by Intel Capital provided €18.8 million for the further development of the company's innovative CIGSe techology. With this fresh capital, Soltecture is forging ahead with development of production machinery and increasing the capacity of its fully-automated manufacturing facility for the new CIGSe modules.

Photos/Multimedia Gallery Available: http://www.businesswire.com/cgi-bin/mmg.cgi?eid=6731277&lang=en

PKU makes China's first CIGS solar integrated power circuit

In the 6th Asia Solar Photovoltaic Industry Exhibition, the first copper indium gallium selenide (CIGS) solar integrated power circuit of China was exhibited in Shanghai on May 5.

Technically supported by Peking University (PKU), Henan Yanyuan Photovoltaic Technology Co., Ltd developed the China's first CIGS solar integrated power circuit. This new product proves to be a new innovation in Chinese Solar Photonics Industry. With the booming solar industry nowadays, people are familiar with solar collectors and solar cells. However, what they don't quite know is the combination of these two elements–the solar integrated power circuit, a new type of CIGS solar cell's application. It provides a new approach to promote its scale production.

Gan Zizhao, professor of the PKU School of Physics and member of the Chinese Academy of Sciences (CAS), talked about the invention during an interview. "The application of CIGS solar cell is going to be the development trend in the solar industry. It reduces pollution and costs compared with the old material, which is mainly silicon. Moreover, it's cheaper and more efficient," said Professor Gan.

The PKU research team had independent intellectual property of this technology, added Professor Gan. Compared with other few ountries like US and Germany, they are still in an intermediate level, having a long way to reduce the gap in craftsmanship. However, there are large potential markets for this innovation in China.

Wolfgang Palz, chairman of the World Council

for Renewable Energy (WCRE), expressed his compliments for China's remarkable achievements in energy conservation and pollution reduction, especially efforts made in developing new energy.

http://english.pku.edu.cn/News_Events/News/Focus/8251.htm

SDG&E signs contracts with Soitec for 125 megawatts of solar power

Project agreements follow April signing of three solar power generation contracts in the San Diego area.

San Diego Gas & Electric (SDG&E) and subsidiaries of Soitec Solar Development, LLC, a renewable energy company managed by Soitec (Euronext Paris), today announced the signing of two additional 25-year contracts for a total of 125 megawatts (MW) of solar energy to be generated in the utility's service territory. The energy will be produced using Soitec's Concentrix concentrator photovoltaic (CPV) technology with solar modules manufactured in a new Soitec factory to be built in the San Diego area.

These new agreements are separate from the three San Diego contracts the two companies signed in April for 30 MW of CPV-generated solar power. Combined, the five contracts SDG&E recently signed with Soitec represent five separate projects capable of generating a combined total of 155 megawatts of clean, renewable solar power, or enough energy to supply more than 60,000 homes. Both of the new proposed projects will be located in San Diego County and will be situated near SDG&E electric substations.

"Our projects with Soitec will bring local jobs to the community and will help us to meet our renewable energy goals," said James P. Avery, SDG&E's senior vice president of power supply. "We are very confident in our choice of technology and in Soitec's plans for a solar panel manufacturing facility in the San Diego region."

The announcement confirms the attractiveness of Soitec's renewable energy technology – which generates large amounts of power with industry-leading efficiency and low environmental impact – in areas such as Southern California with abundant sunshine.

"These new contracts with SDG&E reinforce Soitec's decision to build its new manufacturing site in the San Diego area, and confirms the importance of the U.S. market for our company," said André-Jacques Auberton-Hervé, chief executive officer and chairman of the board of Soitec. "We are very pleased to have a direct role in bringing 'home grown' solar energy to the people of San Diego."

Soitec's new manufacturing facility will have an annual production capacity of 200 MW and will supply all of SDG&E's projects with Soitec's exclusive Concentrix CPV technology, which produces power at a much higher efficiency relative to standard solar panels. At full capacity, Soitec's San Diego operations facility will generate up to 450 direct jobs and more than 1,000 indirect jobs. The factory location is expected to be announced this summer, with completion within 18 months of construction start.

The power contracts require approval from the California Public Utilities Commission.

www.sdge.com
www.soitec.com

Record efficiency of 18.7% for flexible CIGS solar cells on plastics

Scientists at Empa, the Swiss Federal Laboratories for Materials Science and Technology, have further boosted the energy conversion efficiency of flexible solar cells made of copper indium gallium (di) selenide (also known as CIGS) to a new world record of 18.7% – a significant improvement over the previous record of 17.6% achieved by the same team in June 2010. The measurements have been independently certified by the Fraunhofer Institute for Solar Energy Systems in Freiburg, Germany.

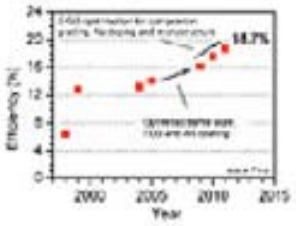
Caption: Flexible thin film CIGS solar cell on polymer substrate developed at Empa (Copyright: Empa)

It's all about the money. To make solar electricity affordable on a large scale, scientists and engineers worldwide have long been trying to develop a low-cost solar cell, which is both highly efficient and easy to manufacture with high throughput. Now a team at Empa's Laboratory for Thin Film and Photovoltaics, led by Ayodhya N. Tiwari, has made a major step forward. "The new record value for flexible CIGS solar cells of 18.7% nearly closes the "efficiency gap" to solar cells based on polycrystalline silicon (Si) wafers or CIGS thin film cells on glass", says Tiwari. He is convinced that "flexible and lightweight CIGS solar cells with efficiencies comparable to the "best-in-class" will have excellent potential to bring about a paradigm shift and to enable low-cost solar electricity in the near future."

One major advantage of flexible high-performance CIGS solar cells is the potential to lower manufacturing costs through roll-to-roll processing while at the same time offering a much higher efficiency than the ones currently on the market. What's more, such lightweight and flexible solar modules offer additional cost benefits in terms of transportation, installation, structural frames for the modules etc., i.e. they significantly reduce the so-called "balance of system" costs. Taken together, the new CIGS polymer cells exhibit numerous advantages for applications such as facades, solar farms and portable electronics. With high-performance devices now within reach, the new results suggest that monolithically-interconnected flexible CIGS solar modules with efficiencies above 16% should be achievable with the recently developed processes and concepts.

At the forefront of efficiency improvements

In recent years, thin film photovoltaic technology based on glass substrates has gained sufficient maturity towards industrial production; flexible CIGS technology is, however, still an emerging field. The recent improvements in efficiency in research labs and pilot plants – among others by Tiwari's group, first at ETH Zurich and since a couple of years now at Empa – are contributing to performance improvements and to overcoming manufacturability barriers.



Improvement in energy conversion efficiency of flexible CIGS solar cells on polymer film.

Working closely with scientists at FLISOM, a start-up company who is scaling up and commercializing the technology, the Empa team made significant progress in low-temperature growth of CIGS layers yielding flexible CIGS cells that are ever more efficient, up from a record value of 14.1% in 2005 to the new "high score" of 18.7% for any type of flexible solar cell grown on polymer or metal foil. The latest improvements in cell efficiency were made possible through a reduction in recombination losses by improving the structural properties of the CIGS layer and the proprietary low-temperature deposition process for growing the layers as well as in situ doping with Na during the final stage. With these results, polymer films have for the first time proven to be superior to metal foils as a carrier substrate for achieving highest efficiency.

Record efficiencies of up to 17.5% on steel foils covered with impurity diffusion barriers were so far achieved with CIGS growth processes at temperatures exceeding 550°C. However, when applied to steel foil without any diffusion barrier, the proprietary low temperature CIGS deposition process developed by Empa and FLISOM for polymer films easily matched the performance achieved with high-temperature procedure, resulting in an efficiency of 17.7%. The results suggest that commonly used barrier coatings for detrimental impurities on metal foils would not be required. "Our results clearly show the advantages of the low-temperature CIGS deposition process for achieving

highest efficiency flexible solar cells on polymer as well as metal foils", says Tiwari. The projects were supported by the Swiss National Science Foundation (SNSF), the Commission for Technology and Innovation (CTI), the Swiss Federal Office of Energy (SFOE), EU Framework Programmes as well as by Swiss companies W.Blösch AG and FLISOM.

Scaling up production of flexible CIGS solar cells

The continuous improvement in energy conversion efficiencies of flexible CIGS solar cells is no small feat, says Empa Director Gian-Luca Bona. "What we see here is the result of an in-depth understanding of the material properties of layers and interfaces combined with an innovative process development in a systematic manner. Next, we need to transfer these innovations to industry for large scale production of low-cost solar modules to take off." Empa scientists are currently working together with FLISOM to further develop manufacturing processes and to scale up production.

http://www.empa.ch/plugin/template/empa/3/107443/---/l=2

GT Solar launches ASF100 sapphire growth system

The new advanced system increases yielded output of high quality sapphire material.

GT Solar International, a global provider of sapphire and silicon crystalline growth systems and materials for the solar, LED and other specialty markets, has revealed the ASF100 advanced sapphire growth system.

GT Solar's ASF100 Advanced Sapphire Furnace

The ASF100 increases yielded output of sapphire material by producing a larger, 100 kilogram sapphire boule in the same chamber as previous versions of the furnace.

"We have received an enthusiastic response from early adopter customers for our ASF sapphire growth systems as they enter the market to provide high quality sapphire material for the fast-growing LED industry," said Cheryl Diuguid, vice president and general manager of GT Solar's sapphire equipment and materials group. "Our advanced sapphire crystallisation systems are built on a highly scalable and reliable architecture that lets customers quickly ramp to volume production with a lower capital investment compared with other competing crystallisation technologies."

With over 40 years of proven sapphire production and crystalline growth process technology, the ASF100 provides a highly automated, low risk operating environment, capable of producing consistently uniform sapphire boules that yield high quality material ideally suited for high brightness (HB) LED applications. "With competing crystallisation technologies customers entering the sapphire crystallisation market are forced to choose between systems that provided quality or systems that offer high throughput," continued Diuguid. "Our ASF100 offers high quality and high volume so

customers get both in one system."

Since the commercial introduction of the ASF system in the fall of 2010, GT has booked more than $450 million in orders from new entrants and existing sapphire producers. The ASF100 advanced sapphire furnace offers a proven path to producing high-quality, large-area sapphire substrates for markets that demand the highest grade material.

PKU unveils China's first CIGS solar integrated power circuit

In the 6th Asia Solar Photovoltaic Industry Exhibition, what was claimed by the innovators to be the first Chinese CIGS solar integrated power circuit, was exhibited in Shanghai on May 5.

Technically supported by Peking University (PKU), Henan Yanyuan Photovoltaic Technology claims to have developed China's first CIGS solar integrated power circuit.

This new product proves to be a new innovation in the Chinese solar photonics industry. With the booming solar industry nowadays, people are familiar with solar collectors and solar cells. However, what they don't quite know is the combination of these two elements–the solar integrated power circuit, a new type of CIGS solar cell's application. It provides a new approach to promote volume production.

Gan Zizhao, professor of the PKU School of Physics and member of the Chinese Academy of Sciences, talked about the invention during an interview. "The application of CIGS solar cell is going to be the development trend in the solar industry. It reduces pollution and costs compared with the old material, which is mainly silicon. Moreover, it's cheaper and more efficient," said Gan.

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Wolfgang Palz, chairman of the World Council for Renewable Energy, expressed his compliments for China's remarkable achievements in energy conservation and pollution reduction, especially efforts made in developing new energy.

III-V cells could help plants to provide more efficient solar energy

The multi-junction tandem solar cell initially developed at NREL has proved to be an important strategy to understand how to boost the efficiency of corn, grasses, algae, and other plants that use photosynthesis to produce stored solar energy in plants.

Plants can overcome their evolutionary legacies to become much better at using biological photosynthesis to produce energy, the kind of energy that can power vehicles in the near future, an all-star collection of biologists, physicists, photochemists, and solar scientists have found.

A U.S. Department of Energy (DOE) workshop that drew a prestigious collection of 18 scientists to compare the efficiency of plants and photovoltaic solar cells led to an important and provocative scholarly article in the journal *Science*. Two of the scientists are from DOE's National Renewable Energy Laboratory (NREL), Arthur J. Nozik and Maria Ghirardi.

Titled "*Comparing Photosynthetic and Photovoltaic Efficiencies and Recognizing the Potential for Improvement*," the article combines lessons learned from evolutionary photobiology and modern solar cells to make the case for a potentially huge boost in the efficiency of the solar production of biofuels.

The multi-junction tandem solar cell initially developed at NREL proved to be an important strategy to understand how to boost the efficiency of corn, grasses, algae, and other plants that use photosynthesis to produce stored solar energy.

Solar panel in a field

The annually averaged efficiency of photovoltaic electrolysis based on silicon semiconductors to produce fuel in the form of hydrogen is about 10 %, while a plant's annually averaged efficiency using photosynthesis to form biomass for fuel is about 1 or 2 %.

Plants, following the path of evolution, are primarily interested in reproducing and repairing themselves. The efficiency at which they produce stored solar energy in biomass is secondary.

Still, things can change.

Just as early Native Americans manipulated skinny, non-nutritious Teosinte into fat, juicy kernel corn, today's plants can be manipulated to become much better sources of energy.

Nozik, a NREL senior research fellow, and Senior Scientist Mark Hanna recently demonstrated how a multi-junction, tandem solar cell for water splitting to produce hydrogen can provide higher efficiency – more than 40 %-- by using multiple semiconductors and/or special photoactive organic molecules with different band gaps arranged in a tandem structure.

The coupling of different materials with different energy gaps means photons can be absorbed and converted to energy over a wider range of the solar spectrum.

"In photovoltaics, we know that to increase power conversion efficiency you have to have different band gaps (i.e., colours) in a tandem arrangement so they can more efficiently use different regions of the solar spectrum," Nozik said. "If you had the same gap, they would compete with each other and both would absorb the same photon energies and not enhance the solar conversion efficiency."

Photosynthesis does use two gaps based on chlorophyll molecules to provide enough energy to drive the photosynthesis reaction. But the two gaps have the same energy value, which means they don't help each other to produce energy over a wider stretch of the spectrum of solar light and enhance conversion efficiency.

Furthermore, most plants do use the full intensity of sunlight but divert some of it to protect the plant from damage. Whereas photovoltaics use the second material to gain that photoconversion edge, plants do not, Nozik noted.

Flower shaped solar panel

One of NREL's roles at the DOE workshop was to help make it clear how the efficiency of photosynthesis could be improved by re-engineering the structure of plants through modern synthetic biology and genetic manipulation based on the principles of high efficiency photovoltaic cells, Nozik said. In synthetic biology plants can be built from scratch, starting with amino acid building blocks, allowing the formation of optimum biological band gaps.

The newly engineered plants would be darker, incorporating some biological pigments in certain of nature's flora that would be able to absorb photons in the red and infrared regions of the solar spectrum.

As plants store more solar energy efficiently, they potentially could play a greater role as alternative renewable fuel sources. The food that plants provide also would get a boost. And that would mean less land would be required to grow an equivalent amount of food.

The new information in the Science manuscript will help direct the development of new plants that have a better propensity for reducing carbon dioxide to biomass. This could spur exploration of blue algae, which not only comprise about one quarter of all plant life, but are ideal candidates for being genetically engineered into feedstock, because they absorb light from an entirely different part of the spectrum compared to most other plants.

"It would be the biological equivalent of a tandem photovoltaic cell," said Robert Blankenship, one of

the lead authors in the Science paper who studies photosynthesis at Washington University in St. Louis. “And those can have very high efficiencies.”

Sunovia and EPIR bury the hatchet

The firms will benefit equally from a jointly developed solar patent related to CdTe solar technology. Contracts between the companies relating to the joint development of CdTe solar technology are terminated without further obligation.

Sunovia Energy Technologies and EPIR Technologies and affiliates have settled the litigation between them that arose in August of 2010.

The terms of the settlement provide that Sunovia and EPIR will share equally in the revenues from the jointly developed solar patent 12/261,827 published in 2010. In addition, each company will return to the other certain shares issued in the course of their venture, and the contracts between them relating to the joint development of CdTe solar technology are terminated without further obligation on the part of either company.

“It is important to Sunovia to resolve this dispute and move ahead with its LED outdoor lighting business,” said Art Buckland, Sunovia’s CEO. “If the solar technology can be developed and commercialised, our shareholders will share equally in those gains. Meanwhile, both Sunovia and EPIR can move forward with their respective businesses without the ongoing cost and risk of this litigation.”

“We are eager to move ahead with other projects,” said Siva Sivananthan, CEO of EPIR, “and to eliminate the distraction from our primary business and the expense the lawsuit creates for our company and shareholders. Both companies have worked very hard to come to a resolution that is fair for all.”

Opel proposes new directors to the board

The GaAs based solar cell manufacturer is planning to replace Denis Colbourne from its Board of Directors after his announcement of retirement. Two nominees have been since proposed; Christopher Grasset and Tristram Collins.

Opel Solar International has announced a realignment of its Board of Directors.

Denis Colbourne, a Director since September 2006, Chairman of the Board from 2008-2010, and a member of the Compensation Committee and of the Audit Committee, will be retiring from the Board at the Company’s upcoming Annual General Meeting of Shareholders.

His years of board and operational experience in the industry, including with Spectalis, SiGe Semiconductor, International Datacasting, Wi-LAN and Nortel Semiconductors have been of vital importance to the growth of the Company.

The Company is pleased that Colbourne will continue his involvement with Opel in an advisory role, to be called upon for his expertise from time to time, and as such will enter into a Consultancy Agreement with him. Leon M. Pierhal, the President & CEO of Opel, Lawrence R. Kunkel, Chairman of the Board, and Samuel Peralta, Board Director, will be continuing in their current capacities.

The Board is proposing two nominees. These are Christopher Grasset and Tristram Collins, for election as Directors of the Company at the AGM, scheduled for Tuesday, June 21, 2011 at the Toronto Hilton Hotel. The Record Date for Voting and Receiving Notice of the AGM has been set at May 12, 2011. The Company anticipates that Proxy Material will be mailed to Shareholders on May 20th.

Christopher Grasset, J.D. has over 35 years of experience in the high-technology sector. He is currently Vice-President, Business Affairs for Covalon Technologies and a Member of the Law Society of Upper Canada. Building on his background in communications and information technology,

Grasset co-founded the technology business law

firm Grasset/Fleisher LLP (subsequently merged with a major law firm) and the consultancy firm KBE International, focused on knowledge-based enterprises. Grasset has been an advisor to international organisations including the Sprinkles Global Health Initiative at the renowned Hospital for Sick Children in Toronto and UNICEF. His "Crossing the Pond" initiative was a marquee international technology business development program of Canada's Department of Foreign Affairs and International Trade.

He has published numerous articles on technology business, policy, law, tax and related issues; and he has chaired numerous conferences on subjects including international transactions and financing, and intellectual property and technology transfer.

Tristram Collins has over 25 years of business experience and holds an MBA from the Amos Tuck School of Business Administration and an AB from Dartmouth College. Currently President of Grassmere Acquisition Corporation and President & CEO of Great Point Holdings, LLC, his recent focus has been on financing and management of high-growth firms, exemplified by AcuStream LLC, Sustainable Building Innovations, and numerous other portfolio companies.

Previously, he was a Director and Senior Managing Executive at Nassau Broadcasting Partners, L.P. where he grew the company from 11 radio stations into the 15th largest radio broadcaster, by station count, in the U.S. He was also previously an investment banking executive with over $85 billion of transaction experience. At Citigroup Global Markets, he was a Managing Director and sector head specialising in broadcasting and media, where he managed global relationships, transactions and mergers and acquisition advisory assignments, including $6 billion of Viacom financings. He also held senior executive positions at Merrill Lynch & Co., where, among other assignments, he helped execute Infinity Broadcasting's $3.2 billion initial public offering.

"We are honoured that both candidates have accepted being nominated to the Board," stated Lawrence R. Kunkel, Chairman of Opel. "Their nomination exemplifies the Company's commitment to enhancing shareholder value, and their integrity and experience will be invaluable to the strategic growth of Opel on a going forward basis."

Kunkel added, "Both candidates bring strong knowledge-based and high-value transactional expertise to the Board and will provide solid support to the management team while Opel continues its vision for expanding the vertical and geographic reach of its photovoltaic business, and for realizing optimum value from its proprietary Planar Optoelectronic Technology (POET) semiconductor device manufacturing platform and associated intellectual property portfolio."

In addition to the Board transition and AGM plans, the Company also announced the grant of additional incentive stock options under its stock option plan to directors of the Company to purchase up to an aggregate of 600,000 common shares, representing 0.65% of the outstanding voting shares of the Company. The stock options are exercisable at a price of CA$1.21 per share, expiring May 11, 2021. The exercise price is the closing price on the day prior to the grant, being May 10, 2011.

There are currently 8,179,000 options outstanding and 92,183,256 voting shares outstanding. The options will vest and be exercisable on the basis of 25% on the date of grant and 25% every six months thereafter. The options were granted subject to provisions of the Company's stock option plan which was approved by shareholders in June 2009, and subject to the TSX Venture Exchange policies and the applicable securities laws.

GT Solar continue to cash in Asia

The firm has won $91 million worth of orders for its advanced sapphire furnaces from Taiwanese based Alpha Crystal Technology and Tera Xtal and the Lingyang Group based in China.

GT Solar International, a global provider of sapphire and silicon crystalline growth systems and materials for the solar, LED and other specialty markets, has received three new orders totalling $91 million for its advanced sapphire crystallisation furnaces (ASF).

Two of the orders are from customers in Taiwan, Alpha Crystal Technology, a new customer, and Tera Xtal, who last week announced a sapphire material purchase agreement with GT Solar. The

third order comes from a new customer in China, the Lingyang Group.

"These new orders continue a very robust order rate for our ASF furnaces," said Tom Gutierrez, GT Solar's president and CEO. "The interest shown by new market entrants and existing sapphire producers for our ASF systems has surpassed our expectations and is a testament to the confidence customers have for our proven ability to quickly ramp to high volume, low-cost manufacturing with leading edge crystal growth technology to meet the market demand for high quality sapphire material."

GT Solar says its crystallisation process technology and global support resources offer customers a path to productive and profitable sapphire manufacturing operations with high levels of throughput and a greater return on their investment.

GT Solar to sue ARC Energy

GT Solar says that ARC and two of its employees have used trade secrets relating to GT Crystal Systems' technology for manufacturing sapphire crystals, as a means of entering the sapphire crystallisation equipment business.

GT Solar International subsidiaries, GT Crystal Systems, LLC and GT Solar Hong Kong, Limited have filed a lawsuit in the Hillsborough County Superior Court (Southern District) in New Hampshire against Advanced RenewableEnergy Company, LLC (ARC).

The firms also plan to sue Kedar Gupta, ARC's Chief Executive Officer and Chandra Khattak, an ARC employee, for the misappropriation of trade secrets relating to sapphire crystallisation processes and equipment.

The complaint alleges that ARC and the named individuals misappropriated trade secrets relating to GT Crystal Systems' technology for manufacturing sapphire crystals, as a means of entering the sapphire crystallisation equipment business. The complaint further alleges civil conspiracy, unfair competition, breach of contract and interference with contractual relations.

"We have an obligation to our shareholders to be diligent about protecting our intellectual property," said Hoil Kim, GT Solar's General Counsel. "When we believe our intellectual property has been compromised, we will take the necessary action to protect our rights."

Emcore enters agreement With Space Systems/Loral

The multi-year supply contract for its multi-junction compound semiconductor solar cells represents the second largest award in Emcore's history.

Emcore Corporation, a provider of compound semiconductor-based components and subsystems for the broadband, fibre optic, satellite, and terrestrial solar power markets, has entered into a long-term supply agreement with Space Systems/ Loral (SS/L).

The firm wll manufacture and deliver high-efficiency, multi-junction solar cells for Space Systems/Loral's commercial satellite programs.

The multi-year contract represents the second largest award in Emcore's history. The agreement is subject to certain terms and conditions, including a provision allowing SS/L to terminate the agreement for convenience. Production of the solar cells will take place at Emcore's state-of-art manufacturing facilities located in Albuquerque, New Mexico.

"Emcore has been a highly reliable partner in helping us deliver some of the world's most powerful satellites to our customers," said Vivian Mackintosh, Vice President of Materiel at Space Systems/Loral. "We can count on Emcore for the highest quality solar cells delivered on time and priced fairly."

"We are extremely proud of Space Systems/ Loral's choice of Emcore to supply multi-junction solar cells for all SS/L flight missions," said Christopher Larocca, Chief Operating Officer of Emcore. "Emcore has delivered more than 800,000 solar cells to Space Systems/Loral over the past decade, and this agreement further strengthens our successful long-term relationship."

Emcore is one of the world's largest manufacturer

of fully space qualified, highly efficient radiation-hard multi-junction solar cells for space power applications. With a solar-to-electric conversation efficiency of nearly 30%, Emcore's multi-junction solar cells are claimed to offer superior performance at an affordable price when compared to competing technologies.

Q-Cells COO resigns from executive board

The CIGS solar cell manufacturer has appointed CEO Nedim Cen to assume Gerhard Rauter's responsibilities for the time being.

Gerhard Rauter has stepped down from his position as a member of the Executive Board of Q-Cells SE at his own request effective immediately. The Supervisory Board of Q-Cells approved his decision in its meeting on 4 May.

Gerhard Rauter, 53, held the position of Chief Operation Officer (COO) at Q-Cells since October 2007 and was most recently responsible for production and technology. His key accomplishments during this time include professionalising cell production in Thalheim and successfully setting up cell production in Q-Cells´ production site in Malaysia as well as module production using thin-film technology (Solibro).

He also developed the solar module portfolio in cooperation with international external production partners. The Supervisory Board would like to express its sincere appreciation to Gerhard Rauter for his performance, even in the difficult reorganisation phase during the year 2009, and wishes him all the best for the future.

Gerhard Rauter's responsibilities will be assumed by CEO Nedim Cen for the time being. Jirko Lohse and Peter Wawer will support the CEO in production and technology matters, respectively.

Emcore's profits continue to plunge

Although it has a large back log with some new orders, Emcore is still on a losing streak after announcing poor financial results with operating and net losses totalling $9.4 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 second fiscal quarter ended March 31, 2011.

Consolidated revenue for the second quarter ended March 31, 2011 was $47.2 million, which represents a 2% decrease compared to the prior year. On a segment basis, revenue for the Fibre Optics segment was $30.0 million, which represents a 1% decrease compared to the same quarter the prior year . Revenue for the Photovoltaics segment was $17.2 million, which represents a 4% decrease compared to the prior year. Consolidated gross profit was $10.6 million, which represents a 33% decrease compared to the prior year and gross margin was 22.4%, which represents a decrease from the 32.7% gross margin reported in the prior year.

On a segment basis, Fibre Optics gross margin was 18.0%, which represents a decrease from the 24.4% gross margin reported in the prior year. Photovoltaics gross margin was 30.2%, again, a decrease from the 46.6% gross margin reported in the same quarter last year.

The consolidated operating loss was $4.2 million, which represents a $3.3 million increase in operating loss when compared to the prior year.. During the second quarter ended March 31, 2011, the Company recorded a $2.6 million litigation settlement gain related to a patent infringement award associated with the Company's Fibre Optics

segment.

The consolidated net loss was $5.2 million, which represents a $3.7 million increase in net loss when compared to the prior year. The consolidated net loss per share was $0.06, which represents a $0.04 increase in net loss per share when compared to the same quarter last year. During the second quarter ended March 31, 2011, the Company recorded $0.6 million of non-operating expense related to the Company's Suncore joint venture.

As of March 31, 2011, the Company had a consolidated order backlog of approximately $50.5 million, a 12% decrease from the $57.3 million order backlog reported as of December 31, 2010.

On a segment basis, the Photovoltaics order backlog totalled $26.4 million, a 27% decrease from $36.1 million reported as of December 31, 2010. The Fibre Optics order backlog totalled $24.1 million, a 14% increase from $21.2 million reported as of December 31, 2010. Order backlog is defined as purchase orders or supply agreements accepted by the Company with expected product delivery and/or services to be performed within the next twelve months.

Emcore has however, received a large purchase contract from Space System/Loral for satellite solar cells. With this and other orders that it has received since March 31, 2011, the order backlog has increased significantly.

As of March 31, 2011, cash and cash equivalents and restricted cash was approximately $17.0 million. In April 2011, the Company announced a common stock private placement of $9.6 million. The closing of the private placement is subject to the completion of customary closing conditions for transactions of this type, including approval of applicable Chinese government agencies.

For the third quarter ending June 30, 2011, the Company expects consolidated revenue to be $48 to $50 million.

Nanosolar to supply 1GW CIGS panels in Europe

The supply agreements, signed with French and German installers, range from a three to six year term, and in total may account for up to one GW of committed module deliveries .

Thin film solar CIGS solar innovator Nanosolar has signed long-term supply agreements for up to one GW of Nanosolar Utility Panel supply with Belectric of Kolitzheim, Germany; EDF Energies Nouvelles of Paris, France; and Plain Energy of Munich, Germany.

As several of the largest and most experienced installers of thin film panels in Europe, these long-term strategic Nanosolar partners will utilise the cost-efficient Nanosolar Utility Panel to expand their solar power plant developments.

Each of the supply agreements ranges from a three to six year term, and in total may account for up to one GW of committed module deliveries as Nanosolar achieves its volume and cost targets. Each of the three companies has worked closely with Nanosolar as a strategic partner since 2008.

"Nanosolar's commitment to quality, customer relationships, and targeting one of the world's lowest cost solar panels makes it an ideal partner to help us tap into the world's fastest growing renewable energy markets," said David Corchia, CEO EDF Energies Nouvelles. "Through this partnership with Nanosolar, we look forward to achieving a very competitive levelised cost of energy for our solar installations."

Nanosolar combines proprietary technology with advanced system design and manufacturing processes to reduce both panel and balance of system costs. Leveraging its competitive CIGS solar cell and panel efficiencies in combination with proprietary printing techniques, Nanosolar says it can become the lowest-cost panel manufacturer at hundreds of megawatts of production versus GW within the next several years.

The firm's roll-to-roll printing process allows the company to benefit from the combination of low capital expenditure and high throughput, which results in an extremely low fixed-cost portion of the

production cost per watt. This when combined with a panel design that uses less overall materials for production and installation will enable the company to surpass the $.60 per Watt cost threshold within the next several years. Nanosolar will reach an annual production capacity of 115 megawatts by Fall 2011, and expects to at least double capacity each year thereafter.

“Nanosolar’s industrial printing approach to manufacturing its utility-scale panel combined with its lower balance-of-systems costs will allow solar to be cost competitive with fossil fuels,” said Bernhard Beck, CEO Belectric. “We look forward to combining Belectric’s state-of-the-art, low-cost installation methods with the Nanosolar Utility Panel to further drive down the cost of solar power plants.”

“Nanosolar takes great pride in its commitment to working closely, effectively and in complete collaboration with strategic partners,” said Geoff Tate, CEO of Nanosolar. “We are honoured to sign long-term agreements with three of the world’s leading thin film solar power plant developers, and consider it a validation of our pledge to enable them to better compete within global energy markets.”

First Solar profits down due to low prices

Year over year, the net income decrease was primarily driven by reduced average selling prices and higher expenses, partially offset by increased module production and lower module cost per watt.

First Solar has announced its financial results for the first quarter of 2011.

Net sales were $567 million in the quarter, a decrease of $42.5 million from the fourth quarter of 2010, due to the allocation of modules to our systems projects in order to meet the project contractual delivery schedules, seven fewer production days, and a full quarter impact of the pricing change implemented in December of 2010. Quarterly net sales decreased slightly from $568 million in the first quarter of 2010, primarily due to lower average selling prices.

First quarter net income per fully diluted share was $1.33, down from $1.80 in the fourth quarter of 2010 and $2.00 in the first quarter of 2010. Quarter over quarter, the net income decrease was primarily driven by lower net sales and gross margin. Year over year, the net income decrease was primarily driven by reduced average selling prices and higher expenses, partially offset by increased module production and lower module cost per watt.

“Despite European market uncertainties, First Solar has good visibility into our demand for 2011,” said Rob Gillette, CEO of First Solar. “We continue to execute our cost roadmaps, invest in new module capacity, build our project pipeline and develop promising new markets around the world.”

First Solar has updated its 2011 guidance and expects net sales of $3.7 to $3.8 billion with an operating income of $900 to $970 million. Earnings per fully diluted share are expected to be $9.25 to $9.75. Manufacturing start-up expenses are anticipated to be $50 to $60 million and $10 to $15 million factory ramp costs. Total capital spending is anticipated to be $1.0 to $1.1 billion and operating cash flow, $0.8 to $1.0 billion.

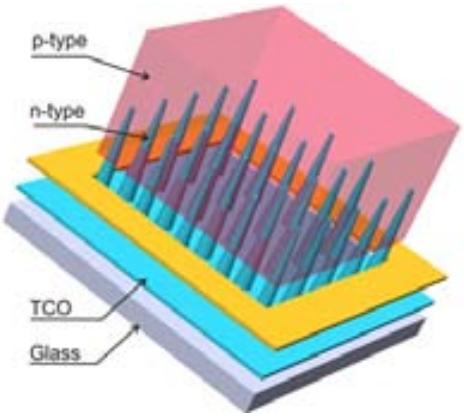
ORNL solar cell technology cranks up efficiency

The structure consists of n-type zinc oxide nanocones surrounded by a p-type polycrystalline CdTe semiconductor. The n-type nanoncones serve as the junction framework and the electron conductor while the p-type matrix is the primary photon absorber medium and hole conductor.

With the creation of a 3-D nanocone-based solar cell platform, a team led by Oak Ridge National Laboratory’s Jun Xu has boosted the light-to-power conversion efficiency of photovoltaics by nearly 80 percent.

The technology substantially overcomes the problem of poor transport of charges generated by solar photons. These charges, negative electrons and positive holes, typically become trapped by defects in bulk materials and their interfaces and degrade performance.

"To solve the entrapment problems that reduce solar cell efficiency, we created a nanocone-based solar cell, invented methods to synthesise these cells and demonstrated improved charge collection efficiency," said Xu, a member of ORNL's Chemical Sciences Division.



Nanocone-based solar cell consisting of n-type nanocones, p-type matrix, transparent conductive oxide (TCO) and glass substrate.

The new solar structure consists of n-type nanocones surrounded by a p-type semiconductor. The n-type nanoncones are made of zinc oxide and serve as the junction framework and the electron conductor. The p-type matrix is made of polycrystalline CdTe and serves as the primary photon absorber medium and hole conductor.

With this approach at the laboratory scale, Xu and colleagues were able to obtain a light-to-power conversion efficiency of 3.2% compared to 1.8 % efficiency of conventional planar structure of the same materials.

"We designed the three-dimensional structure to provide an intrinsic electric field distribution that promotes efficient charge transport and high efficiency in converting energy from sunlight into electricity," Xu said.

Key features of the solar material include its unique electric field distribution that achieves efficient charge transport; the synthesis of nanocones using inexpensive proprietary methods; and the minimisation of defects and voids in semiconductors. The latter provides enhanced electric and optical properties for conversion of solar photons to electricity.

Because of efficient charge transport, the new solar cell can tolerate defective materials and reduce cost in fabricating next-generation solar cells.

"The important concept behind our invention is that the nanocone shape generates a high electric field in the vicinity of the tip junction, effectively separating, injecting and collecting minority carriers, resulting in a higher efficiency than that of a conventional planar cell made with the same materials," Xu said.

Research that forms the foundation of this technology was accepted by this year's Institute of Electrical and Electronics Engineers photovoltaic specialist conference and will be published in the IEEE Proceedings. The papers are titled "*Efficient Charge Transport in Nanocone Tip-Film Solar Cells*" and "*Nanojunction solar cells based on polycrystalline CdTe films grown on ZnO nanocones*."

The research was supported by the Laboratory Directed Research and Development program and the Department of Energy's Office of Nonproliferation Research and Engineering.

Other contributors to this technology are Sang Hyun Lee, X-G Zhang, Chad Parish, Barton Smith, Yongning He, Chad Duty and Ho Nyung Lee.

Constellation Energy to acquire 30 MW solar installation

The First Solar CdTe panels will be installed by Belectric in Sacramento, California.

Constellation Energy has acquired a 30-megawatt DC (25-megawatt AC) solar generation project in Sacramento, California, from utility-grade photovoltaic power plant developer Belectric.

The system will be comprised of approximately 381,000 First Solar CdTe thin film photovoltaic panels, ground-mounted at multiple sites near the city of Sacramento. Constellation Energy will own and operate the system and sell the electricity generated from it to the Sacramento Municipal Utility District (SMUD) under ten, 20-year power purchase agreements. The project is anticipated to be commercially operational by the end of 2011.

The transaction was arranged by Smart Energy Capital, LLC, a finance and investment company located in White Plains, New York, focused exclusively on the North American solar photovoltaic industry.

"This utility-scale generation project is an attractive opportunity for Constellation Energy to grow its existing solar portfolio," said Andrew Good, senior vice president of corporate strategy and development for Constellation Energy. "We're excited to invest in this project, which will help provide a long-term source of clean and emissions-free electricity to more than half a million customers in SMUD's service territory."

"Belectric is proud to be working with Constellation on this project, among the first to be installed under SMUD's feed-in tariff program," said David Taggart, president and COO of Belectric, Inc. "For the past 18 months, the Belectric Team has worked closely with SMUD, Sacramento County and local land owners to develop this project, which clearly demonstrates the competitiveness of Belectric's integrated thin film PV system design. The installation of these power plants will create local jobs and generate clean power for the Sacramento region. Based on the great experience we have had with both Constellation and Smart Energy, we look forward to further collaboration."

David Slomka resigns from Opel Solar as International Director

The GaAs based solar cell manufacturer will fill the vacancy at its next Board meeting on 21 June 2011.

Opel Solar International has announced the resignation of David Slomka as a Director of the Company for personal reasons. Slomka, who resigned on April 30th, served on the Board since June 2007 and was also the Chairman of the Compensation Committee.

The Board intends to fill the vacancy thus created at the next scheduled Board Meeting. The Board remains committed to its goal of increasing long-term shareholder value. The Board continues to be confident in the Company's strategy for both its solar business that includes greater vertical integration, development of its brownfields initiative and its burgeoning solar systems rollout in North America and China and its Planar Optoelectronic Technology (POET) device development program.

The Company's next Annual General Meeting of Shareholders is scheduled for Tuesday June 21, 2011.

GT Solar hits the jackpot with $218.9 million order

The order for sapphire crystallisation furnaces from China based firm HTOT shows that the buoyant market for this technology is growing.

GT Solar International, a global provider of sapphire and silicon crystalline growth systems and materials for the solar, LED and other specialty markets, has received an order for its advanced sapphire crystallisation furnaces.

The order totals $218.9 million and is from China-based Guizhou Haotian Optoelectronics Technology (HTOT). The order marks HTOT's entrance into the fast-growing LED industry, and continues GT Solar's market momentum for its sapphire crystalline growth technology based on its advanced sapphire furnace. The order will be included in GT Solar's backlog for its current Q1 FY12, which ends on July 2, 2011.

GT Solar's Advanced Sapphire Furnace (Photo: Business Wire)

"Our entrance into the LED market offers a new strategic growth opportunity for our company and Guiyang City as well as the Guizhou region of China," said Hao Xu, chairman of the board of Guizhou Industrial Investment Group.

"Our new sapphire production facility will help to stimulate economic growth in the region and establish HTOT as a leading supplier of material to the LED industry. This project requires a technology partner that can deliver reliable, highly productive equipment as well as installation and support know-how to quickly get our new factory up and running. We selected GT Solar because of its leading technology, proven track record, and years of experience enabling cost-effective, high-volume manufacturing," concluded Xu.

"We are pleased that HTOT has selected our advanced sapphire crystallisation furnaces and look forward to a long and successful partnership over the coming years," said Tom Gutierrez, GT Solar's president and CEO. "We continue to see growing interest from companies looking to enter the fast-growing LED industry. Our sapphire crystal growth technology provides a proven path to producing high quality material, and our global installation and support resources enable our customers to quickly ramp to high volume, low-cost manufacturing."

GT Solar's advanced sapphire furnace technology is the result of over 40 years of continual process improvement and development at Crystal Systems, which was acquired by GT Solar in July of 2010. Crystal Systems is recognised as one of the leading providers of quality sapphire material for the LED and specialty optical and mechanical industries.

HTOT will be a vertically integrated manufacturer of a wide range of sapphire products including sapphire crystal, sapphire cores, sapphire wafers and other crystalline products for LEDs, RFICs, optoelectronics and other optical applications. Once fully operational, HTOT will be capable of producing very high-quality sapphire in volume production of various sizes and orientations of substrates and windows.

Q-Cells expands horizons in Japanese PV residential market

The firm is teaming up with Japanese installers and has formed an innovative sales network, QMC which offers integrated residential photovoltaic solutions to Japanese end customers.

Q-Cells SE, a leading CIGS solar developer and manufacturer says it is the first company of German origin to enter the Japanese residential market with integrated photovoltaic (PV) solutions.

In order to ensure a successful market entry, QCells has founded the Q-Cells Meister Club (QMC), which is an innovative sales network of selected local installers, offering residential PV solutions with Q-Cells solar modules. The QMC delivers Japanese residential end customers high quality solar systems kits for their roof-top installations from a single source.

"The QMC was initiated before the earthquake hit Japan", says Nedim Cen, CEO of Q-Cells SE. "Yet, we believe that solar energy will be an important resource and growing market for the Japanese energy supply. This is why Q-Cells strengthens its presence in Japan with local partners and PV solutions."

Since January 2010, Q-Cells has been running

an office in Tokyo, selling its solar cells, multi crystalline solar modules Q.PRO and Q.BASE and thin-film solar modules Q.SMART. With the official start of QMC in early March, Q-Cells moves into offering complete PV packages to residential end customers.

The residential market makes up for 90% of the overall photovoltaic market in Japan with a forecast volume of 1 GWp in 2011. In March, Q-Cells installed its first residential system of 9.87 KWp in Osaka, which can make up for an electricity supply of 10.594 kWh or a reduction of 3.300 kg CO2 emissions per year.

The QMC already counts 30 members, offering entire solar systems kits, including solar modules, inverters, mounting systems, monitoring systems, cables and other components. The members of the QMC benefit from installation and sales trainings provided by Q-Cells with the overall aim, to offer highly secure and best quality system kits and services to Japanese customers.

“Our German Engineering solar modules match the quality of the components of our selected local partners and meet the high quality requirements of Japanese customers”, said Steffen Studeny, Managing Director of Q-Cells Japan. Q-Cells will put further effort in increasing the number of members of the QMC throughout 2011.

The main advantages of Q-Cells solar modules are their outstanding low-light behaviour, their flex-resistant frame as well as their resistance to high snow and wind loads up to 5.400 Pascal. This makes the systems also suitable for snowy areas and low irradiation regions in Japan.

Emcore raises $9.6 million in private share transaction

The capital raised from this transaction will allow Emcore to aggressively execute its business plan.

Emcore Corporation has entered into a Stock Purchase Agreement to sell an aggregate of 4,407,603 shares of its common stock to Shanghai Di Feng Investment Co. Ltd. in a private placement.

The transaction, which represents 4.9% of the total number of shares outstanding, is expected to raise a total of approximately $9.6 million. The purchase price per share for the shares sold in such private placement will be $2.19, representing a discount of approximately 5.3% based on a 15-day volume-weighted average price as of April 25, 2011.

Emcore did not issue any warrants or pay any broker fees or commissions in connection with the transaction. The closing of the private placement is subject to the completion of customary closing conditions for transactions of this type, including approval of applicable Chinese government agencies.

The shares of common stock sold in this private placement have not been registered under the Securities Act of 1933, as amended (the “Securities Act”), or applicable state securities laws, and accordingly may not be offered or sold in the United States except pursuant to an effective registration statement or an applicable exemption from the registration requirements of the Securities Act and such applicable state securities laws.

The Company has agreed to register the shares of common stock issued in this private placement pursuant to an S-1 registration statement to be filed by the Company with the Securities and Exchange Commission.

“This Common Stock Private Placement, combined with our line of credit with Wells Fargo and our improved operating performance, has substantially improved the Company’s liquidity position. The capital raised from this transaction will allow the Company to aggressively execute its business plan,” said Hong Q. Hou, President and CEO of Emcore.

Net proceeds from this sale of the shares will be primarily used for capital expenditures and increases in working capital necessary to support the growth in certain sectors of our business.

Power Electronics

Anadigics' InGaP PA powers Samsung Droid Charge smartphone

The firm's AWC6323 indium gallium phosphide dual-band power amplifiers enable the Droid Charge, Samsung's first 4G LTE smartphone.

Anadigics, a provider of RF products has announced that it is shipping production volumes of its AWC6323 dual-band High-Efficiency-at-Lower-Power (HELP3E) power amplifiers (PAs) to Samsung Electronics for the Droid Charge smartphone.

The feature packed Droid Charge includes a 4.3 inch AMOLED display, rear-facing 8 megapixel camera, front-facing 1.3 megapixel camera and Android 2.2 operating system.

"The Samsung Droid Charge raises the bar for 4G Android smartphones, by delivering an exceptional multimedia experience," said Michael Canonico, senior vice president of worldwide sales at Anadigics.

"With a stunning 4.3 inch Super AMOLED Plus display, sharp 8 megapixel camera, and HTML5 Web browser, this device provides an unparalleled mobile lifestyle experience. Anadigics has forged a strong relationship with Samsung Electronics by providing power amplifiers with industry-leading efficiency, linearity, and integration. We look forward to supporting Samsung through each successive generation of mobile connectivity," he continued.

Anadigics' AWC6323 PA is part of the company's HELP3E product family. These PAs use the Anadigics' exclusive InGaP-Plus technology to achieve optimal efficiency across low-range and mid-range output power levels and provide low quiescent currents. The compact 3 mm by 5 mm package footprint can reduce printed circuit board space by 25% compared with current generation single-band solutions.

The AWC6323 has three mode states to achieve high power-added efficiencies at low-range and mid-range output power levels. With a low quiescent current of 4 mA, Anadigics says the AWC6323 features the best-in-class linearity at maximum output power.

The highly integrated module has independent PCS and cell-band PAs in a single package, internal voltage regulation and integrated RF coupler.

RFMD branches out with P2P radio chipsets

The highly integrated chipsets, which employ the firm's 0.15µm gallium arsenide technology, optimise each front end component for next-generation high-capacity 3G/4G radios using complex modulation schemes.

RF Micro Devices, a designer and manufacturer of high-performance radio frequency components and compound semiconductor technologies, has expanded its product portfolio to include several point-to-point (P2P) radio chipsets targeting the growing cellular backhaul market.

The highly integrated radio chipsets combine multiple RF/microwave radio front end components and expand RFMD's product portfolio to encompass all critical RF and IF functions in the P2P radio transceiver.

The P2P radio market is growing rapidly as the proliferation of smartphones and the increasing

demand for mobile data are forcing cellular operators to expand capacity in cellular backhaul networks. RFMD's highly integrated P2P radio chipsets help to satisfy operators' capacity expansion requirements by optimising each front end component for next-generation high-capacity 3G/4G radios using complex modulation schemes.

The front end components deliver industry-leading narrowband performance, enabling the realization of state-of-the-art radio performance. Additionally, the broadband nature of the front end components enables radio designers to maximize design flexibility and simplify inventory bill-of-material control.

Jeff Shealy, general manager of RFMD's Defence and Power business unit, said, "RFMD is rapidly expanding our product portfolio in support of the Point-to-Point microwave radio market. With the launch of these highly integrated radio chipsets, RFMD enables our customers to develop high-reliability, next-generation Point-to-Point radio solutions while reducing design time requirements and lowering overall bill-of-material costs."

Each new RFMD P2P radio chipset is available in a surface mount QFN package. The integrated up-converters include a LO amplifier (with integrated x2 multiplier where applicable), IQ mixer, VVA and driver amplifier in a single package. The integrated down-converters utilise 0.15µm GaAs technology to deliver industry-leading IIP3 and noise figure performance. Finally, the integrated MMIC VCOs exhibit industry-leading phase noise performance coupled with flat output power over the frequency tuning bandwidth. To complement the new radio chipsets, RFMD also offers a comprehensive portfolio of converters and gain blocks aimed at the IF section of the radio.

Samples and production quantities are available now through RFMD's online store at http://www.rfmd.com/products or through local RFMD sales channels.

RFMD raises the bar with qualified 65 V GaN1 process

The 65V gallium nitride process succeeds the firm's GaN1 process for 48V and enables miniature, 0.5kW power devices with high operating efficiency for L- and S-Band military and civilian radar applications.

RF Micro Devices, a designer and manufacturer of high-performance radio frequency components and compound semiconductor technologies has qualified its GaN1 power semiconductor process technology for 65V operation.

The high reliability power semiconductor process technology supports RFMD's GaN-based power semiconductor product designs and is also available to foundry customers through RFMD's Foundry Services business unit.

Previously, RFMD's GaN1 power semiconductor process technology had been qualified for 48V operation. The increase in operating voltage from 48V to 65V enables miniature, 0.5kW power devices with high operating efficiency for L- and S-Band military and civilian radar applications.

Bob Van Buskirk, president of RFMD's Multi-Market Products Group (MPG), said, "The qualification of our 65V GaN1 power process technology enables RFMD to target multiple higher voltage market opportunities across MPG's diversified markets while helping our foundry customers to design smaller periphery die for high power applications. RFMD continues to optimize our game-changing GaN process technology for both foundry customers and proprietary RFMD product designs, with particular emphasis on higher peak efficiency, lower power consumption and higher linearity."

RFMD's 48V GaN1 process technology is an established performance leader in the high power semiconductor industry, and RFMD's 65V GaN1 process technology moves the performance bar even higher. RFMD's 65V GaN1 process technology demonstrates a Mean-Time-to-Failure (MTTF) of 43 million hours with a channel temperature of 2000C at power densities of 10 W, a significant industry performance benchmark. The high reliability power semiconductor process is ideally suited for higher voltage operations in

next generation military, radar, and public/defence mobile radio applications.

Nitronex announces smallest gallium nitride broadband 5W PA

The firm says its NPA1003 GaN-on-Silicon MMIC enables the world's smallest 5W 20-1500 MHz PA solution.

Nitronex, a designer and manufacturer of GaN based RF solutions for high performance applications in the defence, communications, cable TV, and industrial & scientific markets, says it has developed the industry's smallest broadband 5W PA solution.

The NPA1003 is a GaN PA MMIC and features a 4mm x 4mm thermally-enhanced QFN package with RF input and output matched to 50 Ω. The highly integrated NPA1003 GaN MMIC only requires an external resistor and inductor to provide bias. With output power over 5W from 20 to 1500MHz and typical efficiency of over 50%, the overall solution size is less than 0.25 square inches.

"The new NPA1003 has created a pull in the market that we fully anticipated it would," commented Gary Blackington, VP of Sales & Marketing at Nitronex. "This new device has filled a market void with the right power, gain, frequency response, compact size, and ease of use all at the right price point. We have already achieved several design-ins at top tier accounts."

"Nitronex's MMIC process was established under a joint development agreement with a large military contractor, resulting in a fully-qualified, production-ready process in July 2009. We have worked with multiple strategically selected customers since 2009 to develop and productize custom MMICs and have shipped more than 50,000 production devices to customers," said Ray Crampton, VP of Engineering at Nitronex.

"Nitronex's proprietary GaN-on-Silicon process has a significant advantage over our competitors using SiC substrates. Our superior starting substrate quality and cost structure allow us to develop high performance, large area MMICs at competitive prices which gives us the freedom to solve customer problems in ways our competitors can not."

Nitronex's qualified MMIC process is based on a 28V, 0.5µm gate length GaN HEMT and features high voltage capacitors, air bridges, through-wafer vias, nichrome and epi resistors, and two levels of metal interconnect. Furthermore, a 3.5µm plated gold top metallization results in low loss inductors, and a high resistivity silicon substrate is used which supports low loss transmission lines to over 20 GHz.

Toshiba introduces GaN HEMT PA for extended Ku-Band

The high power, high gain devices include Toshiba's gallium nitride amplifier for satcom applications to support VSAT.

This week at the 2011 IEEE MTT-S International Microwave Symposium, Toshiba America Electronic Components (TAEC) and its parent company, Toshiba Corporation revealed the TGI1314-25L, GaN HEMT. This is the latest addition to its power amplifier (PA) product family.

The TGI1314-25L, Toshiba's new GaN HEMT for Ku-band satellite communication application, operates in the 13.75GHz to 14.5GHz range with output power of 25W. The device features output power of 44.0dBm (typ.) with 39dBm input power, linear gain of 8.0dB (typ.) and drain current of 2.5

Amps (typ.) and an efficiency of 29 %. The new product comes in a 77-AA07A package and is targeted to Satcom applications including very small aperture terminals (VSAT).

"The expansion of Toshiba's GaN power amplifier family brings higher gain and very efficient features to microwave designers, which reduce heat sink requirements and enable smaller terminals and converters with a full GaN HEMT line-up that includes drivers," said Homayoun Ghani, business development manager, Microwave, Logic, and Small Signal Devices, TAEC Discrete Business Unit.

"Since Toshiba released its 50W Ku-band product a few years ago, many customers have requested a full line-up of GaN HEMTs, which will simplify the power supply design of Solid-State Power Amplifiers (SSPA) and block up converters (BUC). In addition, small output power applications, such as VSAT, can benefit from GaN HEMTs, making fan-less or very small equipment possible," he concluded.

In 2009, Toshiba announced the addition of the Extended Ku-band TGI1314-50L to its GaN power amplifier family, which operates in the 13.75GHz to 14.5GHz range for Satcom to support SSPA applications. The TGI1314-50L is now in mass production.

Samples of the TGI1314-25L will be available in the third quarter 2011, with mass production scheduled for the fourth quarter 2011.

Fujitsu develops world's first GaN HEMT T/R C-Ku band module

The firm's latest gallium nitride creation enables consolidation of communications equipment into one compact module.

Fujitsu Laboratories has successfully developed what it claims is the world's first transmitter/receiver (T/R) module using GaN HEMT technology.

It features an output of 10 W and operates in a wide bandwidth range of C-band, X-band, and Ku-band (C-Ku band) radio frequencies over 6-18 GHz.

By combining the world's best performing GaN power amplifier (PA) developed last year with the newly developed GaN low-noise amplifier (LNA), the researchers achieved a compact T/R module that generates a high-output.

This technology makes possible the integration of multiple types of communications equipment—each currently operated at a different frequency range—into a single module, making for the development of smaller, lighter radar equipment and wireless communication systems.

GaN is used as a blue-LED in traffic signal lights, and compared to the conventional semiconductor materials of silicon and GaAs, it features a high saturation carrier velocity and relative resistance to the breakdown caused by voltage. Given these characteristics, GaN HEMTs show promise for high-output and exceptionally efficient operations.

In line with the advance of a network-based society, radio wave demand in a variety of wireless systems is expected to increase even further. For example, aircraft radar typically switches between the C-band, which can detect distant objects and works well in rain, and the X- and Ku-bands which are able to measure physical objects with high-precision.

Currently, this demand for multiple frequency ranges requires different communications equipment each suited to their respective frequency band. However, a single T/R module capable of covering the entire C-Ku band range would meet a variety of needs, allowing systems to become more compact.

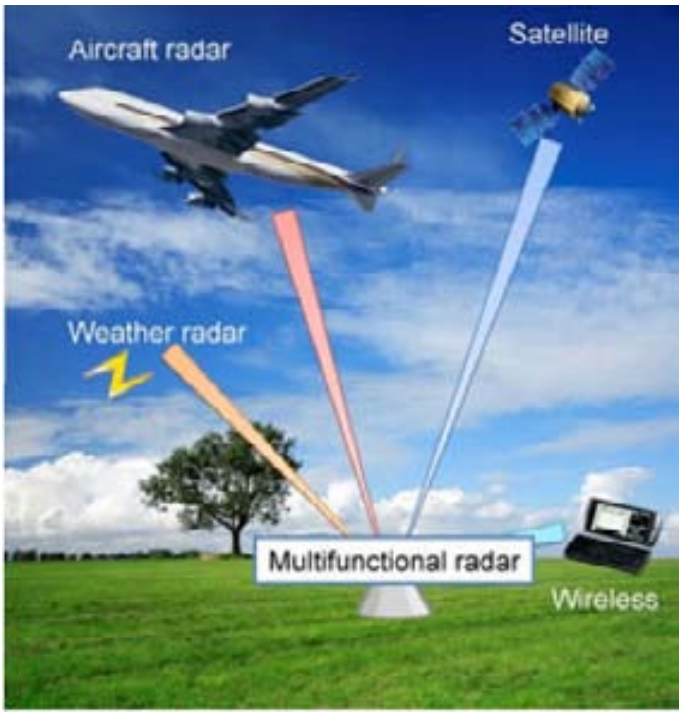


Figure 1: Usage scenarios for multifunctional radars operating across C-Ku bands

T/R modules are essential to operate multifunctional radar over a broad spectrum. Users therefore demand that T/R modules possess wideband features capable of operating across multiple frequency ranges, and high output performance so as to cover a wide area.

To develop a T/R module with 10 W-class high output power over a wide broadband range, such as the C-Ku band, not only is a wideband PA and LNA required, but it is also critical to improve the T/R module's heat dissipation characteristics as heat generation intensifies in tandem with higher output levels.

In addition, it is also necessary to reduce signal losses in the input/output terminal to maintain frequencies up to 18 GHz. This is because at higher frequency ranges input/output signal losses increase in the terminal portion of the T/R module.

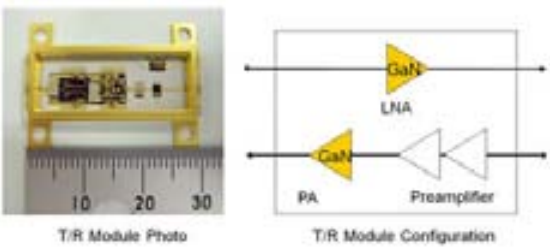


Figure 2: Photo and structure of GaN wide broadband T/R module

Key features of the new technology include an embedded heat sink structure that efficiently dissipates the heat generated at high output levels. The heat sink is built into the T/R module's multilayer alumina ceramic substrate. Compared to previous designs, heat dissipation improved by a factor of five times, enabling high output levels of 10 W.

An ultra-broadband terminal structure reduces the input/output terminal signal loss that occurs at higher frequencies. High frequency signals passing through the module can be transmitted at up to 40 GHz, three times the frequency levels of previous designs.

In addition to the GaN HEMT PA, the researchers have now developed a new LNA that uses a GaN HEMT. The compact 2.7 × 1.2 mm LNA achieves a gain of 16 dB across 3-20 GHz, and noise figures of 2.3-3.7 dB, representing one of the world's best performance levels.

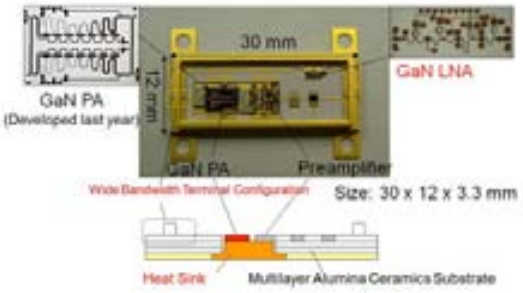


Figure 3: Photo and cross-sectional diagram of GaN wide broadband T/R module

The T/R module measures only 12 × 30 mm and paves the way for further system integration in broadband communications and radar systems that utilise various frequencies, meaning more compact and lighter equipment.

Cree unveils gallium nitride HEMTs for S-Band radar

The firm will be showcasing its GaN transistors and MMICs which it says deliver industry leading power and efficiency for applications at 2011 IEEE IMS.

The firm says these products offer power and efficiency achieving typical power-added efficiencies (PAEs) of 60%. This results in a reduction in power consumption of up to 20% over existing solutions.

"Cree is pleased to offer these industry leading S-Band GaN HEMT devices for a variety of civilian and military applications, such as air traffic control, weather radar, and homeland defence. Thermal management is a key consideration for radar systems and Cree GaN HEMT products are enabling ultra-high efficiency solutions, which result in lower dissipated power, simplified power distribution, smaller device footprints and lighter weight systems," said Jim Milligan, Cree, director of RF.

The S-Band transistors, CGH31240F and CGH35240F, are fully internally matched to 50 Ω and provide saturated RF output power of 240 watts over 2.7 to 3.1 GHz and 3.1 to 3.5 GHz, respectively, with power gains of greater than 11dB in small package footprints (0.9" x 0.68") with typical power added efficiencies of 60%.

The devices also demonstrate impressive pulse droop of less than 0.2dB at specified operating conditions, owing to the combination of high efficiency and the superior thermal properties of GaN on SiC when compared to other technologies such as GaAs and Si.

The CMPA2735075F is a two-stage GaN HEMT high power MMIC amplifier providing a saturated RF output power of 75 watts over 2.7 to 3.5 GHz with a power gain of 20dB in a small package footprint (0.5" x 0.5"). This, Cree says is the first and only S-Band GaN HEMT MMIC HPA on the market which offers 60% typical PAE with RF pulse widths of 300 microseconds and a 20% duty cycle.

EPC reveals second generation 200 V eGaN power transistor

The EPC2010 delivers high frequency switching with enhanced performance in a lead-free, RoHS compliant package.

Efficient Power Conversion Corporation (EPC) is introducing the EPC2010 as the newest member of its second-generation enhanced performance eGaN FET family. The EPC2010 is environmentally friendly, being both lead-free and RoHS-compliant.

The EPC2010 FET is a 200 VDS device with a maximum RDS(ON) of 25 milliohms with 5 V applied to the gate. This eGaN FET provides significant performance advantages over the first-generation EPC1010 eGaN device. The EPC2010 has an increased pulsed current rating of 60 A (compared with 40 A for the EPC1010), improved RDS(ON) at very low gate voltages, and lower capacitance.

Compared to a state-of-the-art silicon power MOSFET with similar on-resistance, the EPC2010 is 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.

"EPC was the first company to make gallium nitride power FETs commercially available. With our second-generation of products, we are now raising the bar for the performance of gallium nitride FETs. In addition, our new generation of eGaN products are the 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 EPC2010 is priced at $5.06 and is immediately available through Digi-Key Corporation.

Kyma enhances product portfolio with AlGaN templates

Initially developed as part of an advanced mid UV LED technology research project, the firm is hoping its AlGaN Templates will also highly impact high power RF communications and high power switching electronics.

Kyma Technologies, a supplier of crystalline nitride semiconductor materials, has added AlGaN templates to its product portfolio.

Kyma developed this product in collaboration with a partner as part of an advanced mid UV LED technology research project, which is ongoing. However, AlGaN Templates have great potential to impact other applications too, including high power RF communications and high power switching electronics.

Kyma's initial AlGaN Template product offering consists of a 5-micron thick epi-ready Al0.9Ga0.1N buffer layers grown on top of a 2" diameter sapphire substrate. Additional compositions and thicknesses will be offered in the future.

"Transistors based on AlN/AlGaN heterostructures have already been demonstrated which outperform their GaN counterparts in high temperature operation that is required for uncooled automotive applications," stated Ed Preble, Kyma's Chief Technology Officer. "Our AlGaN templates should support a further boost in transistor performance since they support lower defect density active regions when compared to typical MOCVD or MBE buffer layers grown on SiC or sapphire substrates."

Keith Evans, Kyma's president & CEO, added, "Our engineers have accomplished a lot very quickly and have already demonstrated high Al-content crack-free AlGaN layers over 10 microns thick. And we aren't stopping there. Our goal is to get up to 100 microns within the next six months and to demonstrate free-standing AlGaN in 2012."

In the future, the company plans to expand their AlGaN Template product offering to other combinations of Al-content, AlGaN thickness, substrate diameter (e.g., 3" and 4"), and substrate composition (e.g., silicon and SiC).

Skyworks to acquire power management guru Advanced Analogic Tech

The firm is expanding its portfolio with Advanced Analogic's cutting edge analogue products and accelerates Skyworks' entry into adjacent vertical markets.

Skyworks Solutions, an innovator of high reliability analogue and mixed signal semiconductors enabling a broad range of end markets, has signed a definitive agreement to purchase Advanced Analogic Technologies Incorporated.

Advanced Analogic is a semiconductor company focused on enabling energy-efficient devices for consumer electronics, computing and communications markets. This acquisition expands Skyworks' portfolio with highly complementary analogue semiconductor products including battery chargers, DC/DC converters, voltage regulators and LED drivers. 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.

"Skyworks' acquisition of Advanced Analogic Technologies will enable us to further capitalise on our strong smart phone, tablet, set-top box and infrastructure positions with an expanded and differentiated product portfolio while accelerating our entry into new vertical markets," said David J. Aldrich, president and chief executive officer of Skyworks.

"At a higher level, analogue power management semiconductors represent a strategic growth market for Skyworks as our customers increasingly demand both ubiquitous wireless connectivity and power optimization across seemingly every kind of electronic platform. With Advanced Analogic Technologies, Skyworks will be well positioned to address these massive twin market opportunities leveraging our broad customer relationships, innovative product portfolios and increasing operational scale," he continued.

"The Advanced Analogic Technologies team is excited to be joining forces with Skyworks given their leadership market positions coupled with scale advantages," said Richard K. Williams, president, chief executive officer and chief technical officer of Advanced Analogic Technologies. "Both companies share a common vision of the enormity and growth potential of the analogue semiconductor market. Together, we can better address our customers' demand for highly integrated power management solutions across a broader range of markets and applications. We believe this transaction will benefit our customers, employees and, most importantly, our shareholders."

Skyworks has entered into a definitive agreement

to acquire Advanced Analogic Technologies for a nominal price of $6.13 per share, representing a 52 % premium to Advanced Analogic Technologies' 30-day trailing average. The $6.13 nominal share price consists of $3.68 per share in cash and .08725 of a share of Skyworks common stock for each outstanding share of Advanced Analogic Technologies common stock. The amount of stock is based upon the average closing price of Skyworks common stock over the 30-trading days prior to May 26, 2011.

At that average price, the stock component of the price has a nominal value of $2.45. The value of the stock component will be tested again at closing, based on the average closing price of Skyworks common stock during the five trading days prior to the closing. If the average pre-closing value is lower than $2.45, the amount of cash per share will be increased by the difference, and if the average pre-closing value is higher than $2.45, the amount of cash per share will be reduced by the difference, to maintain a calculated nominal value of $6.13 per Advanced Analogic Technologies share in either case.

The transaction is subject to approval by Advanced Analogic Technologies' shareholders. The transaction is also subject to other customary closing conditions, including the receipt of applicable regulatory approvals. Excluding any non-recurring acquisition related charges and amortization of acquired intangibles, Skyworks expects the acquisition to be immediately accretive to non-GAAP earnings post-closing and will finalise estimates of the transaction's financial impact, as well as the accounting for the transaction, upon deal close.

SPTS and Australia's Griffith University to develop SiC-on-silicon technology

The three-year collaboration aims to commercialise SiC-on-silicon as a viable semiconductor material for LED, power and MEMS devices.

SPP Process Technology Systems (SPTS), a manufacturer of plasma etch and deposition, and thermal processing equipment for the semiconductor and related industries, and Griffith University in Australia have signed a joint development agreement (JDA) targeting the commercialisation of SiC-on-silicon technology. SiC-on-silicon substrates have a wide variety of applications for the rapidly growing LED, micro-electro-mechanical systems (MEMS) and power markets.

SiC is an important substrate for growing the GaN films used to manufacture LEDs. The increased radiation hardness, mechanical strength and thermal properties of SiC also make it a suitable replacement for silicon in MEMS devices for harsh environments. In addition, SiC is used to create semiconductor devices for high power, high frequency applications where the electrical properties of SiC are significantly superior to common silicon.

Technology created by the research team at Queensland Microtechnology Facility (QMF) at the Griffith University's Queensland Micro- and Nanotechnology Centre (QMNC), has demonstrated the ability to grow crystalline SiC directly onto low cost silicon wafers. Through the JDA, SPTS will develop the thermal process and equipment expertise necessary to commercialise the technology.

Three key technologies required for SiC-on-silicon devices are SiC deposition, etch and oxidation. The QMNC has commercially orientated research into all these areas. "The JDA enables transfer of this SiC deposition process technology to device research and development activities, and provides a bridge to volume production through batch processing for up to 300mm diameter Si wafers. SPTS's strength in thermal processing makes them an attractive partner," said Alan Iacopi, Operations Director of QMNC. "This JDA is an important step in the commercialization of our SiC research efforts, especially with a partner with the global reach of SPTS" agreed Sima Dimitrijev, Project Leader and Deputy Director of QMNC.

"As a market leader in providing capital equipment to the MEMS, LED and Power markets, SPTS is constantly looking at cutting-edge development opportunities. We are very pleased to have this opportunity to work with leading researchers at Griffith University to commercialise their SiC-on-silicon technology," said William Johnson,

president and CEO of SPTS. “Providing production knowledge to this collaboration and helping to develop and deliver new materials processing technology is an important business strategy. This JDA further enhances the portfolio of offerings to our served markets and will help to broaden our customer base.”

Mitsubishi Electric’s GaN HEMT raises the bar for PAE

With a record PAE rating of 67%, the amplifier is designed for C-band satellites and wireless communication systems.

Mitsubishi Electric has developed a GaN HEMT power amplifier for C-band satellites featuring what it claims is the world’s highest power-added efficiency (PAE) rating, 67%.

This is an increase of more than seven points compared to conventional amplifiers. The amplifier is expected to lead to smaller and lighter transmitter devices to help microwave communication satellites save power.

The device has power-saving features to help make satellites more efficient and reliable.

The new amplifier’s record PAE of 67% is enabled by the world’s first harmonic tuning circuit placed in front of each GaN HEMT cell on the substrate. The PAE was improved by second harmonic impedance of GaN HEMT with highly accurate input control. The harmonic tuning circuit comprises a MIM capacitor and a spiral inductor.

The module has a high output power of 107W (50.3dBm) and is 17.4 x 24.0 x 4.3 mm weighing just 7.1g. It is an internally impedance- matched GaN HEMT amplifier.

As more satellites complete their operational lifespan, the demand is increasing for new microwave communication satellites with smaller, lighter and more efficient satellite transponders. Conventional transponder devices use travelling wave tube amplifiers (TWTAs) because solid-state power amplifiers with GaAs HEMTs, which lack sufficient output power and efficiency, require an additional amplifier to gain high output power.

More efficient GaN HEMT amplifiers with high output power, high-field electron velocity and high-breakdown fields are expected to replace TWTAs in communication satellites.

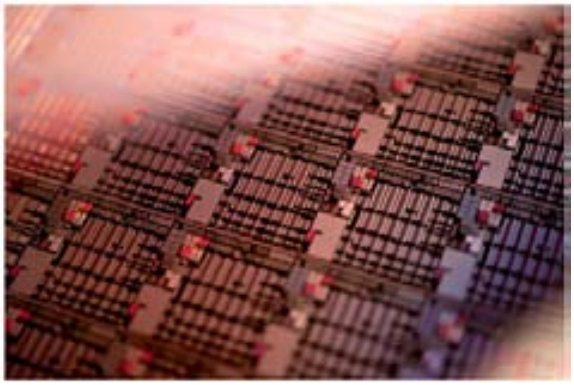
Going forward, Mitsubishi Electric intends to further enhance the efficiency and power performance of GaN HEMT amplifiers for satellites and wireless communication systems.

Imec processes first power devices on 200mm GaN-on-Si

The wafers were made using an advanced MOCVD system from Applied Materials and the devices were processed using standard CMOS tools.

Imec and its partners in the GaN industrial affiliation program (IIAP) have produced device-quality wafers with GaN/AlGaN layers on 200mm silicon wafers.

With these wafers, functional GaN MISHEMTs were processed using standard CMOS tools. The used processes are compatible with the strict contamination rules in a standard CMOS processing line (e.g. no use of gold). These first GaN devices on 200mm wafers are an important milestone on the path to cost-effective production of power devices in high-productivity 200mm fabs.



GaN is a promising material for next-generation power devices with a performance beyond what is possible with silicon. Imec has recently succeeded in producing 200mm GaN-on-Si wafers with crack-free surfaces and a bow of less than 50µm.

The wafers were made using an advanced MOCVD system from Applied Materials. The ability to use

200mm wafers is an important milestone, because it brings processing in reach of regular high-productivity 200mm fabs, allowing for an important cost reduction compared to processing smaller wafers on dedicated processing lines.

A second prerequisite for cost-effective processing, next to the wafer size, is that power devices can be fabricated with processes that are compatible with standard CMOS processes and tools. Imec proved this by processing its GaN-on-Si wafers using standard CMOS tools, yielding functional GaN MISHEMTs (metal-insulator-semiconductor HEMT).

All equipment was verified for its capability to handle the wafers, and required only minimal adjustments in software and hardware. Conventionally, gold is used for ohmic contacts and gate structures in power devices, but it makes GaN processing incompatible with conventional CMOS processing.

To overcome this, imec based the ohmic contact formation on an Au-free metallization system, and modified the Schottky gate to a gate dielectric based gold-free metal-insulator-semiconductor (MIS) structure. This introduction of the MISHEMT structure had the added advantage of reducing the high leakage current of conventional HEMTs.

Nitronex ships 500,000th GaN RF device

The company says that expanding markets and customers, alongside an already robust U.S.-based supply chain, sets the stage for continued rapid growth.

Nitronex, a designer and manufacturer of GaN based RF solutions for high performance applications in the defence, communications, cable TV, and industrial & scientific markets, has shipped more than 500,000 production devices since introducing its first production-qualified products in 2006.

Volume production began in 2009, and shipments predominantly consisted of 10 different products to five customers with a roughly even split between domestic and international sales.

"Shipping more than 500,000 devices is a testament to the early successes we've had in military communications, jammers, and cable TV infrastructure. We provide our customers with complete RF solutions including final, driver, and pre-driver discrete and MMIC amplifiers, product models, reliability data, and applications support," commented Charlie Shalvoy, President and CEO of Nitronex.

"We have also established a robust supply chain with U.S. manufacturing partners based on our proprietary GaN-on-Silicon technology. We believe this is more scalable than competing technologies that are based on exotic substrates. We look forward to continued growth by expanding into emerging GaN markets such as RADAR, and eventually commercial wireless infrastructure," he concluded.

Nitronex says its patented SIGANTIC GaN-on-Si process is the only production-qualified GaN process using an industry standard silicon substrate. This ensures a robust supply chain, which, combined with innovative new products, has positioned the company well for the significant growth expected in GaN markets in upcoming years.

II-VI declares two-for-one common stock split

This financial measure is intended to further improve the firm's liquidity and make its shares more accessible to institutional and individual shareholders.

II-VI Incorporated has announced that its Board of Directors has authorised a two-for-one stock split of the Company's Common Stock in the form of a 100% common stock dividend.

Shareholders of record as of the close of business on June 3, 2011 will receive one additional share of II-VI common stock for each share then owned. II-VI expects that its transfer agent, American Stock Transfer and Trust Company, will distribute the additional shares on or about June 24, 2011. There are currently approximately 31.3 million shares of II-VI common stock outstanding. Upon completion of the stock split, there will be approximately 62.6

million common shares outstanding.

Francis J. Kramer, president and chief executive officer of II-VI Incorporated, stated, "Today's stock split reflects our continued commitment to building value for our shareholders and demonstrates the confidence of our Board of Directors and management in both the fundamentals and growth potential of our business. In addition, the split is intended to further improve our liquidity and to make our shares more accessible to institutional and individual shareholders."

II-VI Incorporated is a vertically-integrated manufacturing company that uses crystal growth technology to manufacture and markets products for diversified markets including industrial manufacturing, military and aerospace, high-power electronics and telecommunications, and thermoelectronics applications.

Headquartered in Saxonburg, Pennsylvania, with manufacturing, sales, and distribution facilities worldwide, the company produces numerous crystalline compounds for infrared laser optics, SiC for high-power electronic and microwave applications, and bismuth telluride for thermoelectric coolers.

Transphorm only company to offer fully GaN solution

The company's 600 V transistor using its patented EZ-GaN technology is ultra-efficient, compact and easy-to-embed, and cuts switching losses by up to 95%.

Transphorm has unveiled its EZ-GaN transistor, the latest in the company's line of breakthrough products designed to eliminate the pervasive power waste that occurs during power conversion in everyday electrical systems and devices.

The company showcased the module at PCIM Europe 2011 Conference.

At a time when energy and environmental constraints call for dramatic improvements in energy efficiency, Transphormsays it is the first company to provide a viable solution to the power conversion problem.

Transphorm's GaN products are designed to replace conventional silicon-based power conversion technology, which can no longer provide efficiency gains without compromising system performance. Transphorm is redefining electric power conversion to help customers optimise their use of existing electrical generation.

Transphorm's 600 V transistor replaces silicon-based super junction transistors and IGBT devices in switch mode power conversion circuits, such as bridge converters and inverters, in order to reduce switching losses by up to 95 percent. The release of the transistor closely follows the EZ-GaN diode launched in March. This, Transphorm says, makes it the world's only company offering customers a Total GaN solution.

"This is the first 600 volt GaN HEMT device to survive accelerated life testing per JEDEC industry standards, which Transphorm has demonstrated in engineering tests," said Umesh Mishra, CEO of Transphorm. "Our transistor has proved that it is possible to switch extremely fast without increasing electromagnetic interference (EMI), a feat never before achieved and most believed to be infeasible."

Transphorm has redefined power conversion by developing and supplying efficient, compact GaN solutions for electrical energy conversion. The transistor is the latest product that offers customers new opportunities to reduce the size of systems while improving and maintaining efficiency, something that is no longer possible with Silicon-based conversion devices. For example, a unique aspect of the transistor is its improved packaging, which reduces ringing that results in equal or lower EMI.

"Our competitors are using Silicon devices, which have up to 25 times as much switching losses compared to our transistor," said Primit Parikh, President of Transphorm. "Transphorm customers are already using the transistor in products such as power suppliers, PV inverters and motor control systems."

By using a proprietary EZ-GaN transistor and diode, Transphorm can reduce power system size, increase energy density while reducing overall system cost. The EZ-GaN transistor is the latest product aimed to achieve new levels of product

performance in semiconductor devices operating at 600 volts or above.

Transphorm designs and supplies application-specific modules for a variety of customers, and plans on launching new products on a quarterly basis. A vertically integrated company, Transphorm offers high performance products at competitive cost and rapid time to market.

Transphorm acknowledges and thanks the Office of Naval Research for the initial and sustained funding of all aspects of the GaN technology, including materials, RF transistors and power transistors.

Transphorm also gratefully acknowledges the funding from DARPA and the support of ARPA-E in the development of advanced high frequency, compact and efficient GaN-based inverters that will revolutionise motor drives in the future, while helping us to provide our customers with near-term solutions.

EPC eGaN FETs win ACE award for "Energy Efficiency Technology"

The firm has been recognised for its enhancement-mode FETs and has been awarded the prestigious EE Times award for demonstrating leadership and innovation.

Efficient Power Conversion Corporation's (EPC) family of enhancement-mode GaN on silicon (eGaN) power FETs has won the Energy Technology Award issued as part of the prestigious EE Times Annual Creativity in Electronics (ACE) Awards. These awards celebrate the creators of technology who demonstrate leadership and innovation in the global industry and shape the world we which we live.

"We are very proud to have won the ACE Award. This award substantiates that EPC's enhancement-mode GaN power transistors represent a major breakthrough in power conversion technology. We believe that performance from silicon-based MOSFETs has reached the end of the road and that eGaN technology will lead the way for continued increases in performance in power management." said Alex Lidow, EPC's co-founder and Chief Executive Officer.

In its seventh year, the EE Times ACE Awards is a leading electronics industry recognition award selected by a panel of distinguished industry technology leaders. The awards were announced on May 3rd at an event honouring the people and companies behind the technologies that are changing the way we work, live and play.

The Energy Technology Award is a new category this year recognising those companies that have made the most significant contribution through the introduction of new concepts and products that help conserve energy or create new energy sources. EPC eGaN FETs have lower losses and higher switching frequency capabilities than power MOSFETs or IGBTs. These advantages can be applied in power conversion circuits to significantly reduce the consumption of electricity and enable greater penetration of alternative energy generation.

Spanning a range of 40 Volts to 200 Volts, and 4 milliohms to 100 milliohms, eGaN FETs demonstrate significant performance advantages over state-of-the-art silicon-based power MOSFETs. EPC's technology produces devices that are smaller than similar resistance silicon devices and have many times superior switching performance.

Applications that benefit from this eGaN performance are DC-DC power supplies, point-of-load converters, class D audio amplifiers, notebook and netbook computers, solar microinverters, Power over Ethernet (PoE), LED drive circuits, telecom base stations, and cell phones, to name just a few.

Products based on eGaN technology are available today and are priced between $1.12 and $5.00 in 1k quantities.

Farnell markets high-reliability SiC diodes

The SiC diodes are suitable for high-temperature operation and feature low forward voltages. They are ideal for the most demanding applications including high-efficiency and high-frequency designs.

Farnell has announced the stocking of two new high-performance product ranges from TT electronics. One of these is Semelab's SML family of six high reliability SiC diodes.

Semelab's family of SiC diodes combines the attributes of silicon carbide and advanced packaging to provide high-end performance and reliability. Suitable for high-temperature operation and featuring low forward voltages, the devices are ideal for the most demanding applications including high-efficiency and high-frequency designs, says the company.

"The addition of these two high performance product ranges from the TT electronics portfolio increases the choice of device solutions we can offer to our customers," said Richard Curtin, head of product and supplier management, Farnell Europe. "By offering specialised components like these, with applications engineering support, design engineers can utilise Farnell and the element14 online community as a one-stop resource for all their new designs."

Kyma cashes in with $400k grant

The firm is one of 16 selected by North Carolina Green Business Fund to improve its plant efficiency by a very significant amount.

Kyma Technologies, a supplier of ultra-high purity crystalline GaN and AlN materials and related products and services, has won an NC Green Business Fund grant to develop a more energy efficient manufacturing facility.

The NC Green Business Fund which is managed by the North Carolina Department of Commerce. Triangle-based companies and organisations have been awarded more than $2.8 million in grants from the North Carolina Green Business Fund, state Commerce Secretary Keith Crisco announced.

Statewide, a total of 16 organisations received grants which totalled to $4.6 million; the grants are being funded through the American Recovery and Reinvestment Act.

Under this award, Kyma will receive over $400,000 to install several elements of an ultra-high energy efficiency manufacturing infrastructure. This includes installation of a geothermal heating, ventilation, and air conditioning (HVAC system); installing better insulation; implementation of high efficiency LED based solid state lighting; implementation of smart utility control sensors; and creation of an energy usage monitoring and optimisation centre.

"While we have always prided ourselves with our relatively low carbon footprint, especially compared to that of many of our competitors, NC Green's support is going to enable us to improve our plant efficiency by a very significant amount," said Heather Splawn, Kyma vice president of operations.

Keith Evans, Kyma's president and CEO, added, "We are pleased to receive the support of the NC Department of Commerce's NC Green fund. This helps us become even greener in the manufacturing of our products, which is almost poetic, because our products in turn are used by our customers used to make their products greener too."

Kyma's GaN and AlN materials are designed to enable their customers to make energy efficient nitride semiconductor devices such as LEDs and power switching electronics.

The market for nitride semiconductor devices is expected to surpass $65B over the long term, including over $32B in visible lighting applications and over $33B in power electronics applications.

Equipment and Materials

RFMD(R) Expands Portfolio of Broadband Components With New IQ Modulators Featuring Integrated Local Oscillators

RFMD's World-Class IQ Modulators Drive Superior Integration and Industry-Leading Performance

RF Micro Devices, Inc. (Nasdaq:RFMD), a global leader in the design and manufacture of high-performance radio frequency components and compound semiconductor technologies, today announced it has extended its portfolio of broadband components to include two new low power IQ Modulators featuring integrated fractional-N synthesizers and voltage controlled oscillators (VCO).

The RFMD2080 and RFMD2081 are broadband devices capable of generating output frequencies from 45MHz to 2700MHz. They are suitable for a wide range of applications, including satellite communications, Point-to-Point radio, software defined radio, and other wireless and wireline applications requiring QPSK/QAM modulators. The broadband nature of the components and the integration of the local oscillator offer customers a competitive combination of functionality, versatility, and size.

The RFMD2080 features a baseband interface incorporating programmable filtering and gain control. Optimized for low power operation, the device has current consumption of 150mA from a 3V supply, allowing customers to create more environmentally friendly systems with reduced power consumption. Both the RFMD2080 and RFMD2081 are programmable using a simple 3-wire serial interface and offered in QFN 5x5mm packages.

Alastair Upton, general manager of RFMD's Broadband Components Business Unit, said,"RFMD's new IQ Modulator products significantly reduce implementation size and complexity, power consumption and cost for our customers. We are very pleased to offer these market-leading devices, which leverage our optimal technology matching (OTM®) strategy and highlight our 'green' approach to product development and performance."

Nanometrics to open Singapore Advanced Metrology Centre

The advanced modelling capabilities at the new centre expands support to the firm's Asia customer base.

Nanometrics Incorporated, a provider of advanced metrology systems, is opening the "Singapore Advanced Metrology Centre", an applications development center for customers using Nanometrics metrology systems.

The centre provides dedicated support throughout Asia for customers requiring advanced modelling of complex structures and recipe development. Nanometrics investment and commitment to additional applications resources reflects the rapid growth and adoption of optical critical dimension (OCD) technology in semiconductor manufacturing due to smaller, more complex structures and new materials.

The Singapore location provides access to a large pool of technical talent and a significant concentration of the company's customers. In addition to applications development staff, the facility also includes sales and service support for Nanometrics customers. It also serves as a training center for regional customers and Nanometrics' branch offices.

"This expansion is important to our efforts to improve responsiveness in Asia and to better serve our customers," said Nagesh Avadhany, vice president of applications engineering and training programs. "We are pleased to have a highly-skilled local staff of engineers and scientists who now form the core of our regional applications team. They bring to Nanometrics a vital resource to build our customers' confidence in our ability to enable their

most critical structures."

"Singapore offers a deep talent base, and will serve as a gateway to all of our customers in Asia," said Timothy J. Stultz, president and chief executive officer. "This significant commitment to our customers in the region will help us serve them as a more local company, with improved access and communication. We look forward to expanding relationships with our customers, as we grow our team in Singapore."

Riber revenue set to double to €40 million over 5 years

MBE Systems business growth will be driven by the expansion of the commercial offer, made possible by the development of new dedicated systems for research institutes and the semiconductor industry, which is seeing an average annual growth rate of 8%.

At its combined general meeting, Riber, a global provider of MBE equipment, set out its objectives for the current year and presented its development plan for 2011-2015.

Thanks to Riber's portfolio of orders, it is able to forecast strong growth in its business over 2011. At April 30th, it represented €19.7 million (€9.2 million at the end of April 2010), including certain sales to be delivered after 2011.

In view of the current order book and the performance recorded over the first quarter, revenues are expected to climb to between €27 and €29 million for 2011, enabling Riber to achieve a further improvement in its profitability.

In the MBE Systems business, growth will be driven by the expansion of the commercial offer, made possible by the development of new dedicated systems for research institutes and the semiconductor industry, which is seeing an average annual growth rate of 8%.

The Services and Accessories business will continue to capitalise on the installed base of 800 systems, combined with growth in epitaxy equipment sales and the development of activities in emerging countries. Sales are expected to grow 40% by 2015.

The diversification into the thin-layer CIGS solar cell technology and OLED markets which look set for strong growth is also expected to support Riber's sales and consolidate its position as a high value-added equipment manufacturer.

Looking ahead to 2015, Riber is targeting €40 million in revenues (compared with €20.7 million in 2010).

Stephen Newberry joins Nanometrics Board of Directors

Newberry is the CEO of Lam Research and serves as a director and vice chairman of Lam's Board of Directors. He is also a director of SEMI, the semiconductor industry's trade association.

Nanometrics Incorporated, a supplier of advanced metrology systems to the semiconductor industry, has announced that Stephen G. Newberry, a veteran of the semiconductor capital equipment industry, has joined its Board of Directors.

"Steve has a track record of creating shareholder value and brings to Nanometrics his extensive experience driving operational excellence," said Bruce C. Rhine, Chairman of the Board of Directors at Nanometrics. "He will be an important sounding board for our management team and contributor to our Board as we focus on growing the value of Nanometrics in the framework of excellent corporate governance."

Newberry is the chief executive officer of Lam Research Corporation and currently serves as a director and vice chairman of Lam's Board of Directors. He joined Lam in August 1997 as executive vice president and chief operating officer and was promoted to the role of chief executive officer in June 2005.

Newberry also serves as a director of Semiconductor Equipment and Materials International (SEMI), the semiconductor industry's trade association. In addition, he serves as a member of the Haas Advisory Board, Haas School

of Business, University of California at Berkeley and as a member of the Dean's Advisory Council, University of California at Davis Graduate School of Management.

Prior to joining Lam Research, Stephen Newberry was group vice president of global operations and planning at Applied Materials. He is a graduate of the U.S. Naval Academy and the Harvard Graduate School of Business.

Plasma-Therm voted one of the best for 12th year

The PECVD supplier has been recognised for its excellence when it comes to supplying chip-making and wafer processing equipment, much of it used in the compound semiconductor industry.

VLSIresearch has announced that equipment users have honoured Plasma-Therm, a global supplier of plasma process equipment with one of its "10 BEST 2011 Suppliers of Chip Making Equipment" and one of "THE BEST 2011 Small Suppliers of Wafer Processing Equipment" awards.

This extensive survey which spans two and a half months and four languages, received feedback from more than 550 organisations for this year's Customer Satisfaction Survey.

Participants in this survey were asked to rate equipment suppliers in fields including Equipment Performance, Customer Service, and Supplier Performance. Two new categories, Trust in Supplier and Partnering, provided additional insight into key attributes of a supplier's performance in 2011.

Plasma-Therm achieved its 12th consecutive year of being voted one of the 10 BEST and THE BEST Small Suppliers of Wafer Processing Equipment in 2011. This year, Plasma-Therm was also voted one of 10 BEST in Focused Suppliers of Chip Making Equipment.

"Customer service and outstanding equipment performance have always been core values for Plasma-Therm. These VLSIresearch awards continue to validate that we are successfully implementing our principles into action," said Abdul Lateef, CEO of Plasma-Therm.

Plasma-Therm, founded in 1974, designs, manufactures and supports plasma etch and plasma enhanced chemical vapour deposition (PECVD) equipment to various high technology market segments and industries.

Plasma-Therm systems are used in markets ranging from leading edge university R&D to high volume production. Served markets include photomask etching, compound semiconductor, wireless communication, MEMS, nanotechnology, data storage, solar cells and LED/photonics processing.

"Plasma-Therm has once again achieved one of the industry's highest standards for customer satisfaction and equipment performance. The Customer Satisfaction Survey has been measuring these industry standards for over 22 years, and Plasma-Therm has proven, year after year, to affirm their commitment to these important goals," said Risto Puhakka, President of VLSIresearch.

Aixtron shareholders approve all resolutions

At the Aixtron SE General Meeting 2011, shareholders elected a new Supervisory Board for Aixtron SE.

Shareholders of Aixtron SE, a leading provider of deposition equipment to the semiconductor industry, voted strongly in favour of the resolutions presented by the Executive Board and the Supervisory Board.

Following the legal conversion of the Company from an AG structure into a European Company at the end of 2010, Aixtron's shareholders elected a new Supervisory Board for Aixtron SE.

In the first Ordinary General Meeting of the SE, Petra Denk was elected as a new member into the SE Supervisory Board. Denk holds a Doctor of Physics and teaches Business Administration and Energy Management at the University of Landshut.

Joachim Simmroß, who has been involved with Aixtron for more than 21 years and was a founding member of the Aixtron Supervisory Board, had decided not to put himself forward for re-election.

The following resolutions were also approved at Aixtron's 14th Annual General Meeting:

Dividend payment of 60 Euro-Cents per share for fiscal year 201

Approval of the activities of the members of the Executive Board and of the Supervisory Board during fiscal year 2010

Remuneration of the first and the new Supervisory Board of Aixtron SE

Election of the auditors and the Group auditors for fiscal year 2011

Creation of new Authorised Capital 2011

About 49 percent of Aixtron SE's share capital was represented at the shareholder meeting held at the Eurogress in Aachen, Germany.

The Supervisory and Executive Board speeches given during the meeting were broadcast live via the internet, and are now available as webcasts under (www.aixtron.com/agm). The speaker notes and the slides to the presentation to Topic 1 of the agenda are also available for download from the website.

Nanotronics "Point and Shoot" technology ideal for CS defect characterisation

The flexible system images defects on 2" to 8" wafers and aims to eliminate a learning curve for users, whilst providing accurate and easy to interpret data.

Nanotronics Imaging introduced its nSPEC semiconductor analysis system at the CS Mantech show in Palm Springs, California.

The proprietary software and hardware underlying nSPEC enable rapid and detailed analysis of wafer defects and are particularly suited to compound semiconductor wafers.

Specifications subject to change without notice, please contact Nanotronics Imaging for current specifications.

Complete system automation with cassette-to-cassette loading of 2"-8" wafers is also available. Nanotronics uses "Point and Shoot" microscopy, and aims to eliminate a learning curve for users, while giving accurate and easy to interpret data.

Nanotronics Imaging has also appointed a new Vice President Ivan Eliashevich, who brings a level of expertise in the semiconductor industry that is unique. "I knew Ivan as a client, who helped me to understand wafer technology. He is honest, knowledgeable, and a powerful proponent for the customer and supplier. I feel lucky to have him as a part of our team", says CEO and founder Matthew Putman.

Oxford wins multiple etch system order from GCS

GCS chose Oxford because its ICP etchers offer a combination of process capability, consistency, value and diversity to process a variety of compound semiconductor materials, including GaAs, InP and GaN to achieve the desired device performance.

Etch, deposition and growth systems manufacturer Oxford Instruments has received an order from Global Communication Semiconductors (GCS) for multiple PlasmaPro System100 ICP 180 etch systems.

This will expand California based GCS's foundry capabilities in dielectric and GaN etching and further increase the number of systems installed from Oxford Instruments.

"GCS chose Oxford Instruments because their ICP etchers offer an excellent combination of process capability, consistency, and value", added Franklin Monzon, VP of Operations at GCS, "As a boutique foundry, GCS has a great diversity of customers who utilise a variety of materials, including GaAs, InP, GaN, and silicon, to achieve the desired device performance. Most of these customers also require process customisation that, in turn, mandates that the process tools be flexible enough for development work but also reliable enough for production. "

The addition of the Oxford Instruments ICP etchers backs up and expands our dry etch process capability so that existing customers, especially in the InP and GaN arenas, get faster, better, service, while at the same time allowing GCS to develop new customers. We look forward to expanding our relationship with Oxford Instruments and expect that our customers will be very pleased as these tools come on-line during the course of our expansion."

Stuart Mitchell, VP Oxford Instruments America Inc said, "As a world class manufacturer of etch, deposition and growth systems, Oxford Instruments is proud to have been chosen as a supplier to GCS. We offer excellent and innovative III-V compound semiconductor technologies, and coupled with our expert process engineers, this ensures that we can provide not only superior equipment, but a full backup support and service capability."

Tektronix SiGe oscilloscopes should reign supreme

The firm's early integration testing of the tools illustrates that IBM's 8HP SiGe technology will meet the world's most demanding oscilloscope requirements at over 30 GHz.

Tektronix, a manufacturer of oscilloscopes, has announced that validation of ASICs designed in IBM's 8HP SiGe BiCMOS Specialty Foundry technology are exceeding target specifications for a planned new performance oscilloscope capable of greater than 30 GHz bandwidth across multiple channels while minimising noise found in older chip sets.

The new oscilloscope platform will meet electronic designers' needs for more accurate characterisation of high speed serial data beyond 10 Gb/s, and enhance optical modulation analysis of 100GbE where complex signalling requires accurate bit capture.

"This represents our first commercial integration of 8HP technology and clearly shows the latest generation of SiGe is delivering significant performance differentiation to the industry's most demanding oscilloscope applications.This year, we will be delivering a new series of performance oscilloscopes with the lowest noise and class-leading signal acquisition performance across multiple channels," said Roy Siegel, general manager, Oscilloscopes, Tektronix.

"IBM's SiGe technology has long delivered the performance and reliability our customers demand and as our lab demonstration indicates, this will continue well into the future."

IBM's 8HP technology is a 130 nm SiGe bipolar complementary metal oxide semiconductor (BiCMOS) process that offers twice the performance over the previous generation process. SiGe technology leverages highly-reliable and mature fabrication processes associated with the 50-year-old silicon industry, but with performance levels comparable to that of exotic materials such as InP and GaAs.

Unlike those alternatives, SiGe BiCMOS provides access to high-speed bipolar transistors on the same die as standard CMOS, enabling a class of circuitry which marries extreme performance with large-scale integration. It is this union which has allowed Tektronix to reliably deliver feature-rich, high-speed data acquisition systems for over a decade.

"As Tektronix's lab demonstration makes very apparent, IBM's 8HP SiGe technology continues to deliver a winning combination of speed, accuracy and integration required for high-end instrumentation," said Regina Darmoni, Director, Specialty Foundry, IBM.

Initial Tektronix product deployments using 8HP SiGe technology are expected later this year.

GT Solar to sue ARC Energy

GT Solar says that ARC and two of its employees have used trade secrets relating to GT Crystal Systems' technology for manufacturing sapphire crystals, as a means of entering the sapphire crystallisation equipment business.

GT Solar International subsidiaries, GT Crystal Systems, LLC and GT Solar Hong Kong, Limited have filed a lawsuit in the Hillsborough County Superior Court (Southern District) in New Hampshire against Advanced RenewableEnergy Company, LLC (ARC).

The firms also plan to sue Kedar Gupta, ARC's Chief Executive Officer and Chandra Khattak, an ARC employee, for the misappropriation of trade secrets relating to sapphire crystallisation processes and equipment.

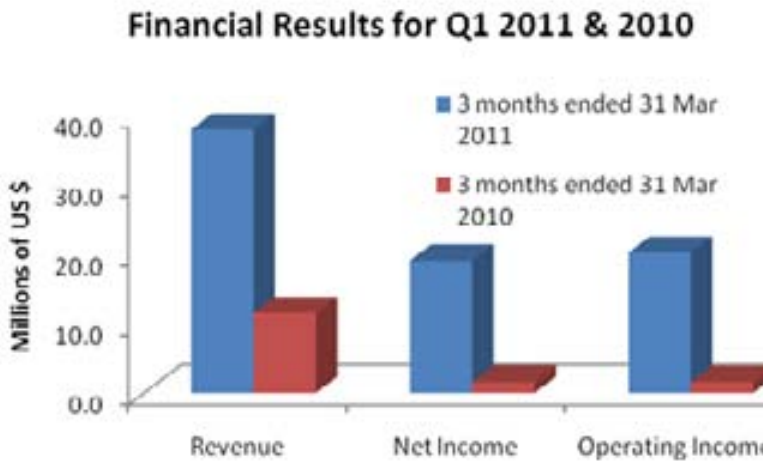
The complaint alleges that ARC and the named individuals misappropriated trade secrets relating to GT Crystal Systems' technology for manufacturing sapphire crystals, as a means of entering the sapphire crystallisation equipment business. The complaint further alleges civil conspiracy, unfair competition, breach of contract and interference with contractual relations.

"We have an obligation to our shareholders to be diligent about protecting our intellectual property," said Hoil Kim, GT Solar's General Counsel. "When we believe our intellectual property has been compromised, we will take the necessary action to protect our rights."

Rubicon revenues rocket 69.7%

Like other substrate manufacturers, Rubicon has reported strong first quarter 2011 results, which have increased sequentially as well as compared to last year.

Rubicon Technology, a provider of sapphire substrates and products to the LED, RFIC, Semiconductor, and Optical industries, has reported financial results for its first quarter ended March 31, 2011.



Revenuesrose to $38 million, up 29 % sequentially and a massive 69.7% over the same quarter last year. Gross margin was 63 % while operating margin reached 53 %. Diluted earnings per share increased $0.16 sequentially to $0.80.

Commenting on the results, Raja Parvez, President and CEO said, "I am very pleased with our exceptional start to the new year and believe that 2011 will be a very productive year in terms of financial performance, extending our technological leadership, and expanding our customer base worldwide."

The Company's revenue increased 29 %

sequentially to $38 million driven by robust demand from the LED market. The Company continues to add capacity in order to serve this rapidly growing market. Parvez continued, “Our customer base continues to grow and we are aggressively adding capacity to meet their needs.”

The Company reported continued strong interest for its polished six inch wafers. Parvez continued, “While we were capacity constrained in the first quarter, we expect a significant increase in revenue from six inch polished wafer sales in the second quarter.”

Second Quarter 2011 Guidance

Commenting on the outlook for the second quarter of 2011, William Weissman, Rubicon’s Chief Financial Officer said, “We expect continued strong demand resulting in revenue increasing to between $40 million and $43 million. We have projected overall substrate pricing in the second quarter to be slightly lower than first quarter pricing due to some reduction in the price of two inch core products. We anticipate gross margin to be in the high fifty percent range in the second quarter with diluted earnings per share of between $0.82 and $0.86. This assumes a diluted share count of 24 million shares and a tax rate of 7 %, which represents accrual for state income taxes only.”

Parvez continued, “Each quarter we evaluate our tax valuation allowance and determine whether it is appropriate to begin accruing for federal income taxes for financial statement purposes. That determination is made after evaluating many factors, including the projected earnings for the full year. It is possible that we may release the tax allowance and begin accruing federal taxes in the second quarter. If that were the case, we estimate that our total federal and state effective tax rate for financial statement purposes for the last three quarters of this year to be approximately 40 %. It is important to note that our projected tax rate for 2012 remains at our previously provided rate of 30 to 35 %. In addition, our projected cash basis tax rate for 2011 remains low at approximately 10 percent despite our increased earnings.”

Keithley launches power system meter for CS device characterisation

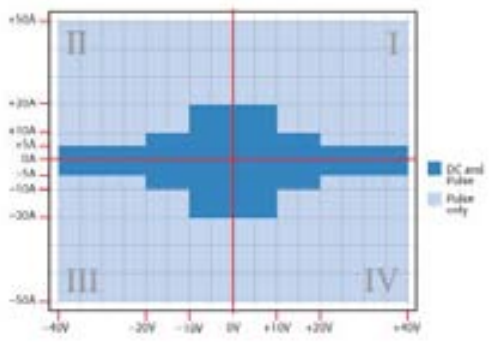
The “breakthrough” 2651A can characterise GaN, SIC, and other compound semiconductor materials and devices and provide data on semiconductor junction temperature characteristics.

Keithley has introduced the 2651A High Power System SourceMetre Instrument which it claims offers breakthrough capabilities for testing the latest high power electronics, semiconductors, and materials.

Keithley Model 2651A

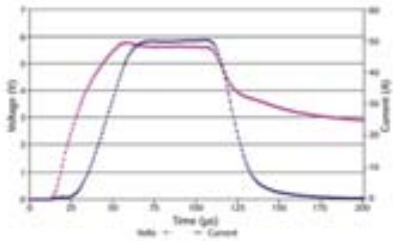
The 2651A instrument addresses a wide range of applications including power semiconductor, HBLED, and optical device characterisation and testing. It can also characterise GaN, SIC, and other compound semiconductor materials and devices and provide data on semiconductor junction temperature characteristics. Operating at a high speed and with high precision digitisation, it is capable of high current and high power device testing and can also be used for electromigration studies.

With a broad dynamic range, the machine has the ability to source or sink up to 2,000W of pulsed power (±40V, ±50A), or 200W of DC power (±10V@±20A, ±20V@±10A, ±40V@±5A).



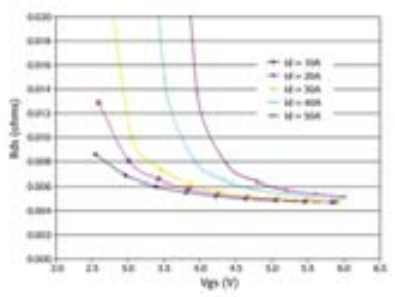
The Model 2651A can source or sink up to ±40V and ±50A

The 2651A current sourcing and measurement is 1pA to 50A (100A with two units). It can test a wider range of power semiconductors and other devices than previous models and has two measurement modes in a single high power/high current instrument.



The dual digitising A/D converters continuously sample at up to 1µs/point, enabling full simultaneous characterisation of both current and voltage waveforms

It also has dual A/D converters for each measurement mode and enables full simultaneous characterisation and measurement of both current and voltage waveforms. The Keithley 2651A is fully isolated and has independent channels with 500nSec synchronisation and provides easier, faster, and more flexible connection and grounding schemes that enable true SMU-per-pin testing in multi-channel applications.



1µV measurement resolution and current sourcing up to 50A (100A with two units) enable low-level Rds measurements to support next-generation devices

Oxford announces more plasma etch deposition & growth seminars

The firm will present in conjunction with leading research organisations in the U.K., U.S.A. and France.

Oxford Instruments is continuing its series of seminars and workshops once again this summer and autumn. Co-hosted with leading research organisations worldwide, the events include:

30th June 2011: A one day event at the prestigious University of Southampton, UK where a number of speakers will conduct presentations on ALD, Ion Beam, Plasma Sources and many other aspects of Etch, Deposition and Growth Technologies.

14 July 2011: 'New frontiers in plasma nanopatterning' at LBNL, USA, where a workshop event will be held for the 3rd consecutive year.

18 October 2011: 'Nanoscale plasma processing' at CEA-LETI, Grenoble, France

These seminars are all free of charge, but must be booked in advance as places are limited.

Schedule of Seminars

30 June 2011: Knowledge creation partnership - from funding to results

Hosted by the University of Southampton, UK & Oxford Instruments

This seminar shares experiences in successful collaborations between industry and the scientific research community. It also presents technical

results of collaborations and how partners can truly benefit from this.

Presentations on processing and servicing of Oxford Instruments' equipment will give support to users, and a practical insight into Oxford Instruments and the extensive etch, deposition and growth equipment and process solutions offered.

Venue: Mountbatten Building, University of Southampton, UK

Programme: Initiating and funding successful partnerships

UK Academic/Industrial partnerships - a model for success
Understanding public funding sources
First results of a successful partnership: Materials and etchers for nanowire biosensors
Oxford Instruments/Southampton University collaboration success

Results of successful partnerships

Plasma source & Ion Beam technologies
Developing plasma etch processes
How to get the most from your tool (CS)
ALD and technical achievements/working in a successful partnership
Cleanroom tour & Networking Tea

Speakers include specialists in their fields:

From the University of Southampton, speakers include:

Don Spalinger, Director, Corporate Relationships
Myrddin Jones, Lead Technologist; Electronics, Photonics & Electrical Systems, Technology Strategy Board

Peter Ashburn, ECS

From Oxford Instruments Plasma Technology, speakers include:

Frazer Anderson, Business Development Director
Mike Cooke, CTO
Bob Gunn, Applications team leader
Nick Curtis, Training Officer
Chris Hodson, ALD Product Manager

There is no charge for this event however booking is essential

To book or for further information please email: plasma@oxinst.com

14 July 2011: New Frontiers in Plasma Nanopatterning

Hosted by Molecular Foundry, LBNL, CA, USA and Oxford Instruments

Venue: LawrenceBerkeley National Laboratory, Berkeley, CA, USA

Timing: Thursday 14th July: 9:00am - 5:00pm

(Seminar takes place the same week as Semicon West in SF, enabling delegates to attend Semicon prior to the Seminar)

Invited Speakers include:

Steve Shannon, NCSU
Friedrich Prinz, Stanford University
Deirdre Olynick, LBNL
Paul Ashby / Dominik Ziegler, Molecular Foundry LBNL
Owain Thomas & Leslie Lea, Oxford Instruments

Topics include talks on:

Energy conservation at the Nanoscale
Fabrication of high performance cantilevers in aqueous solution
Radio frequency heating for Nanoscale etching
Plasma etching/deposition tools and applications

Tours of the Molecular Foundry will be available on Wed 13th (3-5pm) or Thurs 15th (9-11am) and booking will be essential.

Process Helpdesk -Oxford Instruments process experts will be on hand to answer any specific Process Application questions

Space is limited, so early booking is advisable.

18 October 2011: Nanoscale Plasma Processing

Being held at CEA-LETI, Grenoble, France

This one day event will cover many aspects of

Plasma Processing, including Ion Beam, MEMS, Atomic Layer Deposition, and III-V Etch.

These topics and more will be presented both by experts from the Oxford instruments Applications team and by Guest speakers from LETI and other key organisations.

A full programme will be available shortly.

Email plasma@oxinst.com to register your interest or to book a place

Oxford Instruments promotes Dan Ayres to General Manager

With over 10 years experience at Oxford, Ayres was Operations Director at Plasma Technology before being promoted to this newly created role.

Oxford Instruments Plasma Technology, a leader in etch, deposition and growth equipment, has announced the promotion of Dan Ayres to General Manager.

Dan Ayres, General Manager at Oxford Instruments Plasma Technology

With over 10 years experience at Oxford Instruments, Ayres was Operations Director at Plasma Technology before being promoted to this newly created role, and prior to that held roles in the fields of Supply Chain, Product Management and Project Management within the Oxford Instruments Group. Ayres gained an Engineering degree before joining Nissan Motor Manufacturing (UK) to work in roles covering Supply Chain and New Product Introduction, and was awarded an MBA from Warwick Business School while working for Oxford Instruments.

Managing Director Andy Matthews comments, "In order to maintain our business' current growth, we need strong focus on the efficiency and effectiveness of all areas. Dan will lead the Business, Engineering, Finance and HR functions towards a clear vision that better delivers the needs of our customers and establishes the competencies and resources that support our future growth. Dan's previous experience together with his work within projects at Oxford Instruments, equips him well to take on this new challenge".

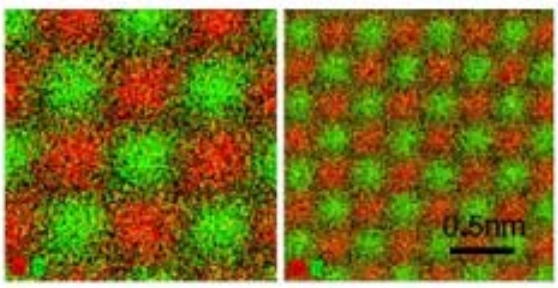
This new appointment will further facilitate the ongoing expansion of Oxford Instruments Plasma Technology's Bristol, UK production capacity that has seen a workforce increase of 30% in the past 12 months, and 50% increase in production facilities. It will enable additional focus on delivering the innovative, world class, etch, deposition and growth systems that meet the ever increasing demands of Oxford Instruments Plasma Technology's customers.

FEI ChemiSTEM technology enables atomic-level spectroscopy

The combination of high detection sensitivity and high spectral rates are enabling better EDX mapping of materials that are highly sensitive to electron beam damage, such as composition analysis in nanometre-scale InGaN quantum wells used in LEDs and other compound semiconductor devices.

FEI, a leading instrumentation company providing systems for research and industry, is extending its ChemiSTEM Technology to enable, what it says for the first time, atomic-level energy dispersive X-ray (EDX) spectroscopy across the periodic table.

The combination of increased current in an atomic-sized probe by Caesium-correction and the increase in X-ray detection sensitivity and beam current of the ChemiSTEM Technology allows results to be obtained within minutes.



The images show atomic-level EDX spectroscopy of the material Strontium Titanate; the individual atomic positions of the crystal structure can be easily distinguished by their chemical signal (red is Strontium, green is Titanium).

"The powerful combination of the groundbreaking ChemiSTEM Technology and an aberration corrector offers unique capabilities for material science," said Ferdinand Hofer of Graz University of Technology, Austria. "One of the most important applications for the new technology will be element-specific imaging at atomic resolution. We will apply the technology to study interfaces in semiconductors, solar cell materials, LEDs and ceramic materials with previously unknown detection sensitivity and accuracy.

George Scholes, FEI's vice president for product management, adds, "The ChemiSTEM Technology will enable breakthough results in many key application areas for our customers, such as catalysis, metallurgy, microelectronics, and green energy materials, to name a few. For example, in a recent experiment with ChemiSTEM Technology, our customer was able to clearly resolve the core-shell structure of 5nm catalyst nanoparticles in about three minutes and with three times greater pixel resolution than a previous experiment with conventional technology. And the conventional technology failed after three hours of data collection to clearly resolve the same structure."

ChemiSTEM Technology achieves a factor of 50 or more enhancement in speed of EDX elemental mapping on scanning/transmission electron microscopes (S/TEMs) compared to conventional technology employing standard EDX Silicon-drift detectors (SDDs) and standard Schottky-FEG electron sources.

It combines FEI's proprietary X-FEG high brightness electron source, providing up to five times more beam current at a given spatial resolution; the patent-pending Super-X detection system, providing up to ten times or more detection sensitivity in EDX; and fast scanning electronics, capable of achieving EDX spectral rates of up to 100,000 spectra per second. Additionally, the windowless detector design employed for each of ChemiSTEM Technology's four integrated SDD detectors has proven to optimize the detection of both light and heavy elements.

This combination of high detection sensitivity and high spectral rates of up to 100,000 spectra per second are enabling better EDX mapping of materials that are highly sensitive to electron beam damage, such as composition analysis in nanometre-scale InGaN quantum wells used in LED devices, and semiconductor devices with potentially mobile dopant materials, as well as many others devices used in emerging nanotechnologies.

Novel Devices

Thickness of graphene on SiC no longer an enigma

New developments have shown that the thickness of graphene on SiC can be measured using Electrostatic Force Microscopy in ambient conditions.

Scientists from NPL, in collaboration with Linköping University, Sweden, have shown that regions of graphene of different thickness can be easily identified in ambient conditions using Electrostatic Force Microscopy (EFM).

The exciting properties of graphene are usually only applicable to the material that consists of one or two layers of the graphene sheets. Whilst synthesis of any number of layers is possible, the thicker layers have properties closer to the more common bulk graphite.

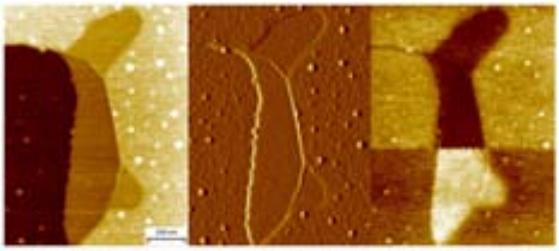


Figure: EFM images. The left hand image is the topography, the middle the topography error image; and right the electrostatic force microscopy image where the tip bias has been switched half way through the image.

For device applications one- and two-layer graphene needs to be precisely identified apart from the substrate and regions of thicker graphene. Exfoliated graphene sheets up to ~100 μm in size can be routinely identified by optical microscopy.

However, the situation is much more complicated in the case of the epitaxial graphene grown on SiC wafers with a diameter up to 5 inches where the straightforward identification of the graphene thickness is difficult using standard techniques.

This research shows that EFM, which is one of the most widely accessible and simplest implementations of scanning probe microscopy, can clearly identify different graphene thicknesses. The technique can also be used in ambient environments applicable to industrial requirements.

Further details of this work can be seen in the article “Mapping of Local Electrical Properties in Epitaxial Graphene Using Electrostatic Force Microscopy” by Burnett *et al*, *Nano Letters*.

DOI: 10.1021/nl200581g

Berlin to host compound semiconductor conference

Organised by the Fraunhofer Institute and the VDE Association for Electrical Technologies, Electronic & Information Technologies, the conference will address the future of compound semiconductors in micro electronics and optoelectronics.

On May 23, 2011, Andre Geim, the 2010 winner of the Nobel Prize in Physics, opened the 2011 Compound Semiconductor Week with a plenary lecture on graphene.

Here, some 450 scientists and industry representatives will discuss current research findings in the field of compound semiconductors. An example of one of the key topics of the event is how to improve energy efficiency while increasing data rates in communications systems – often referred to as “Green IT”.

The conference took place in Berlin from May 22 to 26. The conference was organised by the Fraunhofer Heinrich Hertz Institute HHI, the Fraunhofer Institute for Applied Solid State Physics IAF, and the VDE Association for Electrical Technologies, Electronic & Information Technologies.

“CSW is the most important international conference for the entire spectrum of compound semiconductors. Here, participants will get an overview of what will become possible in micro electronics and optoelectronics,” Oliver Ambacher, ISCS 2011 Conference Chair and head of the Fraunhofer IAF, said.

While silicon is still the most important semiconductor material, today no mobile phone, PC or car would work without additional components used in compound semiconductor technology. Compound semiconductor, in contrast to the elemental semiconductor – like silicon -, consists of

at least two different types of atoms.

Compound semiconductors are used for light generation with LEDs, photonics and communications engineering, as well as for maximum frequency electronics and power electronics. Since 2010, the CSW has combined the two most important conferences on compound semiconductors – the "International Symposium on Compound Semiconductors (ISCS)" and the "International Conference on Indium Phosphide and Related Materials (IPRM)".

"Berlin is the ideal location for hosting the CSW thanks to its broad-based research activities in this field," said Norbert Grote, Chairman of this year's IPRM and head of department at the Fraunhofer HHI. "Some 450 scientists from all over the world will come to Berlin to exchange their knowledge. This gives us the opportunity to further strengthen the location and to promote these issues."

Fraunhofer HHI and Fraunhofer IAF are both leading research institutes in the field of compound semiconductors. In Berlin, it is not only institutes and universities such as the Fraunhofer HHI, the Ferdinand Braun Institute, the Paul Drude Institut für Festkörperelektronik, the Institut für Kristallzüchtung, Humboldt- und Technische Universität, as well as the Helmholtz Zentrum, which are active in this field, but also companies like the u2t Photonics AG, a spin-off from Fraunhofer HHI. "When making a phone-call in the US, your chances of the optical components involved having been made in Berlin are pretty good," said Norbert Grote.