www.compoundsemiconductor.net

COMPOUND SEMICONDUCTOR

CONNECTING THE COMPOUND SEMICONDUCTOR COMMUNITY

LED lighting
Simplifying GaN-on-silicon growth processes

Illumination
Improving the colour balance of LED sources

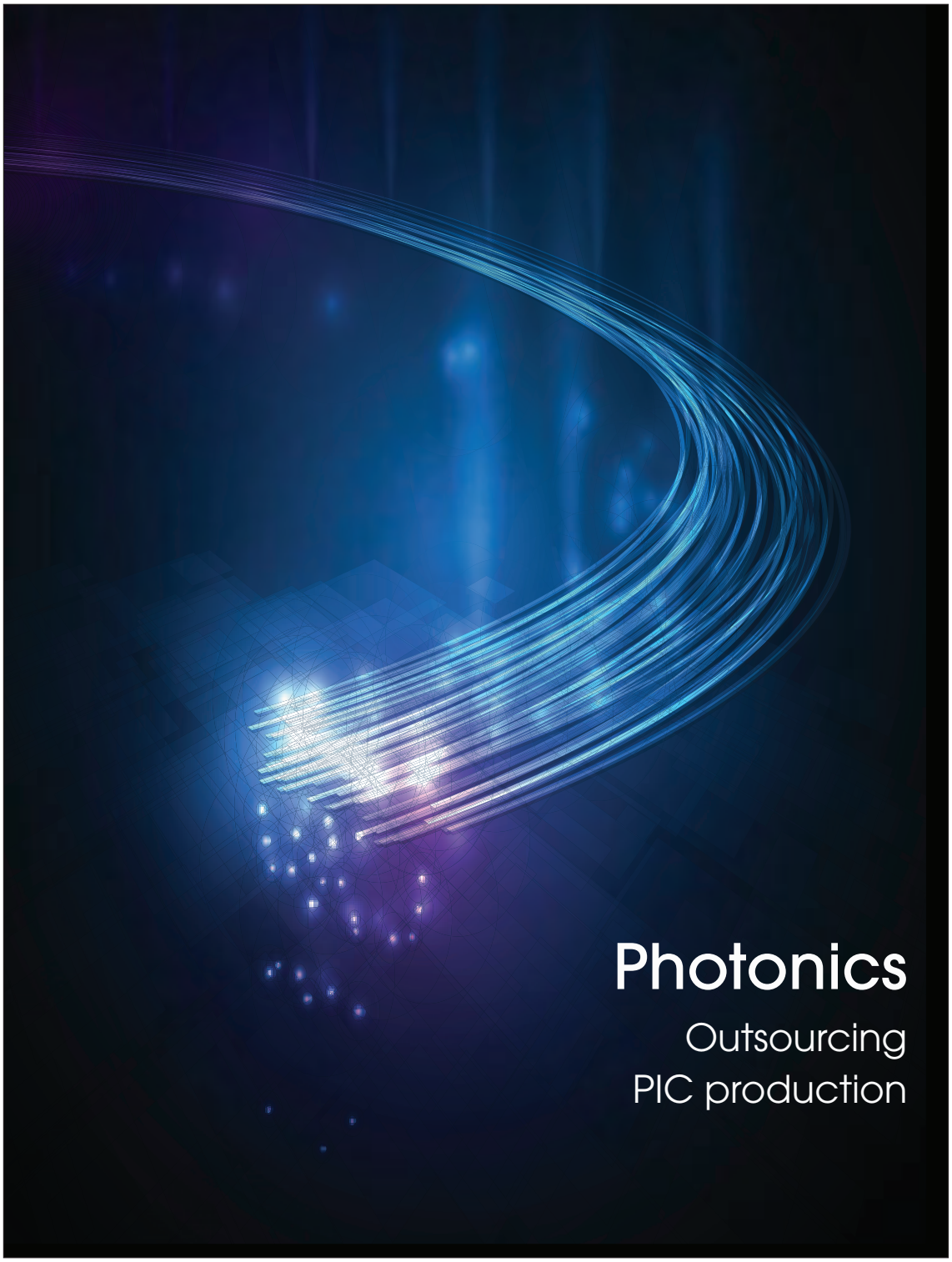
Nitride workshop
Novel deposition technologies grab the limelight

Standards
SEMI drives specs for 150 mm sapphire

III-V solar cells
Analyst tips rocketing sales

Green lasers
Competition for pico-projector market hots up

LED droop
Adding wells boosts performance



Photonics

Outsourcing PIC production

An Angel Business Communications publication

November / December 2012 Volume 18 Number 8

LED Taiwan 2013

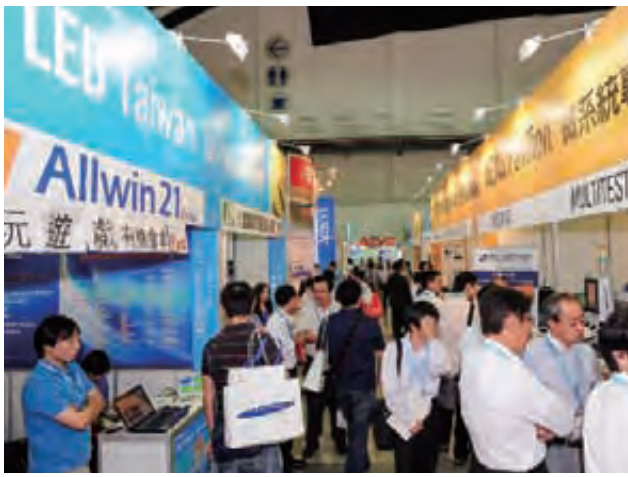
Sept 4 - 6
TWTC Nangang Exhibtion Hall
www.semicontaiwan.org

In conjuction with: SEMICON Taiwan 2013

The Only LED Manufacturing-Focused Exposition in Taiwan

- **Features the newest technology and solutions Attracts**
- **Attracts overwhelming attendance from across the sector**
- **Generates media coverage to boost your brand visibility**

LED Taiwan is the premier platform to showcase your products, technologies, and services for LED manufacturing in the world's leading and most



Highlights of LED Taiwan

- **Booth Decoration**
  Standard booth decoration helps you present your products at an affordable price.

- **Meet Buyers and Prospects**
  The Supplier Search program can gain you face-to-face access with leading chip makers and packaging houses looking for new solutions and suppliers.

- **LED Friendship Luncheon**
  Connect the industry chains is beneficial to the industry growth. LED friendship luncheon offers you an opportunity to access your future business through the gathering.

- **Special Website**
  A special website is provided to promote your products and link to your company's webpage.

- **Various Marketing Resources**
  Websites, databases, ads and other PR tools will be provided to help you get the most out of the show.

Booth Price (tax included)

	SEMI Member	Non-Member
Standard	NT$ 135,135	NT$ 181,440
Raw	NT$ 106,785	NT$ 142,695

Taiwan's Global Leadership in LED Industry

- No. 1 in LED market value with US$6.73 billion
- No. 2 in LED component market (including EPI wafer, grain, packaging, & module)
- No. 2 in LED wafer capacity, with 23% of the global market share
- Complete LED supply chain high demand for manufacturing solutions

(Source: SEM, PIDA)

SEMI Taiwan LED Committee

- AST (Advanced System Technology Co.,Ltd.)
- Air products
- AIXTRON
- Brooks Automation
- DELTA
- Epistar
- Feed Back Technology
- Hermes-Epitek
- HUGA OPTOTECH
- Lextar
- Lite-On Tech
- OPTOTECH
- Suzhou GCL
- TSMC Solid State Lighting
- Veeco
- VisEra
- Walsin Lihwa

Contact SEMI

Ms. Ana Li
Email：ali@semi.org
TEL：+886.3.560.1777 Ext. 101

Exhibit LED Taiwan 2013 Now!

semi

November / December 2012
Volume 18 Number 8

Published by
Angel Business Communications Ltd,
Hannay House, 39 Clarendon Road,
Watford, Herts WD17 1JA, UK
T: +44 (0)1923 690200
F: +44 (0)1923 690201

Angel Business Communications Ltd
Unit 6, Bow Court, Fletchworth Gate,
Burnsall Road, Coventry CV5 6SP
T: +44 (0)2476 718 970
F: +44 (0)2476 718 971

Compound Semiconductor is published eight times a year on a controlled circulation basis. Non-qualifying individuals can subscribe at: £105.00/€158 pa (UK & Europe), $138.00 pa (air mail), $198 pa (USA). Cover price £4.50. All information herein is believed to be correct at time of going to press. The publisher does not accept responsibility for any errors and omissions. The views expressed in this publication are not necessarily those of the publisher. Every effort has been made to obtain copyright permission for the material contained in this publication.
Angel Business Communications Ltd will be happy to acknowledge any copyright oversights in a subsequent issue of the publication. The paper used within this magazine is produced by chain of custody certified manufacturers, guaranteeing sustainable sourcing.

US mailing information: Compound Semiconductor, ISSN 1096-598X, is published 8 times a year, Jan/Feb, March, April/May, June, July, August/September, October, November/December by Angel Business Communications Ltd, Unit 6, Bow Court, Fletchworth Gate, Burnsall Rd, Coventry CV5 6SP. UK. The 2012 US annual subscription price is $198. Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA. Periodicals postage paid at Jamaica NY 11431. US Postmaster: Send address changes to Compound Semiconductor, Air Business Ltd, c/o Worldnet Shipping Inc., 156-15, 146th Avenue, 2nd Floor, Jamaica, NY 11434, USA.

Printed by: Pensord Press.
ISSN 1096-598X (Print)
ISSN 2042-7328 (Online)

recycle When you have finished with this magazine please recycle it.

Looking at the bigger picture

IT'S not been a great year for compound semiconductor start-ups. SiC power electronics pioneer SemiSouth has just closed its doors, and in the concentrating photovoltaic (CPV) sector, GreenVolts has slashed it workforce and is just supporting existing customers, while Amonix has ceased its operations.

What should we make of all of this? Does it mean that compound semiconductor technologies will fail to make an impact in the solar and power electronics markets? Well, maybe, but probably not.

When new technologies burst onto the scene, start-ups always spring up, trying to outdo each other by bringing better-performing products to market. And even when sales from this fledgling industry grow at a phenomenal rate, not all new firms succeed; some shut up shop, some merge and some are acquired. So the failure of one or two start-ups doesn't imply that an entire industry is destined for failure.

It's easy to speculate why SemiSouth has flopped. It had to compete against firms that were far, far larger, such as the likes of Cree, Infineon and ST Microelectronics. Some of these have been major players in the power electronics market for years, with well-established, strong relationships with customers: SemiSouth would have had to break these ties to be successful. The failure of the Missippissi-based outfit has occurred against a backdrop of healthy growth in the wide bandgap, power electronics sector, which should continue.

When it comes to CPV, the woes of Amonix and GreenVolts are a cause for concern. Amonix has been a leader in this sector, and its troubles reveal how tough the solar market is at present, with silicon panel prices tumbling and many thin-film makers going out of business.

How everyone in the solar industry fares in future may hinge on the outcome of the spats between China and the US and Europe over how much financial support companies should be allowed to receive. There might be some levelling of playing fields, which would increase the competiveness of CPV.

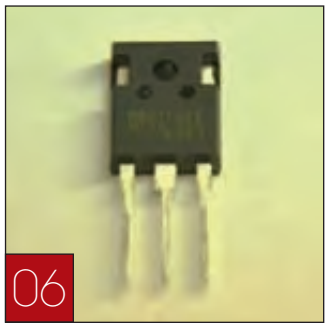
There are good reasons to believe that this sector can succeed. In sunny, dry climes such as the southwestern states of the US, CPV is claimed to be the cheapest solar technology. That's why market analysts covering this sector believe that the technology has a healthy future and I, for one, hope they are right.

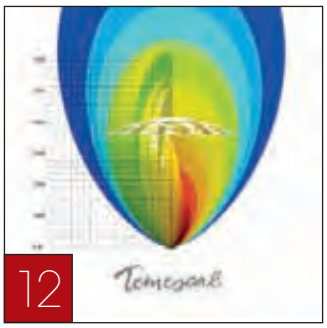
Dr Richard Stevenson
Editor

contents

industry & technology

news





news analysis

GaN substrate costs will fall by 60 percent by 2020

WIDE-BAND-GAP semiconductor materials such as GaN offer far higher performance than traditional silicon but cost significantly more. However, by 2020 GaN costs will drop enough for it to become competitive based on performance gains, according to a Lux Research report.

Bulk GaN is very expensive today, costing about $1,900 or more for a two-inch substrate, compared with $25 to $50 for a far larger six-inch silicon substrate.
But GaN materials offer higher efficiencies than silicon, leading to greater energy savings in devices like power electronics, laser diodes, and LEDs. These gains can offset cost disadvantages – the price-to-performance ratio is the key to adoption.
"The future of bulk GaN is going to come down to how it faces off against silicon substrates," says Pallavi Madakasira, Lux Research Analyst and the lead author of the report titled, 'Price or Performance: Bulk GaN Vies with Silicon for Value in LEDs, Power Electronics and Laser Diodes.'

"Bulk GaN wins in laser diodes and it can become relevant in LEDs and power electronics by boosting yield and performance."

Lux Research analysts broke down the manufacturing costs for ammonothermal and hydride vapour phase epitaxy (HVPE) processes for making bulk GaN, as well as for GaN epitaxy on both silicon and GaN substrates, and determined where the price/performance trade-off will land. They found HVPE is the cheaper alternative. Two-inch ammonothermal substrate costs will fall by more than 60 percent to $730/substrate in 2020. While four-inch HVPE substrate costs will fall by 40 percent to $1,340/substrate in 2020, the larger size makes it the more economical choice.

Performance boost is also key. Bulk GaN can overcome high cost by boosting performance in terms of lumen (lm) output in LEDs or volt-amp (V-A) capacity in power electronics, by allowing the use of smaller dies and providing higher yields. Lux says in LEDs, GaN can match silicon with a 380 percent relative performance – an ambitious but realistic goal. For power electronics, performance at 360 percent of devices on silicon makes bulk GaN a winner.

Emerging materials such as aluminium nitride are suited to very low wavelength, ultra violet-LED, green laser diode and high switching frequency power electronics applications, and can be an effective alternative to bulk GaN.

IMS Research: LED adoption will slide from 2015 to 2016

IT is predicted that by 2016, it will be much more common for LEDs to produce greater than 200 lumens per watt, according to market analyst IMS. This firm has found that the development of several new methods of building replacement LED lamps (light guides, remote phosphors, liquid cooling) is creating new lighting products that can better mimic current lighting technologies at lower prices. The greatest impact from these improvements is that LED lighting will not be boxed into niche lighting markets, but in the long run should be able to penetrate all viable lighting markets that currently use an array of different technologies.

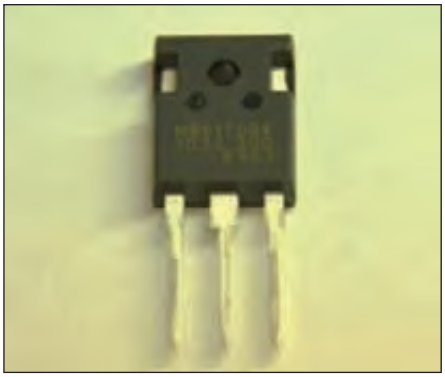
The quick adoption rate of LEDs in certain applications, in conjunction with their long life, will have a profound effect on the global lamp market in the medium term. As more and more sockets are filled with LEDs, the market for replacement lamps will decrease.

This, in conjunction with the year-on-year decrease in prices for LED lamps, will lead to market growth slowing in 2015 and decreasing in 2016. By 2020, IMS Research forecasts that LED lamps will make up 66 percent of the market, and the market will be shrinking.

Fujitsu's GaN-on-silicon power devices

FUJITSU SEMICONDUCTOR has successfully achieved an output power of 2.5kW in server power supply units equipped with GaN power devices built on a silicon substrate.

The firm intends to start volume production of GaN power devices in the second half of 2013, and it is aiming to achieve approximately 10 billion yen in sales of GaN power devices in fiscal 2015. Fujitsu Semiconductor has provided specific power supply-related partners with sample GaN power devices since 2011 and has worked on optimising them for use in power supply units. Recently, in a collaborative effort together with Fujitsu Laboratories Limited, Fujitsu Semiconductor has been engaging in technical development initiatives. These



include developing a process technology for growing high quality GaN crystals on a silicon substrate. The two companies have also optimised the design of electrodes to control the rise of on-resistance during switching, and devising a circuit layout for power supply units that can support the high-speed switching of GaN-based devices.These results have enabled Fujitsu Semiconductor, in a test circuit using a GaN power device, to increase conversion efficiency that exceeds the performance of conventional silicon devices. The company views its success in these results as opening a path to high-voltage, large-current applications for its GaN power devices.

Fujitsu Semiconductor has recently completed setting up a mass-production line for 6-inch wafers at its Aizu-Wakamatsu plant, and will begin full-scale production of GaN power devices in the second half of 2013.

Cree unveils the first 1200V SiC power device

CREE is introducing the first commercially available all-SiC Cree power module, the CAS100H12AM1.

The new high frequency module, rated at 100A current handling and 1200V blocking, allows higher efficiency, compact and lighter weight systems that can result in lower total system costs compared to conventional silicon-based technologies.

"An all-SiC module with these specifications enables us to meet our transit customers' demands for reduced size and weight of auxiliary power converters, while meeting efficiency and cost targets," says Fisal Al-Kayal, innovation and research engineer, Alstom Belgium Transport.

The module includes SiC MOSFETs and SiC Schottky diodes in a 50mm half-bridge configuration rated to 150°C maximum junction temperature.

The SiC components enable the module to be operated at exceptionally high switching frequencies that can reduce the size, weight and cost of the power conversion system. The new power module has demonstrated up to 100kHz switching frequency. Target applications include high power converters, industrial motor drives, solar inverters and uninterruptible power supplies.

"The 1200V, 100A dual module extends our existing discrete MOSFET and diode products into higher power applications," explains Mrinal Das, product marketing manager, Cree Power and RF.

"The efficient switching characteristics of an all-SiC module should allow system designers to meet customer demands for reduced size, weight and cost of the end-system, while reducing global energy consumption. Already, Cree SiC power devices have eliminated an estimated one million metric tons of annual CO_2 emissions – the equivalent to planting 95 million trees."

RFMD to acquire Amalfi to increase smartphone business

RF MICRO DEVICES says it has made a definitive agreement to acquire Amalfi Semiconductor, a fabless semiconductor company. Amalfi specialises in cost effective, high performance RF and mixed-signal ICs for the rapidly growing entry-level smartphone market.

RFMD intends to significantly accelerate the market adoption of Amalfi's RF CMOS and mixed-signal ICs by combining Amalfi's targeted product portfolio and proprietary RF CMOS and mixed-signal expertise with RFMD's deep customer relationships, broad product portfolio, extensive in-house manufacturing scale, and robust global supply chain.
Bob Bruggeworth, president and CEO of RFMD, says, "The acquisition of Amalfi is consistent with RFMD's strategy of matching the most appropriate process technology to each customer's performance and cost requirements.

Amalfi's proprietary RF and mixed-signal expertise in RF CMOS are a great fit for RFMD and a strong addition to our long-term technology strategy. RFMD gives Amalfi the global presence, market credibility, manufacturing scale, and blue-chip customer access to take their business to the next phase of growth."

NGK GaN Substrates to enhance LEDs

NGK INSULATORS claims that it has developed high-quality GaN wafers that significantly reduce defects and roughly double the luminous efficiency of green LEDs over previous materials. It says that it achieved this breakthrough by using a crystal growth technology that it has improved through an innovative technology. The 2-inch diameter GaN wafers have a low defect density all over and a colourless transparency. This is the result of proprietary improvements to liquid phase epitaxial technology for single crystal growth.

Uniting with Nagoya University, NGK found that its GaN wafers for green LED chips showed a 60 percent internal quantum efficiency at injection current density of approximately 200 amperes per square centimetre. According to the company, this figure is roughly double that of the green LED chips currently on the market.
In previous LED chips using sapphire wafers as substrates, defects in light emission layers were common, particularly in green LEDs. These defects prevent a large operation current, which in turn prevent LEDs from achieving sufficient brightness. But with lower defects, NGK says its GaN substrates enable dramatically improved light emission layer quality.
The reduction in current loss that results, allows for a large current, making high brightness green LED elements a reality. When these elements are used to make up green LED light sources, the result could amount to an improvement in brightness of more than 20 times compared to previous models.

Light sources can also be made more compact thanks to the simplified heat dissipation structure made possible by less heat generated from current loss.

This control of heat-related degradation also enables longer product life. NGK says it will take steps to further reduce defect density in its GaN wafers, and produce larger wafers that are greater than 6 inches in diameter. In the future, the company intends to raise production capacity from the current level of 200 wafers per month (for 2-inch wafers) to a monthly output of over 1,000 wafers during fiscal 2012.

Avago and Vitesse join forces

Avago Technologies and Vitesse Semiconductor are launching what they say is the industry's first CXP host joint reference design delivering 100G/120G connectivity.

The model is suitable for use in high-speed routers, Enterprise data centres and high-performance cloud computing applications. The joint reference design is based on Vitesse's VSC7227 12-channel signal conditioner and Avago's AFBR-83PDZ 100G CXP. The firms say it enables customers to accelerate time-to-market with solutions for 100G/120G connectivity.

Sustained growth in cloud computing, mobile networking and video, remote storage and other bandwidth-intensive services drives demand for high density 100G/120G connectivity.

Recent surveys show that network bandwidth demand is one of the most critical issues facing data centres, driven by increases in virtualisation, cloud computing, big data, and convergence. To meet these needs, both carrier and equipment providers are upgrading existing systems with higher density 10G ports which are expected to grow 68 percent in 2012 alone, according to Infonetics.

The reference design supports both these higher density 10G ports, along with the migration to true 100G links and beyond. "The Vitesse reference design demonstrates the combined superior performance of the Avago CXP transceivers with the Vitesse signal conditioning ICs," says Sharon Hall, product manager for parallel fibre optic products at Avago. "With this combined solution, system designers can design 100G/120G optically connected systems with confidence and improved signal integrity."

The modules incorporate the company's 850 nm VCSEL technology, PIN array technology and integrated laser driver and receiver IC technology. In combination, they provide robust electrical and optical performance at high data rates.

UPC prepares to boost GaAs laser production

AIXTRON SE has sold an AIX 2600G3 Planetary Reactor to Union Optronics Corp. (UOC). The system is capable of handling 49 x 2 inch wafers in each run. The purchase was made in the second quarter of 2012 with delivery due in the fourth quarter of 2012.

Aixtron Planetary Reactor showing 12 x 4" configuration. It can also be used in 49 x 2" and 7 x 6" configurations President, Hir-Ming Shieh of UOC comments, "Based on the good experience with our existing Aixtron AIX 2600G3 system, we are now preparing capacity for expanded business opportunities with this new AIX 2600G3. We consider this configuration to be the most suitable choice to ramp up our advanced laser production capacity."

Soitec doubles bonded silicon-on-sapphire production

SOITEC has more than doubled production of bonded silicon-on-sapphire (BSOS) substrates to meet increased demand from its strategic partner, Peregrine Semiconductor Corporation.

Peregrine, a fabless provider of high-performance radio frequency integrated circuits (RFICs), has increased peak-production capability of its latest-generation STeP5 UltraCMOS technology-based RF switches to more than two million units a day, to support design wins in the Radio Frequency Front Ends (RFFEs) of today's most advanced 4G smart phones, and other wireless-communication applications.

These wins established Peregrine Semiconductor as the market leader for the main RF antenna switch for cellular handsets.

Soitec's direct wafer-bonding technologies are used to produce the BSOS substrate employed in the manufacture of Peregrine Semiconductor's highly-tuned semiconductor wafers. It is claimed that the combination of Soitec's innovative substrate and Peregrine Semiconductor's UltraCMOS process technology and IC design expertise enable high-performance RFICs for a variety of applications.

"Soitec's expertise has been important in the development of a substrate technology that offers the reliability, yield, and process scalability of equivalent bulk CMOS technologies," said Mark Miscione, vice president of RF Technology Solutions for Peregrine Semiconductor "As a result of supporting Peregrine Semiconductor's continued strong growth, we have reached a new level in high-volume manufacturing for our bonded-SOS product," said Bernard Aspar, vice president of Soitec's Layer Transfer Solutions Business Unit. "Bonded SOS is part of our strategy to deliver leading-edge engineered substrates for mobile electronic-device markets.

Kyma's GaN materials advance novel optics of navy research

KYMA TECHNOLOGIES has helped Naval Research Laboratory (NRL) scientists to demonstrate a novel approach to making mid-infrared non-linear optics.

Today's most prevalent approaches to non-linear mid-IR optical materials are based on periodically poled lithium niobate and related materials. They suffer from a dramatic drop-off in performance in the wavelength region beyond 4μm.

Addressing this issue, NRL has developed a dramatically different approach to conventional methods. They alternate the actual crystal orientation of the semiconducting nonlinear material to create promising structures from GaN grown by hydride vapour phase epitaxy (HVPE).

Kyma's HVPE GaN has very low impurity levels and low defect densities which supports a large transparency window all the way out to 7μm. They also have a high thermal conductivity (over 250 W/m-K), and a high second-order nonlinear susceptibility, all important for non-linear optics applications.

Anadigics ships amplifiers for the Samsung Galaxy Note II

ANADIGICS is shipping production volumes of its ALT6702, ALT6725, AWC6323 AWC6325, and AWT6624 LTE, CDMA, and WCDMA PAs to Samsung Electronics for the new Galaxy Note II.

The Verizon Wireless model of the Samsung Galaxy Note II uses Anadigics' AWC6323 PA, while the Sprint model is powered by the Company's ALT6702 and AWC6323 power amplifiers (PAs).

Other models for several wireless carriers in the United States and Asia use one or a combination of Anadigics single-band and dual-band power amplifiers.
Samsung's Galaxy Note II continues the evolution of a new class of converged devices that blend the functionality and form factors of both smartphones and tablets, commonly referred to as a "phablet." The device offers a 5.5-inch HD Super AMOLED screen, updated S Pen stylus, 8 megapixel camera, and 1.6 GHz quad-core processor.

"The selection of our high performance power amplifiers for the Galaxy Note II demonstrates the strength of the relationship forged between Anadigics and Samsung Electronics," says Michael Canonico, senior vice president of worldwide sales at Anadigics.

"By working closely with top-tier wireless manufacturers, we have developed a comprehensive portfolio of power amplifier solutions that are optimised to deliver longer battery-life in smartphones and tablets. This performance advantage is backed by high-volume manufacturing prowess, outstanding quality, and exceptionally skilled applications teams to help our customers quickly bring to market leading-edge designs."

RFMD wins GaN contract to enhance RF amplifiers

RF Micro Devices has been awarded a $2.1 million contract from the Defence Advanced Research Projects Agency (DARPA). The money will be used to enhance the thermal efficiency of GaN circuits used in high power radar and other military systems. The award is in association with the Near Junction Thermal Transport (NJTT) effort of DARPA's Thermal Management Technologies (TMT) program.

The goal of the DARPA NJTT initiative is to achieve a three times or greater improvement in power handling from GaN power amplifiers through improved thermal management of the near junction region.

By combining thermally-enhanced diamond substrates with RFMD's GaN-on-SiC high power technology, the firm expects to significantly improve power density and power handling capability.

Jeff Shealy, vice president and general manager of RFMD's Power Broadband business unit, says, "RFMD is excited to work with DARPA to apply new technologies to our existing portfolio of GaN-based high power RF amplifier products.

"We expect the NJTT program will result in a new generation of higher performing, more compact RF high power amplifiers (HPAs) with lower operating temperature and greater RF power-per-unit area."

RFMD's partners in the program include the Georgia Institute of Technology, Stanford University, Group4 Labs, and Boeing.

Brolis installs Veeco MBE system

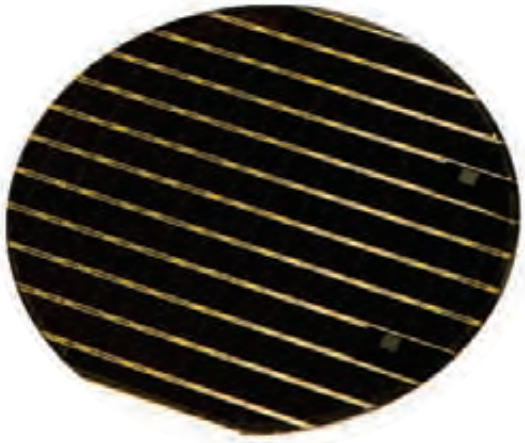
BROLIS SEMICONDUCTORS has received shipment of a Veeco GEN200 Edge MBE production system for installation at their new epitaxial wafer production facility in Vilnius, Lithuania.

Dominykas Vizbaras, CEO of Brolis, commented, "The mission of our company is to become a world-leading provider of complex epitaxial structures for long-wave optoelectronics, such as thermal imaging, concentrator photovoltaic and other custom devices.

Veeco is the world's leading provider of production MBE systems, so we anticipate that the GEN200 will enable us to be extremely competitive in terms of wafer quality, speed to market, and cost effectiveness of our products."

Jim Northup, Vice President and General Manager of Veeco's MBE Operations, commented, "We are pleased Brolis has chosen Veeco as their MBE equipment supplier as they open their new state-of-the-art epitaxial manufacturing fab. The GEN200 will support Brolis' market penetration goals with its production-proven performance and the industry's lowest cost of ownership."

Solar Junction raises efficiency bar to 44%



SILICON VALLEY based solar energy company Solar Junction has set a world record for energy efficiency of a commercial-ready production solar cell. "Breaking our own world record cements Solar Junction as an innovator and leader in the multi-junction cell space," says Vijit Sabnis, VP Technology at Solar Junction. "We continue to push technological boundaries to further drive CPV costs down."

The power conversion efficiency of Solar Junction's cells was measured at 44 percent at 947 suns, beating the company's record of 43.5 percent at 418 suns it set in April 2011. Both records were verified by the National Renewable Energy Laboratory (NREL). Solar Junction's announcement falls on the heels of a successful investment round and a 5-MW order. Earlier this year, Solar Junction and IQE, a global supplier of epitaxial wafers, signed an investment and manufacturing agreement to ramp Solar Junction's SJ3 solar cell product to high volumes.

What's more, Solar Junction is commissioning a 6-inch production fabrication facility, partially funded by a U.S. Department of Energy SUNPATH contract, in Silicon Valley. Shipments will begin in the first quarter of 2013.

GaAs revenues rise thanks to power wireless base stations

IN response to increasing data consumption, operators are developing new wireless network architectures with smaller cells to support these consumer demands. These "small cells", each with lower transmit power will provide a boost to GaAs-based device revenues for wireless infrastructure applications.

The recently released Strategy Analytics GaAs and Compound Semiconductor Technologies Service (GaAs) Data Model, "Wireless Infrastructure Markets: 2011-2016", forecasts that the GaAs device revenue in wireless infrastructure will grow with a Compounded Average Annual Growth Rate of 12 percent to reach nearly $348 million in 2016.

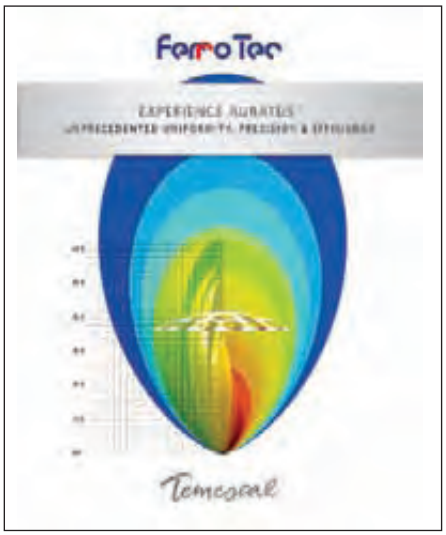
The report also estimates that metro and pico cell growth will increase the number of wireless base station sectors from 2.3 million in 2011 to 6.6 million in 2016.

Asif Anwar, Director in the Strategy Analytics Strategic Technologies Practice, says: "LDMOS will continue to be the main technology for the RF power portion of the base station, but the deployment of small cells will lead to an increase in GaAs device revenue".

Aixtron systems to power up SINANO's nitrides

THE SUZHOU INSTITUTE OF NANO-TECH and Nano-bionics (SINANO), China, has ordered two Aixtron Close Coupled Showerhead (CCS) systems to extend the centre's nitride semiconductor research. The order was placed in the third quarter of this year, with deliveries planned in the fourth quarter of 2012 and in the first quarter of 2013. One system, capable of handling 6x2-inch substrates, focuses primarily on R&D. The other system, a CRIUS, is designed for mass production. It is capable of handling up to 31 x 2-inch or 3 x 6-inch substrates in one run.
Hui Yang, Director of SINANO, says, "Our Nano-Devices and Materials Division will use these systems to develop new applications such as GaN lasers on the 2-inch R&D system and GaN growth on silicon substrates and high electron mobility transistors (HEMT) on the CRIUS system."

Ferrotec Temescal announce breakthrough in electron beam metalization



THE TEMESCAL DIVISION of Ferrotec Corporation has announced a process breakthrough in electron beam metallization for lift-off compound semiconductor applications. The Auratus Deposition Process Enhancement Methodology improves wafer-coating processes dramatically, producing near-perfect uniformity while delivering up to 40% reduction in material consumption, resulting in significant cost savings on process materials like gold and platinum compared to traditional box coaters.

Traditionally, electron beam evaporation takes place inside of box-shaped stainless steel vacuum chambers using a high voltage electron beam to vaporize materials like gold or platinum. Once the material has been vaporized, it forms a flux cloud above the electron beam gun. This results in a thin film coating condensing on the wafers held in an assembly in the upper portion of the chamber. While this process is considered mature, traditional deposition methods have not fully considered optimizing the vapor cloud from the perspective of maximizing efficiency in lift-off process collection. Temescal's new Auratus methodology reinterprets electron beam evaporation by focusing on optimizing vapor cloud utilization.

"With the Auratus process enhancement methodology; we have re-envisioned electron beam deposition with an emphasis on multiple metal uniformity and collection efficiency. The results are incredible, with near-perfect uniformity, increased precision across a wide range of metals, and up to 40% cost savings on process materials, dramatically reducing cost of ownership. " said Gregg Wallace managing director of Ferrotec's Temescal division.

Auratus is a proprietary optimization methodology for lift-off electron beam evaporative coating that incorporates patent pending technology to achieve unprecedented levels of uniformity, precision, and collection efficiency. This will allow a customer to coat wafers with near perfect uniformity, resulting in more consistent, better quality products and fewer defects. Auratus methodology also has the capability to increase the effective deposition rate, enabling customers to increase throughput.

GT to slash substrate costs with assets of Twin Creeks

THE HYPERION ion implanter technology will enable GT to produce thin silicon carbide, germanium, sapphire, silicon and other crystalline material substrates. GT believes this should enable breakthroughs in performance and cost for solar and power semiconductor applications. GT Advanced Technologies Inc. (GT) has acquired certain capital assets and intellectual property of Twin Creeks Technologies, Inc.

Twin Creeks is a privately owned company that has developed an ion implanter technology that enables the production of lower cost thin substrates with minimal material (kerf) loss. The assets were purchased from Twin Creeks' lenders in a private sale for roughly $10 million and royalties that will be based on future sales.

GT expects that Twin Creeks' unique Hyperion ion implanter technology will have a broad application in the production of engineered substrates for power semiconductors and thin wafers for solar applications. The company also expects to pursue the development of thin sapphire laminates for use in applications such as cover and touch screen devices. The Hyperion ion implanter has the potential to minimise, or in some cases eliminate, the need for wafering saws, which would significantly lower the cost of production.

The assets acquired by GT relate primarily to the Hyperion ion implanter as well as Twin Creeks' portfolio of approximately 30 granted US patents and over 70 pending US and international patent applications. GT's ion implanter engineering team will be based in Danvers, Massachusetts.

"Hyperion's unique ion source and beamline design will enable a wide range of exfoliation applications in markets where thin silicon, silicon carbide, sapphire, germanium and other crystalline material substrates can enable breakthroughs in performance and cost," says Vikram Singh, executive vice president of advanced systems development. "Hyperion will enable the production of high throughput and optimum thickness substrates that cannot be achieved with other ion implant technologies."

"The acquisition of these assets from Twin Creeks, coupled with our operational expertise and proven ability to commercialise innovative technology will allow us to develop a new line of products that can deliver advancements in performance and value in the core markets we serve today as well as new markets that we have identified. We are particularly excited about the potential applications in the cover and touch screen markets," adds Tom Gutierrez, president and chief executive officer of GT.

"This continues GT's strategic diversification into new and promising markets with technology that delivers superior value to customers over existing products currently available,"
GT expects to start the commercialisation of this technology in late 2014.

Fairchild's 1200V SiC Bipolar Junction Transistors push the boundaries

THE firm's silicon carbide Bipolar Junction Transistors are the first in its SiC product portfolio. They are claimed to offer the lowest total power losses at high operation temperatures.

In an effort to achieve higher power density, and to meet strict efficiency regulations and system up-time requirements, industrial and power electronic designers are challenged with constantly reducing power losses and improving reliability in their designs.

However, improving these critical design capabilities in applications like renewable energy, industrial motor drives, high-density power supplies, automotive, and down-hole can complicate a design as well as drive overall system costs higher.

To help designers meet these challenges, Fairchild Semiconductor has developed an innovative high-performance power SiC transistor technology ideally suited to power conversion systems.

Fairchild says its optimised, semi-standard, and customised technical SiC solutions take advantage of its large portfolio of semiconductor devices and module packaging technologies. The firm maintains its advanced technologies simplify engineering challenges with functional integration and design support resources that minimise components while reducing engineering time.

The company also claims that its latest SiC products meet the needs of device manufacturers and chipset suppliers by integrating leading device technologies into smaller advanced packages that offer size, cost and power advantages.

Among the first products to be released in Fairchild's SiC portfolio is a family of advanced SiC bipolar junction transistors (BJTs) that offer high efficiency, high-current density, robustness, and easy high-temperature operation.

Fairchild's SiC BJTs enable higher switching frequencies due to lower conduction and switching losses (ranging from 30-50 percent) that provide up to 40 percent higher output power in the same system form factor. Enabling the use of smaller inductors, capacitors and heat sinks, these robust BJTs can lower overall system costs by up to 20 percent.

With performance levels that drive much higher efficiency and superior short-circuit and reverse bias safe operating area, these SiC BJTs will play a significant role in optimising the power management of high-power conversion applications.

Fairchild, as part of a complete SiC solution, has also developed "plug-n-play" discrete driver boards (a 15A and 50A version). When used in conjunction with Fairchild's advanced SiC BJTs, they not only provide increased switching speeds for reduced switching losses and better reliability, but also allow designers to easily implement SiC technology into their applications. Application notes, which provide designers with the additional support needed to design with SiC devices, and reference designs that allow for the development of driver boards to meet specific application needs, are also available from Fairchild and are intended to reduce design time and shorten time-to-market.

Fairchild believes that SiC BJTs offer advantages over other SiC power devices. The company claims that with this technology, they have created the most efficient 1200 V power conversion switch ever made. They also exhibit the lowest total losses, including switching, conduction and driver losses and the lowest switching loss at any given RON, of all 1200V devices.

What's more, the normally-off feature reduces risks, complexity and performance limiting designs. Silicon carbide BJTs also have a stable base input that is not sensitive to over/under voltage peaks and have a high-rated operating temperature of Tj=175°C.

They also offer easy paralleling due to a positive temperature coefficient for RON and negative temperature coefficient for gain. The devices are stable and have a rugged Vbe forward voltage and reverse blocking capability.

LED markets fuel CVD chemicals demand

Yet again AkzoNobel is increasing capacity at its Texas-based speciality chemicals production site. *Compound Semiconductor* finds out exactly what is driving growth.

For the third consecutive year, the High Purity Metal-Organics arm of AkzoNobel has increased capacity at its trimethyl-gallium plants as well as unveiling even bolder expansion plans.

In June 2010, the speciality chemical division doubled capacity for trimethyl-gallium (TMG) production at its LaPorte-based production facility in Texas, US. A year later, TMG capacity had doubled again, with plans also underway to construct a new TMG plant at the same site some three times bigger than the existing unit.

Fast forward to today and the new TMG plant is built, bringing AkzoNobel's total capacity for gallium-based metal-organics to more than 100 tons a year. Meanwhile, fresh plans have been revealed to build a third TMG plant at the LaPorte site by August 2014 that will triple existing TMG capacity. And it's not just TMG. In the past few years, production of trimethyl-indium, triethyl-gallium and trimethyl-aluminium has mushroomed while a new facility for bis-cyclopentadienyl magnesium (Cp_2Mg) has also started up.

But although these chemicals are key to the manufacture of myriad products in the electronics and solar cell industries, one small device is largely driving the soaring demand for each; the LED. Indeed, each of the organometallic precursors is crucial to the chemical vapour deposition of multi-layer LED structures while Cp_2Mg is used as a dopant in semiconductor epitaxy.

"The LED chipmaker market is by far our largest market," says Michiel Floor, Global Business Manager of the High Purity Metal-Organics (HPMO) product group. "And we will continue to execute our capacity growth plans across all products to support further growth of the LED and other compound semiconductor industries."

Floor would not reveal absolute figures for these expansions or the capital involved, but emphasised that the business expects continued strong growth and is expanding capacity to cater for this. As he points out, the backlit LED market segment has fuelled demand for the business's precursors in recent years, and strong demand is expected for the next couple of years.

In addition, Floor now expects the general LED lighting sector to also stoke demand for HPMO products, with strong growth coming from LED manufacturers based in China.

The rising demand for LEDs in back-lighting and general lighting applications is driving growth for manufacturers of organometallic precursors

"Demand has picked up very strongly here in the last two years along with the strong increase in the shipment of CVD tools to China," he adds. "In fact, these tools run at a relatively high rate compared to the worldwide industry average, so we certainly see China as a major growth engine for the LED."

But what of the HPMO group's other key markets? According to Floor, he expects continued growth from the III-V solar cells industry, although not as rapid is the LED segment. However, he is keenly watching the power device market.

"Power devices could be a major future growth area for us," he says. "It will be several years until this becomes a larger metalorganics application, and I think the LED market will remain a bigger market for us. The technology is maturing yet still competing with other technologies, so let's hope that the use of compound semiconductors will be the technology of choice in this new segment."

GaAs device market bucks industry trends

As Strategic Analytics reports record revenues for the GaAs device market in 2011, Compound Semiconductor talks to company director Eric Higham to find out more.

Smartphones from companies such as Apple, Samsung and Rim are driving growth in the GaAs device market. Credit: Apple

Resilient is the word Eric Higham, director of Strategy Analytics, Massachusetts, uses to describe the GaAs device market. Despite the obvious uncertainties in the global economy, the market posted record revenues of more than $5.2 billion in 2011, and grew by 6 percent.

These unprecedented growth rates will not continue indefinitely, but still Higham is certain the industry will remain buoyant, maintaining a relatively healthy 3 percent growth in 2012 and beyond. So why is this market so buoyant as others struggle?

The answer lies largely in the world's insatiable demand for data. Data consumption, via mobile phones, is growing strongly across wireless networks, which spells good news for manufacturers of GaAs devices. As Higham highlights, some 50 percent of this market can be attributed to handsets, specifically power amplifiers. And this significant market slice looks set to grow.

"Today's handset market is tending towards fuller-feature phones and smartphones," he says. "These handsets need many frequency bands and many features including bluetooth and WiFi radio. This has driven the big growth in GaAs devices, and as the entire market continues to move to more complex feature phones, the GaAs content in phones will increase."

Importantly, consumers are replacing their handsets more and more often. "We're all so enamoured with iPhones, the handset is almost a disposable item these days," he says. "The replacement cycle is starting to approach twelve months."

And crucially, the mobile handset is fast becoming a 'must-have' item. According to Higham, recent studies suggest that while the feature phone market growth is slowing – hence the drop in GaAs device market growth to 3 percent – even a cash-strapped consumer will still spend money on a phone. "Your handset will be way down on the list of things you have to give up if your economic situation worsens," he says.

Clearly these factors are all helping to steady GaAs device markets. From the start, GaAs has been a performance-driven technology, offering higher frequency, output power and linearity in handsets.

And more recently, WiFi markets have shown revived interest in GaAs devices following demanding standards that include ever-growing power efficiency and multi-gigabit speeds. But will the technology's bubble burst?

The technology is still seeing stiff competition from GaN, SiGe, LDMOS and CMOS. Both GaN and LDMOS are used in power amplifiers for base stations while SiGe devices have made it into LNA applications. What's more CMOS power amplifiers, already found in entry-level phones, are now making in-roads to smartphones; US-based Javelin Semiconductor revealed just last month that Samsung has selected its CMOS 3G power amplifier for an android-based smartphone.

"These companies are now talking about 3G and 4 compatible power amplifers," says Higham. "As handsets become more sophisticated with the number of frequency bands increasing, GaAs is still the most able technology... although CMOS along with the new linearisation techniques out on the market could be a formidable foe for GaAs."

Industry players will have to wait and see exactly how the market evolves, but in the meantime, strong GaAs device sales are having a positive effect on GaAs bulk and epitaxial substrate markets, which Higham predicts to growth by 3 and 5 percent.

However, he believes economic uncertainty could dampen spending enough to keep growth below historical averages, at least for the next few years.

"The economy is the wildcard. It doesn't need to be how it was, but if it just becomes clearer that we're not going to pick up the paper tomorrow and hear about another country in Europe, or elsewhere, weighing down the global economy, then money will come off the sidelines and help with the network expansions."

BluGlass targets LED markets

Will the Australia-based firm's low temperature deposition technology take the strain away from LED manufacturing, asks *Compound Semiconductor*.

Australia-based novel semiconductor process developer, BluGlass, recently announced it could produce GaN layers with industry acceptable impurity levels using its low temperature Remote Plasma Chemical Vapour Deposition (RPCVD) technology. The breakthrough has been a long time coming – following more than fifteen years of low temperature, thin film development – but could have a profound effect on LED manufacturing.

At the heart of any LED lies a multi-quantum well (MQW) layer, the active region responsible for most of the device's light output and colour. During conventional MOCVD processes, this thermally-sensitive InGaN layer is grown at relatively low temperatures – around 720°C for a blue LED – onto an *n*-GaN layer.

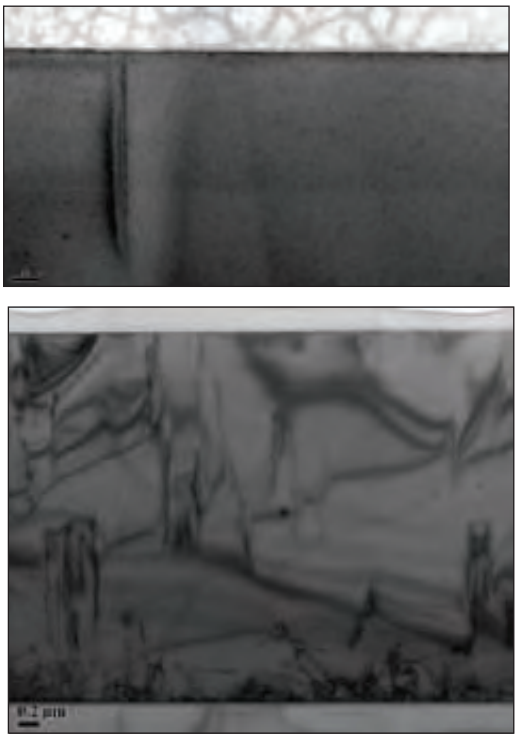
However, p-GaN deposition onto the MQW layer must then take place at around 900°C, and this is where the problems can start. High temperature growth damages this critical active region, depleting LED performance.

However, BluGlass reckons it's cracked this problem by replacing the ammonia source of a typical MOCVD system with a nitrogen plasma. "We no longer have to use high temperatures to dissociate ammonia into nitrogen as the plasma provides active nitrogen," explains BluGlass chief technology officer Ian Mann. "So we can now [deposit GaN layers] at lower temperatures."

Mann will not comment on actual growth temperatures, but confirms the company aims to deposit layers at similar temperatures to those used in quantum well-growth, in MOCVD processes. And as he adds: "the plasma source is not very costly so we don't envision the tool being significantly different in cost [compared to a MOCVD process]."

But while the concept may sound straightforward, in reality the company has spent some time grappling with the levels of carbon, hydrogen and oxygen impurities in its GaN layers. However, having commissioned its fifth generation system earlier this year, the company has since grown GaN layers with carbon, hydrogen and oxygen impurity levels of less than 1 x 10^{17} atoms per cm^3, on a par with MOCVD processes.

"We went through a major re-design earlier this year with most of the benefits coming back from improvements in chamber design," says Mann. "We've also gone through a number of additional hardware changes relating to the plasma source, chamber geometry as well as a lot of process work."



The TEM images shows low temperature RPCVD GaN layers on MOCVD GaN layers; each has a low defect density and good crystalline quality. (The lower image is at a lower magnification)

So with good quality GaN layers in hand where next for BluGlass? The end-point must be to develop a platform that will enable LED manufacturers to fabricate a higher lumen-per-Watt LED. And indeed, BluGlass's chief executive Giles Bourne has publicly announced the company will exploit its low temperature *p*-GaN layer growth to enter the LED equipment market.

In the meantime, Mann and fellow researchers are working on magnesium and silicon doping in the *p*-type and *n*-type GaN layers at low temperatures, and soon hope to unveil a device. Mann cannot reveal performance metrics but says: "We don't want this to be just a simple material specification demonstration, it will need to be an improved device."

Scaling up manufacture is another hurdle. As Mann points out, his team is working with relatively small-scale equipment right now, but this will change.

"Key manufacturers make very large systems and we will work towards this," he says. "But first let's get the fundamental advantage of our low temperature process nailed. We're working on demonstrating, for example, that we can improve LED efficiency and then we'll move on to scaling."

Excitingly, the company has already received interest from several players within the LED industry asking if its low temperature process can be used to deposit GaN on silicon. BluGlass has been working with sapphire and GaN substrates, though as Mann says, silicon also holds potential.

"I believe the bowing issue of large silicon wafers still hasn't been solved, but if you could grow an entire device structure, or the key layers, at a lower temperature then bowing would be reduced," he points out. "We're pretty focused on our *p*-GaN approach right now but this is definitely another possibility for taking advantage of our low temperature processing."

Osram's lasers get the green light

All systems go for high-brightness pico-projectors as Osram launches powerful green lasers

The race to deliver green lasers for pico-projectors embedded in mobile phones has intensified following Germany-based Osram Opto Semiconductors recent launch of direct diode lasers, which it plans to ramp to volume production by the end of this year.

A first InGaN laser emits at 515 to 530 nm, pretty much in the centre of range needed for pico-projectors, has a continuous 50 mW output and 5 to 6 percent efficiency, while a second emits at 510 to 520 nm with 30 mW output. Lifetimes have not been stated, but Osram's director of laser development, Uwe Strauss, asserts the laser diodes will last for several thousand hours, depending on application and lasing conditions.

Crucially, these diodes come in a 3.8 mm diameter package, much smaller than the bulky frequency-doubled infrared lasers already used in pico-projection, and perfect for using in the pico-projectors that will be crammed into mobile phones. What's more, Osram claims the devices cost less to make, have a high modulation rate and reduced speckle.

"We don't need any additional optics parts such as frequency doubling crystals, which makes these lasers compact and reduces the mid-term low cost potential," says Strauss. "These lasers also have a high temperature stability compared to frequency-doubled lasers."

Osram's latest diode signals a green light for high-brightness pico-projection

Osram's latest move can only spell good news for an industry that still falls back on lower brightness LEDs for pico-projectors, only truly effective in darkened rooms. However, the company is hardly alone in its quest to deliver a commercial green laser diode for pico-projection. Japan-based Nichia now mass produces a 515 nm laser with a maximum 100 mW output while Sony and Sumitomo Electric Industries have jointly pioneered a range of green lasers with output powers as high as 169 mW, emitting up to 526.6 nm. At the same time Soraa, a California-based venture from blue laser diode inventor Shuji Nakamura, has unveiled a 520 to 525 nm laser diode delivering 75 mW output.

But despite the potential number of green laser diode options for the pico-projector market, the road to successful manufacturing has been rocky. Difficulties in depositing InGaN quantum well layers onto GaN substrates have been rife, and manufacturers have ultimately chosen one of two crystal cuts, depending on whether they wanted to grapple with strain-inducing lattice mismatches or piezo-electric fields.

Sony and Sumitomo, and Soraa have focused on the semi-polar plane, choosing to master the epitaxy of high-indium content quantum well layers on GaN in a bid to avoid the efficiency-quashing fields that characterise the alternative cut. Meanwhile, Osram, and indeed Nichia, have persevered with the polar plane, also known as the *c*-plane, and as Strauss points out, he and colleagues have actually made the most of its piezo-electric fields.

"The semi-polar plane doesn't have the piezoelectric field, [so you don't struggle to] get the right overlap between electrons and holes, giving efficient light generation," he says. "But the *c*-plane has a big advantage; the internal field reduces the bandgap, so you don't have to put in as much indium to the light-emitting layers, which reduces the [lattice mismatch] strain and defects."

So which route will LED manufacturers opt for? According to Strauss, clearly each works. "The question is, which one gets the better product with the lower cost ...the product cost is a lot less when using *c*-plane [substrates] compared to semi-polar substrates."

But still the future is far from clear cut. Strauss asserts that epitaxial growth on his competitor's semi-polar GaN substrates is difficult, but concedes that solving the handicap of piezoelectric fields on polar planes is equally challenging. "For me it's not clear which product is best in the last three or four years," he admits.

But could issues over colour sway manufacturers? To date, the longest, and arguably greenest, wavelengths have been reported on semi-polar substrates, not Osram's choice of plane. Strauss agrees, but adds: "We've said, 'ok, [the longer wavelength] is nice but what wavelength do we really need?' The high volume projection market [only] needs 520 nm, maybe 525 nm, and our customers are very happy with this."

And given its happy customers, the company now plans to focus on improving the output power of its green lasers, which have already topped 100 mW in the lab. "When we look at the high volume market of laser projectors in mobile phones, this is the future."

China gets set for SiC challenge

Are China-based SiC epiwafer makers ready to take on US and Japan industry heavyweights?

Cree's 4H n-type SiC epitaxial wafers are now available in 150 mm diameter. How long until Chinese firms catch up? Credit: Cree

In early September, China-based Tianyu Semiconductor Technology revealed plans to expand its SiC epitaxial wafer business "globally", after signing three contracts the month before.

Currently using two SiC CVD reactors to produce around a thousand 2,3 and 4-inch 4H-SiC epi-wafers a month, the company intends to dramatically increase production rates, and fast.

As Tianyu spokesman Vincent Zhang told *Compound Semiconductor*: "More systems will start in our fab in the near future to meet the booming demand for SiC devices. Production capacity is 10,000 pieces a month, which can be increased if needed."Indeed, just days after expansion plans were revealed, the company announced a second hydrogen purifier had been added to its production line, "to support capacity expansion".

Within China, Tianyu is not alone in its pursuit of SiC epitaxial wafer market space with competitors including EpiWorld, Xiamen Powerway and TYSTC. Each produces 3- and 4-inch wafers, and each is intent on ramping up production.

But why pursue a market where several key players worldwide – including Japanese giants Showa Denko and Nippon Steel and US heavyweights Cree and II-VI – have long been churning out very nice SiC crystals and epiwafers? For one, access to lower cost materials means a lot of companies now have the chance to ramp up production, but at least for the China-based contingent, the answer is cash.

"These companies receive subsidies from the Chinese government, which at the moment is funding a lot of power electronics with a focus on silicon carbide," explains Philippe Roussel from France-based semiconductor analyst firm Yole Developpement. "Basically the government gives technical equipment to the companies to set up a fabrication plant... some ten to twelve companies are ready to make crystals, epiwafers and even devices."

Clearly the extra production from China will provide competition to existing SiC businesses, as well as toughen access to local markets, but are these relatively new players truly ready to compete? Showa Denko recently more than doubled 4-inch SiC epi-wafer production to 1500 units a month, promising wafers with a high surface smoothness and low crystal defects. The Japan-based company has also pointedly announced its development of high quality, 6-inch epi-wafers. Meanwhile, one step ahead, Cree has unveiled what it describes as high quality, low micropipe 6-inch 4H-SiC epi-wafers, with highly uniform epitaxial layers up to 100 μm thick. And this is perhaps what will make or break any newcomer to the SiC industry.

"A lot of Chinese companies are claiming capacities of 10,000 wafers a month, but what about the quality?" asks Roussell. "Device manufacturers are really struggling to get the right quality and there are typically very long waiting lists for wafers from Cree and Showa Denko as these guys deliver the quality."

And as Roussell also points out, most device manufacturers today are requesting 6-inch wafers, a size that right now appears to be just beyond the reach of China-based companies, or is it? "We have a lot of experience in 4-inch SiC epitaxial and are waiting for six inch, which will come in the near future of course," say Tianyu's Zhang. "[Fabricating] a sufficient supply of 6-inch substrates is a necessity."

This spells good news to device manufacturers at the back of the queue for Cree and Showa Denko epi-wafers, but what about the all-important quality?

Tianyu, for one, has been working with the Institute of Semiconductors, Chinese Academy of Sciences, to optimise wafer quality, and now claims its product specifications reach "the advanced level in international standards".

But when asked about the quality of epi-wafers produced at Tianyu, Zhang replied: "We are working hard to get better products. There is still many aspects that need to be improved for a beginner in this field... we have long been willing to co-operate with global companies."

Perhaps device makers will have to queue for little more time yet.

GaN substrates to challenge silicon

Falling bulk gallium nitride costs could soon see the high bandgap substrates displacing cheap silicon wafers

It's no secret that nitride-based devices pack a powerful performance compared to silicon-based counterparts, but overwhelmingly high GaN substrate costs have held up the development and commercialisation of these devices.

While today's 6-inch silicon wafer costs as little as $ 25, a relatively modest 2-inch GaN substrate will set a device maker back by at least $1900. But this could soon change. US-based Lux Research analyst, Pallavi Madakasira, recently forecast that bulk GaN costs will fall by 60 percent come 2020. As she highlights, plummeting prices coupled with the promise of up to 380 percent performance gains means GaN substrates will at last be ready to displace its cheaper silicon competitor. But how, exactly, can manufacturers slash costs?

Madakasira believes better use of materials is crucial. As she highlights, wafer wastage levels during GaN substrate production are currently high, but manufacturers could drive costs down by using waste material in subsequent production runs. And of course, rising demand for the substrates will boost production capacities. “This is the chicken and egg problem... but cost will come down as the capacity goes up,” says Madakasira.

But assuming rising demand kick-starts a production ramp, can quality substrates actually be produced? Today's GaN substrates are typically manufactured by a HVPE process but the material suffers from high dislocation densities triggered by the use of non-native seeds during crystal growth. Dislocation densities in good quality HVPE-grown substrates come in at around 10^6 cm^{-2} but in practice, many free-standing HVPE GaN substrates are highly stressed and bowed.

Rival technology, ammonothermal growth, produces better quality material – with dislocation densities down to 10^2 cm^{-2} – but crystal growth takes longer. And, despite best attempts from industry players, such as Poland-based Ammono, the process hasn't been proven at scale.

However, a recent announcement from Japan-based Hitachi Cable raises a question mark over the need to fabricate virtually defect-free crystals. In September, the electrical manufacturing giant unveiled the world's first GaN vertical diode, with a high reverse breakdown voltage of 3000 V and a low on-resistance of 1 $m\Omega cm^2$ in the forward direction.

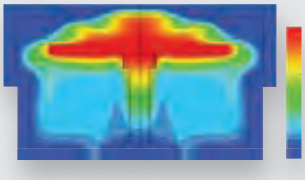
As part of a manufacturing trial, GaN epitaxy layers were deposited via MOVPE onto a HVPE-grown GaN substrate, with the company highlighting how free-standing GaN substrates made in this way have the potential to produce higher performing power devices than those grown on silicon or SiC. But perhaps more noteworthy is that the GaN substrate used in the sample diode had a relatively high dislocation density of 10^6 cm^{-2}.

Good quality GaN substrates, with low defect densities, are considered crucial for fabricating high performance LEDs, laser diodes and power electronics devices. But how low do substrate makers need to go?

Industry has not yet established the defect densities required for specific applications, but some players have suggested dislocation densities as low as 10^2 cm^{-2} may be necessary. Hitachi Cable's diode challenges this view. “[This] recent device is a proof of concept at this point,” says Madakasira. “But perhaps it also demonstrates to industry that you don't need an ammonothermal process for every application in the world.”

As such, the Lux analyst believes less price-sensitive devices, such as high-end laser diodes, ultra-high brightness LEDs and very high voltage power electronic devices, will be fabricated on the highest quality substrates grown via ammonothermal processes. Meanwhile, HVPE-grown substrates will be better suited to lower performing power electronic devices as well as high brightness LEDs, especially as the industry matures and manufacturers accept they don't need to have the lowest defect density substrate for all devices. And as Madakasira points out, we could see these market developments emerging sooner rather than later. “I think our analyses have been pretty conservative,” she concludes. “Maybe the price of these substrates will come down even faster that we have forecast.”

Optimize the Thermal Performance of your Process Equipment.



Extensive computational tools enable product designs to be highly refined for ultimate performance.

Multi-zone circuit layouts in a polyimide construction are highly customized to deliver exacting performance up to 250°C.

EZ-ZONE® RM Multi-loop controllers are fully scalable with up to 152 PID Loops and 256 monitor points per system.

Watlow provides innovative solutions to help process tool manufacturers meet the needs of the semiconductor technology roadmap. Our approach is to work collaboratively to help solve complex thermal challenges associated with state-of-the-art manufacturing processes; helping to improve yield, throughput and cost of ownership. This includes innovative heaters, controllers and sensors for use in front-end and back-end applications such as CVD, PECVD, Etch, Diffusion, Bonding, IC test and more.

ASSURANT™ gas and pump line heaters feature high temperature capabilities with low outgassing.

Contact Watlow® today for the latest thermal solutions for semiconductor applications.

European Technical Sales Offices

Germany +49 (0) 7253-9400-0
info@watlow.de

France +33 1 41 32 79 70
info@watlow.fr

Italy +39 02 4588841
italyinfo@watlow.com

Spain +34 91 675 1292
info@watlow.es

UK +44 (0) 115-964-0777
info@watlow.co.uk

WATLOW®

Singapore MIT Alliance focuses on wafer-scale integration

Singapore and MIT partners have joined forces with Global Foundries to drive III-V CMOS integration forward. *Compound Semiconductor* talks to Professor Eugene Fitzgerald from MIT to find out more.

US-based Massachusetts Institute of Technology and the National Research Foundation of Singapore have joined forces to drive wafer-scale integration of III-V-on-silicon forward.

The Singapore and MIT research centre, known as the Singapore MIT Alliance for Research and Technology (SMART), launched the $35 million Low Energy Electronics Systems (LEES) project in January this year.

Led by Eugene Fitzgerald from MIT's Department of Materials Science and Engineering and Soon Yoon from the Electrical and Electronic Engineering Department at Nanyang Technological University, Singapore, a team of researchers from both organisations aims to develop novel materials, process technologies and integrated circuits on 200 mm CMOS-compatible silicon wafers.

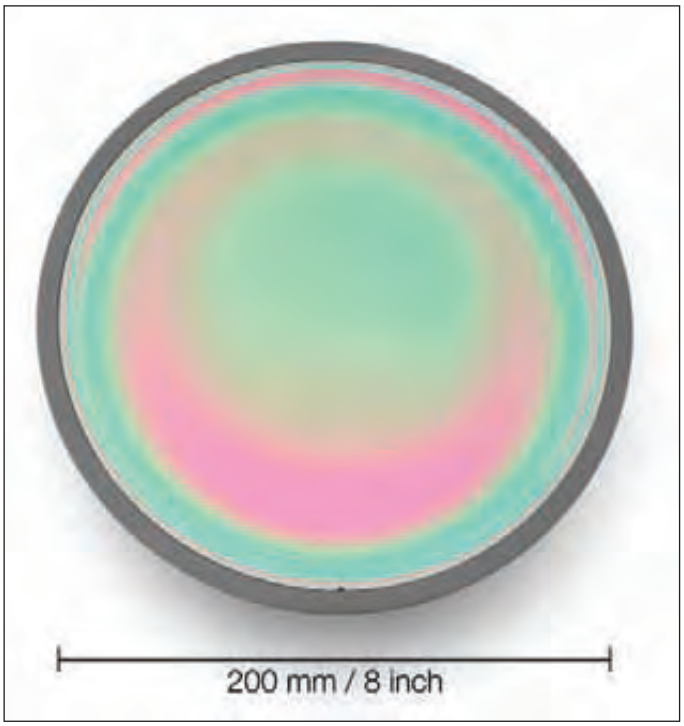
"A lot of III-V device interest for CMOS is being pursued in research labs, but we're not focusing on that. We want to take CMOS as it is and take III-V semiconductors, bring them together and make a silicon system that has great value," says Fitzgerald. "We're looking for new applications and new end-markets."

The team is currently building a fabrication plant in Singapore, which is due to open in January 2013. As Fitzgerald's colleague, Yoon points out, the facility will comprise a clean room with epitaxial tools, particularly MOCVD, so researchers can work on GaN, GaAs and InP deposition on silicon substrates. Indeed, the researchers placed an order for two Aixtron CRIUS 1 x 200 mm systems earlier this year.

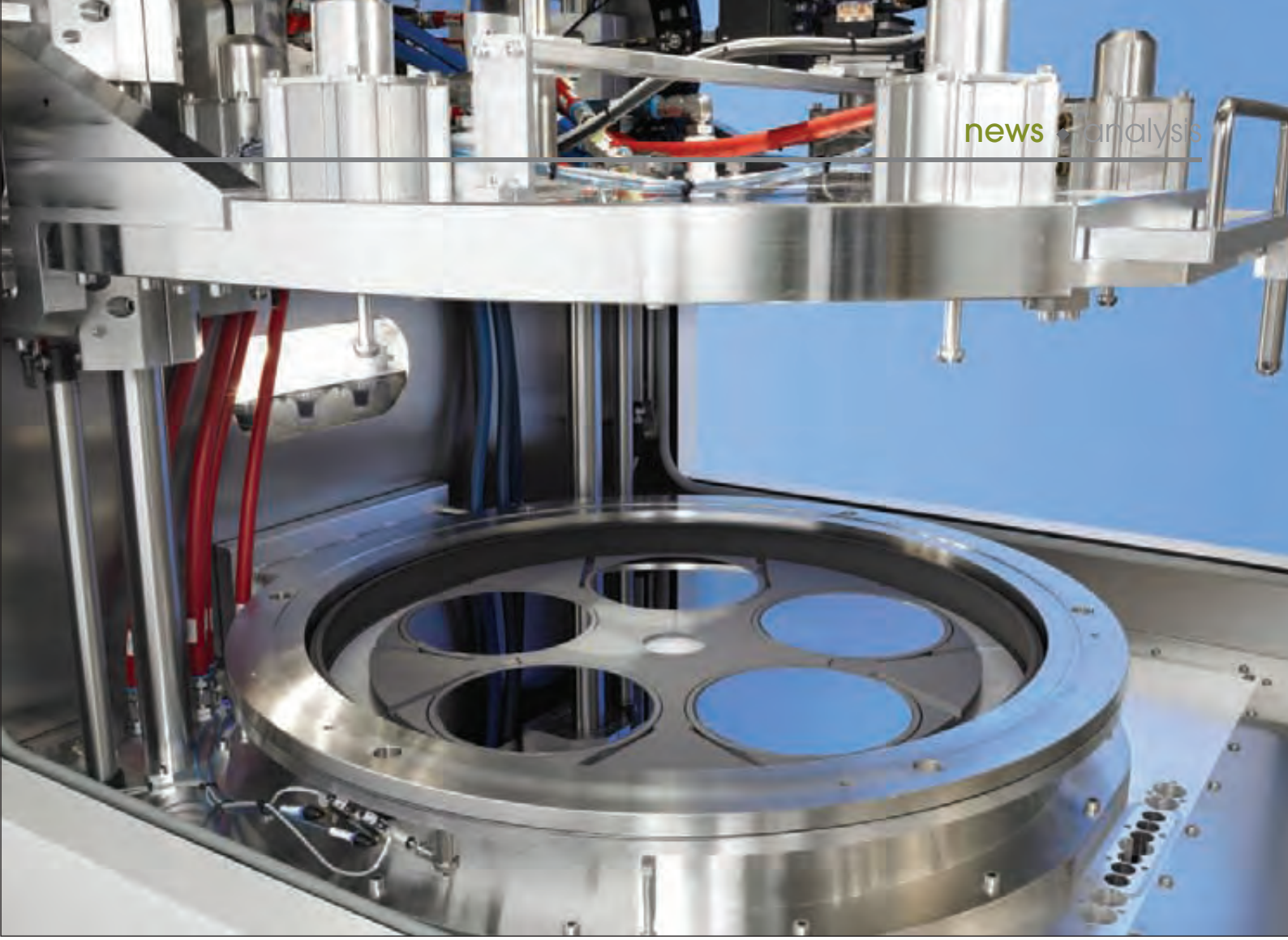
Crucially, the researchers are also working with Singapore-based Global Foundries, the world's second largest independent semiconductor foundry, to trial their III-V semiconductors on CMOS processes.

"We've signed an agreement with Global Foundries to run our technology at the foundry," says Yoon. "Researchers at our LEES laboratory will be working on the III-V materials, with these materials then being moved out of our clean room and into the foundry for CMOS processing. The wafers will then come back to us for the final layers, at which point most of the electronic circuits on the silicon side will have been processed."

As Fitzgerald emphasises, the LEES laboratory is being built to complement manufacturing 200 mm silicon wafer plants. "By building this missing piece we can develop device models based on III-V semiconductors and plug them into CMOS designs. This will allow designers to create new integrated circuits," he adds.



The LEES project aims to develop novel materials compounds and integrated circuits on 200mm silicon wafers. Credit: Aixtron



Aixtron systems will be used as part of the project from the fourth quarter of 2012. Credit:Aixtron

However, materials research remains crucial to the project, and the researchers will be using well-established techniques, including aspect-ratio trapping and metamorphic buffer layers, to minimise the lattice mismatches and strain between III-V materials and silicon substrates.

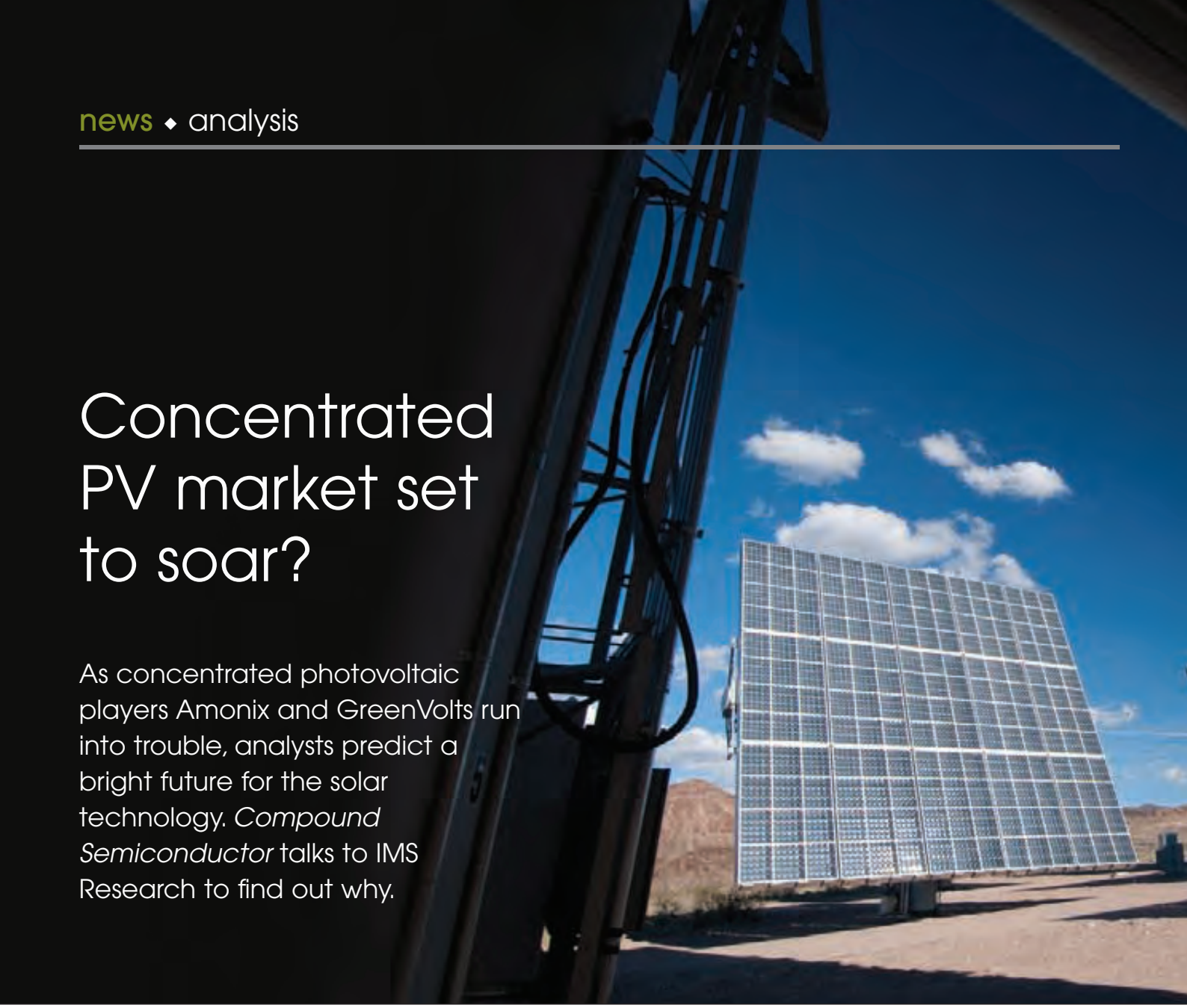
Aspect-ratio trapping uses high-aspect-ratio, sub-micron trenches to trap threading dislocations and reduce the dislocation density of the lattice-mismatched material grown on silicon. The hetero-integration technique has already been used to integrate germanium and III-V devices on silicon including GaAs MOSFETs, lasers and tunnel diodes.

Meanwhile, metamorphic buffer layers are deposited to absorb the strain between lattice-mismatched layers, prevent the propagation of dislocations and ensure the quality of the device active layers. Researchers worldwide have developed myriad buffer layer designs to grow, for example, InP on GaAs and SiGe on silicon. With this in mind, Fitzgerald is now looking forward to having a wealth of different methods to produce quality materials for the desired circuit. “In some cases you might want to use small-area growth or aspect-ratio trapping, while metamorphic buffers can be used to make entire substrates suitable for device [growth],” he says.

But as he points out, his team will be using combinations of these methods to achieve the defect density required for different devices, from transistors, LEDs and lasers to integrated photovoltaics and micro-batteries.

“It all comes down to what defect density you need to achieve the desired performance and reliability in a device,” he adds. “Take reliability, this can only really be determined when you are building your circuits, as that’s when you can test what defect density is needed from a circuit. So in Singapore we will be working at this level to really find out what the missing pieces are to build the desired circuit.”

Materials research remains crucial to the project, and the researchers will be using well-established techniques, including aspect-ratio trapping and metamorphic buffer layers, to minimise the lattice mismatches and strain between III-V materials and silicon substrates



Concentrated PV market set to soar?

As concentrated photovoltaic players Amonix and GreenVolts run into trouble, analysts predict a bright future for the solar technology. *Compound Semiconductor* talks to IMS Research to find out why.

Only two months after market leader, Amonix, closed its manufacturing facility in Nevada, concentrated photovoltaic start-up, GreenVolts, called an end to most operations after key financial backer, ABB, pulled the plug on investment.

News report after news report predicted doom for the CPV market until late September, when UK-based IMS Research forecast sharp growth for the compound semiconductor-based technology. Predicting the CPV market to double in 2012, company analyst, Jemma Davies stated: "[Installations] will grow rapidly over the next five years to reach almost 1.2 GW by 2016."

At a time when key industry players are clearly struggling, why would an analyst firm paint such a rosy picture? According to Davies; "it's all based on perception".

Concentrated photovoltaic technology uses lenses or curved mirrors to concentrate the sun's energy by a factor of several hundred onto photovoltaic cells, fabricated from compound semiconductors, rather than silicon. Thanks to the massive magnification factor, plus a conversion efficiency of around 40 percent – compared to less than 20 percent for typical cells manufactured from crystalline silicon or thin film material – the price per Watt of the actual cell is by far the lowest compared to rival technologies. .

However, factor in technology complexities at the module level, and these cost advantages fade fast. Recent figures from the US Department of Energy's Energy Information Administration (EIA) state the average price of CPV module was $1.32/W in 2011, relative to $1.63/W for crystalline silicon and $1.28/W for thin-film systems.

But as Davies explains, CPV comes into its own when you look at the levelised cost of electricity. This figure represents the system cost or per-kWh cost of building and operating a module across its lifetime.

already competing successfully against manufacturers of other photovoltaic technologies.

Crucially, these regions receive a lot of solar radiation. “In south-west US where the direct normal irradiance is higher, CPV becomes a viable option when you consider the levelised cost of electricity,” says Davies.

And it’s not just this region of the world. Davies expects strong growth to come from Mexico as US-based CPV system developer, SolFocus, readies to provide thousands of systems to a 450 MW project planned in Baja California.

Meanwhile, Soitec and Schneider Electric are busy installing pilot projects in Morocco, totalling 10 MW, as the Moroccan Agency for Solar Energy lays out plans for 2 GW of solar power by 2020. And more than 100 MW of solar power is planned in the north of Chile to power remote mines. Davies reckons CPV will be favoured here as the technology will tolerate the region’s dramatic temperature fluctuations more than convetional PV.

“Saudi Arabia has a 16 GW target, with projects at least 1 MW in size,” she adds. “This is ideal for CPV, as the technology benefits from being deployed on a large scale, and the companies with the lowest levelised cost of electricity will win.”

Clearly myriad projects are taking off, but can we ignore the fact that key industry players, Amonix and GreenVolts, are grounded? Davies highlights Amonix may have closed operations, but it hasn’t disappeared completely. “The company was always planning to come back online with a new generation of systems and there have been no announcements to contradict this,” she says.

Meanwhile, she believes ABB withdrew GreenVolts’ funds following uncertainty in the overall PV market, not a reluctance to invest specifically in CPV.

“Its perception is one of the major barriers for CPV suppliers, and these announcements overshadow success stories from suppliers such as Soitec, SolFocus and SunPower,” she says. “Investors see this technology as an underdeveloped hot-bed of technology. These misplaced perceptions have a negative impact on the bankability of CPV suppliers.”

“Put this technology in one of its target markets and it will generate a much higher amount of electricity over its lifetime than rival [photovoltaic] technologies,” she says. “This means the kilowatt hour cost comes down and the technology will become much more competitive over the next five years.”

And as Davies is keen to point out, industry is beginning to realise this. US and central America are the largest markets for CPV technology; the majority of suppliers are based here and are

Soitec and Schneider Electric are busy installing pilot projects in Morocco, totalling 10 MW, as the Moroccan Agency for Solar Energy lays out plans for 2 GW of solar power by 2020. And more than 100 MW of solar power is planned in the north of Chile to power remote mines

GaN-on-silicon wafers prepare for LED production

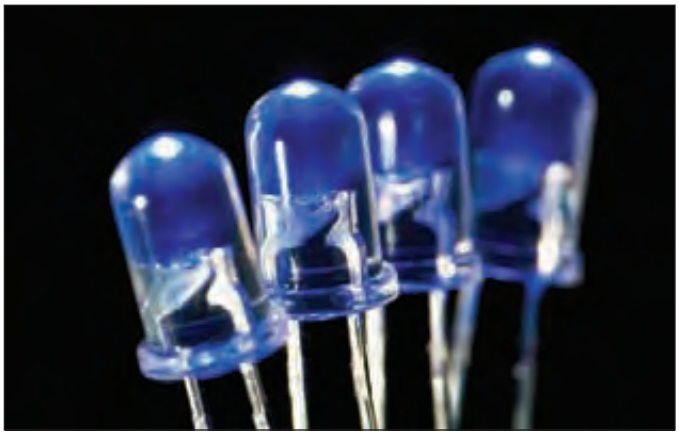
Will a new raft of GaN-on-silicon materials systems speed the LED industry's switch to silicon substrates?

While LED manufacturers usually buy substrates and then perform epitaxy in-house, an alternative manufacturing route is emerging. Recently, a handful of companies has unveiled GaN-on-silicon templates that allow manufacturers to grow LED layers directly onto a silicon wafer. Up and coming players include Germany-based Azzurro Semiconductors, and a pair of US companies, Translucent and Kyma. But why the dash to produce engineered on-silicon templates?

Although silicon is cheaper than the most commonly-used wafer, sapphire, the substrate represents only 5 percent of the total LED package cost. So clearly no major cost savings here. However, factor in the opportunity to manufacture on a silicon line, and this is what makes the switch to silicon wafers very worthwhile.

"Most players would be interested in using this technology," explains Pars Mukish, technology analyst at Yole Développement, France. "By using silicon they could access depreciated CMOS equipment, where the real cost savings are."

But despite the cheaper manufacturing costs, nearly 95 percent of commercial GaN-based LEDs are still grown on sapphire, around 5 percent made on SiC, and less than 0.1 percent deposited on silicon wafers. Clearly, industry has yet to be convinced that silicon-based LEDs will make the grade. Worries over lattice mismatches between GaN and silicon layers leading to bowing and cracking of wafers at high epitaxy temperatures as well as poor manufacturing yields and LED performance run deep. But this could soon change.



Earlier this month, Azzurro Semiconductors, Germany, announced that Taiwan-based LED manufacturer, Epistar, had transferred existing GaN LED structures, previously grown on sapphire, to its 150 mm GaN-on-silicon materials system in just 16 weeks. This template comprises a 150 mm silicon wafer onto which an AlN buffer layer, stain-engineered buffer layer and highly doped *n*-GaN layers, have been deposited. The LED manufacturer then grows the additional GaN layers, specific to the LED architecture, onto the template.

"The issue is how to produce a buffer structure on the silicon template in a sensible time, and that's where our IP is coming into play," says Erwin Ysewijn, vice president of marketing and sales asserts. "The template has a 3.5 μm-thick buffer layer with an *n*-GaN termination, which is in effect the same as the LED leads. We call this plug and play; you take your standard crystal structure and plug it into another material."

And success looks imminent. Both Azzurro and Epistar have confirmed the latest LED performance is on a par with the sapphire-based equivalent, with Ysewijn also highlighting Azzurro's intent to ship 200 mm templates next year.

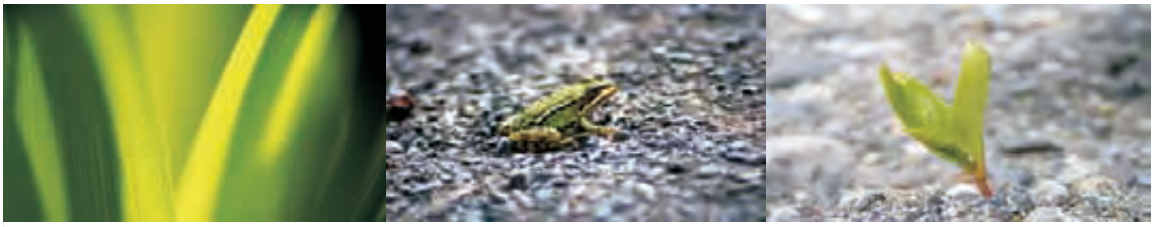
"Our 150mm templates are in production and we are shipping to market," he says. "The 200 mm templates will go into production in the second quarter of next year, and I would say we will be sampling these from the first quarter."

Azzurro also reports that its strain engineered templates enable 150 mm LED epiwafers with a bow value of less than 20 μm, while a 1.5mm by 1.5 mm LED chip will have a 125 lm/W output. But what are the actual yields? Ysewijn remains tight-lipped here, saying yields are 'industry standard'. Meanwhile Shao You Deng, associate vice president of product management at Epistar, categorically states that more work needs to be done.

"Yes, the best record of the optical output power is very close to LEDs grown on a sapphire substrate, but we still have many production issues to overcome, including defects, voids, pits, uniformity bowing and cracking," says Deng. "Yield and cost will trigger production... there is a long road to go before we release a product."

So, if LED makers are still grappling with these issues, will we see the template business model taking off soon? Or will manufacturers keep their all production processes in-house? Mukish from Yole Développement, admits the answer is not yet clear.

"The template business model will help manufacturers to invest a lot less in additional equipment, so it would be a lot more economical to grow [LED structures] on this technology," he says. "If come the mid-term this technology is performing, then yes, they will buy the templates."



CS CLEAN SYSTEMS®

Safe Abatement of MOCVD Gases

- Waste gas treatment for MOCVD research and manufacturing
- Safe, dry chemical conversion of toxic gases to stable solids
- Proprietary CLEANSORB media specially developed for high MOCVD gas flows
- Backup column for 100% uptime
- Integrated capacity endpoint sensor
- Local refill service worldwide
- No handling of toxic waste
- Newly-developed chemisorber for GeH_4 applications

For more information please contact
CS CLEAN SYSTEMS AG under:
Phone: +49 (89) 96 24 00-0
Email: sales@csclean.com

www.cscleansystems.com

Professional Vacuum Motion

Kurt J. Lesker Company

www.lesker.com

Kurt J. Lesker Company
United States
412.387.9200
800.245.1656
salesus@lesker.com

Kurt J. Lesker Canada Inc.
Canada
416.588.2610
800.465.2476
salescan@lesker.com

Kurt J. Lesker Company Ltd.
Europe
+44 (0) 1424 458100
saleseu@lesker.com

Kurt.Lesker (Shanghai) Trading Company
科特·莱思科(上海)商贸有限公司
Asia
+86 21 50115900
saleschina@lesker.com

12-021

CS International Conference

Incorporating CS Europe

www.cs-international.net

4th-5th March 2013 Sheraton Frankfurt Airport, Germany

Agenda Day 1

Chaired by

Dr Andrew Nelson, IQE
President and Chief Executive Officer

Keynote speaker

Dr Wilman Tsai, Intel Corporation
Program Manager of Technology Manufacturing Group, Intel III-V CMOS for High Performance and Low Power Logic Devices

Asif Anwar, Strategy Analytics
Director Strategic Technologies Practice
What's the Future of GaAs Microelectronic Manufacturing

Dr Thomas Uhrmann, EV Group
Business Development Manager
Wafer-Level Packaging of Compound Semiconductor Devices

Michelle Bourke, Oxford Instruments
Senior Product Manager
Review of The Various Deposition Techniques and Their Uses in Compound Semiconductor Devices

Gunnar Stolze, Oclaro Inc
Vice President, Global Sales
Industrial and Consumer High Power Lasers

Malcolm Harrower, Indium
Sales Manager Europe
Overview of CS Critical Elements – Indium, Gallium and Germanium

Allan Jaunzens, Evatec
Marketing Manager
Presentation TBC

Dr Elisabeth Steimetz, LayTec AG
Director Marketing and Sales
In-Situ Monitoring - The Key to MOCVD Production Process Control and Yield Enhancement

Dr Michael Lebby, Translucent Inc
General Manager & Chief Technology Officer
Challenges & Opportunities of Using Epitaxial GaN, GeSn, & Rare Earth Oxides on Large Format Silicon Wafers for Power Electronics, Solar, & Lighting

Noriyuki Matsubara, Panasonic Europe
Dry Etching and Photolithography Engineer
Dry Etching Technology for III-V Devices

Gregg Wallace, Temescal
Managing Director
Fundamental E-Beam Coating Collection Efficiency & Paths to Improvement

Pars Mukish, Yole Développement
Market & Technology Analyst
New Trends in LED Industry: A focus on China and GaN-on-Si LEDs

Dr Schang-jing Hon, Epistar Corporation
Associate Vice President
High-Voltage LED for General Lighting Application

Professor Tao Wang, Seren Photonics
Scientific Advisor
Improving LED Performance

Marianne Germain, EpiGaN
CEO and Co-founder of EpiGaN
GaN Epiwafers for Power and RF Electronics: From Development to Production

Scan the QR to download full conference information

Platinum Sponsors

AIXTRON

evatec process systems

EVG®

LAYTEC in-situ metrology

OXFORD INSTRUMENTS The Business of Science®

SAFC Hitech™ Enabling Technology

Temescal

YOLE Développement

Bringing together leading Compound Semiconductor industry insiders

Gain a comprehensive overview of the entire compound semiconductor industry-the must attend event for 2013 is the 3rd CS International conference in Germany, at the Sheraton Frankfurt Airport on 4th-5th March 2013.

Delegates will have the unique opportunity to network with leading industry professionals of the III-V chip making industry, interact with suppliers and industry experts who will deliver the latest research, business models, and insights.

Agenda Day 2

Chaired by

Dr Andrew Nelson, IQE
President and Chief Executive Officer

Daniel Cline, Lux Research Inc
Senior Analyst
WBG Devices Electricity Grid Opportunities

Dr Philippe Roussel, Yole Développement
Business Unit Manager
GaN vs SiC in Power Electronics - Status and Roadmap to 2020

Dr Frank Schulte, Aixtron
Vice President
MOCVD - Enabler for mobility and energy efficiency

Ms. Ann Hughes, SAFC
Business Manager
Innovation to Maximise Production Uptime

Bryan Bothwell, TriQuint Semiconductor
Strategy and Business Development Manager
Maximizing Gallium Nitride Product Solutions and Foundry Services for Advanced RF Design Success

Dr Markus Behet, Dow Corning Corporation
Global Market Segment Manager Power Electronics
Large Diameter SiC and GaN/Si Substrates as Cost-Effective Solutions for Power Electronic Applications

AJ Nadler, RF Micro Devices (RFMD)
General Manager, R&D and Engineering Gallium Nitride for High Voltage Power Electronics

Keynote speaker

Dr YiFeng Wu, Transphorm
Vice President, Product Development
Status of High-Voltage GaN Power Electronics

Dr Vijit Sabnis, Solar Junction
Vice President, Technology
Really High Efficiency Triple-Junction Solar Cells

Dr Rainer Krause, Soitec
Director Smart Cell Incubator Unit
PV Chip Development

Dr Simon Fafard, Cyrium Technologies Inc
Chief Technical Officer
Novel Solar Cell Technology

Erwin Ysewijn, Azzurro
VP Sales & Marketing
GaN on Si. Large Size High Voltage Wafers showing Superior Electrical Performance and Volume Production Track Record

Dr Tudor Williams, Mesuro Ltd
Senior Systems Engineer
Improving RF Measurements

Dr Ertugrul Sönmez, MicroGaN
Director, Business Development
Addressing Emerging Power Market

All speakers and presentations are subject to change

Please visit www.cs-international.net for further information
or register at: www.cs-international.net/registration

Gold Sponsors

CS CLEAN SYSTEMS · DOW CORNING · EAG Evans Analytical Group · EPIGAN · IQE · INDIUM · Johnson Matthey · MATERION · MERSEN · RFMD · SAES Pure Gas · S3Alliance · Translucent · united monolithic semiconductors

Outsourcing promises profitable PICs

The folding of Metrophotonics in late 2005 was a blessing for one its former employees, Valery Tolstikhin. It encouraged him to try and fulfil his dream of founding a firm with a radically different business model: Using pure-play RF foundries to make optical devices from photonic integrated circuits. Richard Stevenson quizzes him on the details of this vision and the successes to date.

RS Conventional wisdom decrees that photonic integrated circuits (PICs) must be made in-house to ensure high yields. You have a completely different take on this, don't you?

VT Yes. I think that in-house production kills photonic integration, or any other sophisticated component manufacturing for that matter. High yields and low costs only come with appropriate equipment that allows for automated control, quality systems and so on. All of these are only achievable in volumes, and require processes that match the design rules of the fab and the equipment that you deal with.

This is not the case for PICs produced with in-house manufacturing, because, generally speaking, photonics is a very low volume market. It is low on the scale of overall InP production, which is probably about 90 percent RF. So there is no path for any tricks or specific processes to be generalised. So you cannot scale up, and without scaling up you'll never afford high-end equipment or see standardization and automation leading to cost-yield advantages. That is a vicious circle.

What I tried to do in the very beginning – and this was how the company was founded – was to break this circle. My approach was to use standard processes that are available on the market, and preferably, standardize design and fabrication of functional elements of the PICs based on these processes. However, this is only possible when the circuit design is decoupled from the device physics, and design is decoupled from manufacturing. The later requires that you go fabless.

My approach was based on that, and the question was this: Where can I find a big, pure-play foundry to work with? I looked across the board at twelve to fifteen so-called photonic foundries, each contacted directly, and tried to find out what they could and couldn't do. I came to a very clear conclusion: None of them are really pure-play foundries, in a way one would expect, say, in the silicon IC business. So I turned towards the InP electronic foundries, which have some features of volume scalability, design to manufacturing, autoCAD and the like. It's not to the extent found in the silicon industry, but it is at least in this direction.

Working with these foundries has one significant sacrifice – you have to give up all the processes that are not part of these

foundries. Epitaxial re-growth, for example, is totally excluded, and these foundries don't have cleave-and-coat because they don't need this. However, if you manage to go around these issues and reduce the processes to standard etching, passivation, planarization and metallisation steps, you can leverage their cost structure, their tools and their yield control. That's the path to go for PICs to become an industry; not in-house micro-production.

RS What is your core technology?

VT It's an original technology that allows monolithic integration of active and passive devices onto the same substrate in one epitaxial growth step. We do this by vertical stacking of the required materials - all photonic integration is about providing the materials that are right for the function.

We have to use different materials for the detectors and the lasers, and yet combine them on the same substrate. If you don't use re-growth, the only way you can do this is to stack them up vertically, in a form of vertically integrated functional optical guides. Because of this, we term our re-growth free PIC (photonic integrated circuit) technology as Multi-Guide Vertical Integration (MGVI).

RS How does your technology differentiate you from most of the component manufacturers in the telecom industry?

VT Most InP component manufacturers make discrete devices, such as lasers and photodetectors, and package them in TO cans. Other firms then buy them off the shelf and assemble in a photonic circuit. We are different because we don't do discretes – only PICs. This means that we have a totally different package technology. We have to package an entire PIC with full functionality on it, as opposed to mechanical assembly from discrete parts, which on the active device side are usually pre-packaged in TO cans.

There are also a relatively small number of component manufacturers that do some degree of photonic integration, such as Oclaro and JDSU. The way we are different from those is the technique we use for photonic integration. All our competitors, without exception, use multi-step growth fabrication processes, based on multiple selective etching and re-growth steps. We don't do this.

RS How are you different from Infinera, the most famous maker of photonic integrated circuits?

VT Infinera owns and uses by far the most advanced PIC technology in the world. However, this technology is also probably the most costly and least yielding commercial PIC technology, due to the complexity of the PICs produced. The way these chips are fabricated requires many growth steps.

For Infinera, this doesn't really matter. It doesn't sell PICs or components: It only sells systems, and PICs are just a tiny fraction of the cost of the system. Once they have the fab and run three shifts, it works well for them. Whatever the engineers yield, more or less, doesn't really matter because it is still a small cost compared to the cost of the system.

That's a business model that allowed Infinera to start selling early, because imperfectness of the PICs can be hidden by the system. They have never tried to sell any components, because, for them, it would be cost prohibitive.

We are different in all respects. We sell components, and in certain markets we may sell PICs. We cannot hide that cost into the system, so we do care a great deal about the PIC costs.

RS Do you do carry out any part of the manufacturing process in-house?

VT We don't have production *per se* in house, but we do have some packaging process development, as well as an extensive test and measurement capability. The package for the PIC is not the same as for the TO-can. It's not a commodity, so we had to develop some packaging processes in-house before we outsourced them.

RS Ottawa has a rich history in the photonic business. It was once home to the largest systems company, Nortel, and the largest component company, JDSU. Is it a good place to be based today?

VT Although Nortel is now defunct, there are a bunch of companies that bought pieces of Nortel and started building up on that. Why is this happening here? There is a talent pool and there is a vibrant Ottawa photonics cluster that stretches from basic research to photonics entrepreneurs. Beside that, the Canadian government provides nice incentives to hi-tech start-ups. Put all this together and it makes good sense to have a business here.

RS Since the burst of the 'dot.com' bubble a decade or so ago, the telecom sector has seen many mergers and little profit. Given this backdrop, how did you mange to win funding to start?

VT It's a misconception that investors are shying away from this business simply because it was in a bad shape years ago. They are always looking for a good deal. We had a great idea, an experienced team to implement it, and a very, very attractive market.

RS What parts of optical network infrastructure are you targeting?

VT Initially, we started with the ONU [Optical Network Units] sector of the PON market – both Ethernet PON (EPON) and Gigabit PON (GPON). This choice was based on our business model, which required that we choose a market with high volumes and cost sensitivity.

RS Talk me through the key features of your go-to-market product?

VT For FTHH – or say TDM (time-domain multiplexing) PON, which is the biggest slice of this market – we offer PIC-based solutions to ONU transceivers. Currently these are EPON and GPON transceiver modules – a whole module with a pigtail – and also GPON bi-directional optical sub-assemblies (BOSAs).

We have EPON and GPON ONU transceiver modules available now. GPON BOSA is coming a little bit later, but still this year. There is a trend on the market away from a complete module to an on-board BOSA, and we follow this.

RS One of the biggest selling points of your product is its low manufacturing cost compared to traditional transceivers. How big are the cost savings?

VT Of course, I cannot give you the numbers since this is proprietary information. However, think this way. The PON market is a very harsh market and I believe we are the only ones who could put together a PIC-based transceiver for this market. Nobody else could make it for the price.

In addition to the cost saving, our PIC technology provides certain advantages in performance, robustness and footprint size. The PIC itself offers a huge advantage in overall photonic circuit stability by eliminating any moving parts. Then, our specific PIC platform, MGVI, offers best-in-class performance, or at least state-of-the-art solutions, for many key elements of the PIC, like spot-size converters and waveguide photodetectors. We have some advantages in the mode stability of the lasers because of the platform we use, too. This translates into good customer traction.

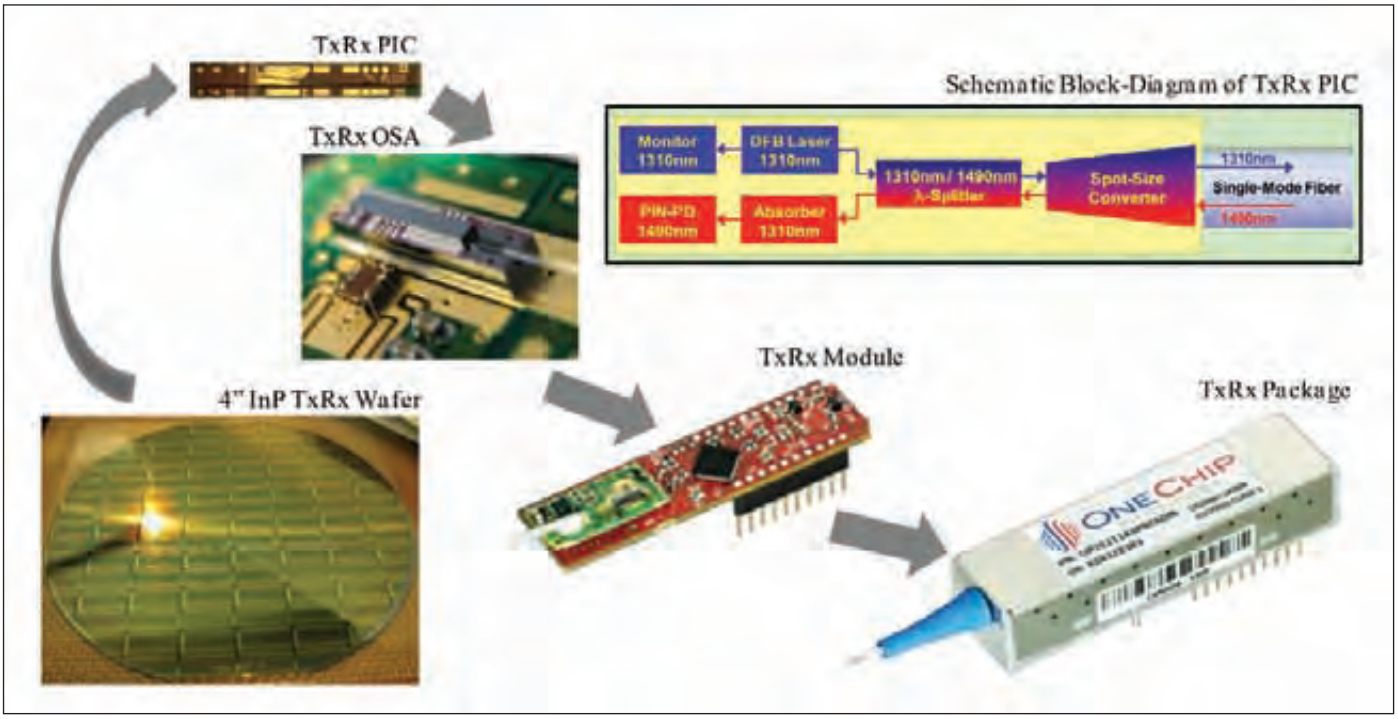
RS How much investment has OneChip netted so far, and when do you expect to hit profitability?

VT We have raised above $60 million, and we will need more for production-capacity-build-up, which is coming. I believe we will be a profitable venture by the end of 2013, with an accuracy of a quarter or so.

RS The company is now in its sixth year, and it is only just starting to sample its first product. That seems like a long time to go to market. Is that a fair criticism?

VT It depends on your perspective. We don't assemble the parts made by others, and we don't use investors' cash to buy equipment to make the things that other people do. We have developed a brand new technology, and this is intimately related to the brand new business model. So it takes time, especially given that our initial products are modules, not just PICs, and hence required an adequate packaging technology to be developed as well. It's not PICs that we sell – we had PICs ready a couple of years before we started sampling the modules. All the rest takes time as well.

Let me give you a few examples, so you can compare our progress to that of others. Infinera started in 2000 and they announced the first digital node product featuring their PICs in about 2006, so it took them about six years [to bring their first product to market], despite an investment of above $300 million. In a different world, silicon photonics, the most prominent company today is Luxtera. They started in 2001 and sold their first active optical cables – essentially a pair of optical transceivers with a piece of fibre between them in – 2009. Luxtera are a bit like us, as they are fabless and have worked with a CMOS foundry.



The manufacturing process flow employed by OneChip Photonics for the production of its first product, which targets the Optical Network Unit market

RS Do you expect the telecom components market to pick up?

VT The telecom component market doesn't seem to have great capacity to grow, apart from the access market. But if you add on the datacom market, that's a totally different picture. We see huge potential in the datacom market, driven by social media rise that skyrocketed demand for bandwidth and data storage/processing, which eventually will result in the datacom market surpassing the telecom market by far.

RS How will your product portfolio expand over the coming years?

VT Over the last five years we have extensively been in development. It's not just the PON product, but generic PIC technology development. This is based on a number of unique things, like the separation of growth and processing, and the separation of device and circuit design.

The latter allows re-use of the once-developed building blocks, which are devices with a certain specific functionality, such as lasers or detectors. This is the key to our product portfolio. We take those building blocks and re-use them with very little modification – not changing basic design, process, or things like that – to other applications.

What are these other applications that we are looking at? We want massive markets with cost sensitivity, so we have started looking at optical interconnect markets for datacom, because they are driven by the same cost-volume dynamics as the PON market.

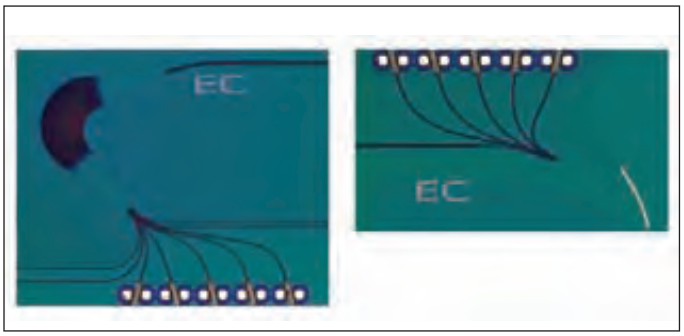
We have in the pipeline, in different stages, 40 G coarse WDM for QFSP and QFSP+ packages and 100G LAN WDM for data centre interconnects. Also, we have space division multiplexing solutions for 40G and 100G optical interconnects, phase and polarization division multiplexing for 100G coherent and various combinations of all multiplexing techniques I have described for expanding our portfolio well beyond 100G.

We have all that in different stages of development, with a roadmap taking us to 1 Terabit. Overall, the markets we address are in the multi-billion dollar range.

RS How many products do you expect to sell over the next few years?

VT It depends on what you mean by product. Some people change the socket and call it a different product. We identify market areas. There is definitely a PON market in which we will continue to build up, so we have more products to offer to them. This market is very healthy, and growing steadily.

We also see a huge opportunity in optical interconnects. This is a very wide area, and we only target the sectors that require a fibre and propagation over a few hundred metres. So it's not chip-to-chip. It's single-mode fibre, with all kinds of multiplexing – space, wavelength, phase and polarization.



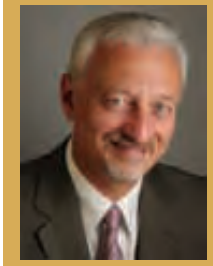
In May 2012 OneChip Photonics released its 4 x 25(28)G LAN WDM receiver PICs, which are now being trialled by tier I customers. Each of these products combines: A spot-size converter for efficient, alignment-tolerant fibre-coupling; a WDM section, either in the form of arrayed waveguide grating or a diffractive echelle grating; and an array of waveguide photodetectors inserted in the output waveguides of the WDM unit

RS You have selected Fabrinet for your contract manufacturing. Why did you choose them, and are they your only partner?

VT We looked at many companies before selecting Fabrinet. For the time being, and given the product of today, we choose Fabrinet as the number one, based on cost-to-value. That fits today's assembly needs. However, we also have agreements with Sanmina SCI, and we are on the lookout for new partners. Fabrinet works for us very well now, but we are not locked in with them forever. For epi and wafer processing we use separate, big commercial foundries.

RS Will your manufacturing partners be able to cope with this ramp in production volumes?

VT Yes. The manufacturing model based on PICs is very scalable. You don't have to hire and train new assemblers – you just add more wafers. There are no limits here. Even if we have the lion's share of the telecom and data-com markets, this will be a small fraction of InP production for RF. Even with existing manufacturing capabilities we are very well placed.



Valery Tolstikhin, Founder and CTO of OneChip Photonics, has been involved in research and commercialization of advanced semiconductor devices for micro- and optoelectronics since completion of his PhD in 1980. His work in photonic integration started in late nineties and includes development of new integration platforms, novel integrated photonic devices and original PICs in InP. Tolstikhin is an adjunct professor at the University of Ottawa

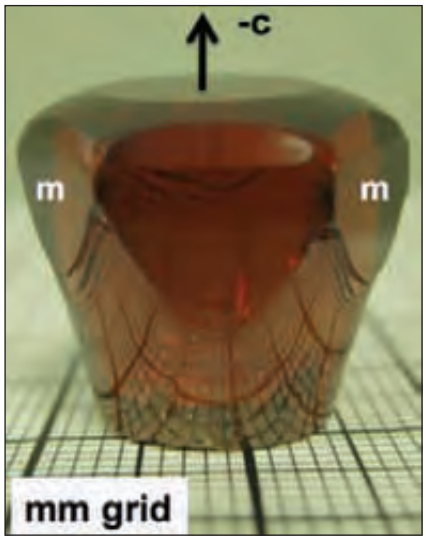
Novel growth technologies are unveiled at Sapporo

Forming high-quality GaN via growth through holes and coalescence, using sputtering to form high-quality nitride films on metal foil and increasing the versatility of this class of material with the addition of scandium all featured at the recent IWN meeting. Stephan Knoll from the University of Cambridge reports.

Japan has now played host to three of the seven biennial International Workshops on Nitride semiconductors. This first ever meeting in this series was held in Nagoya in 2000, six year's later Kyoto was chosen and this year delegates headed to Japan's most northerly island, Hokkaido. Although they were hit by chilly autumn winds on arrival, they couldn't fail to notice the heartfelt welcome they received at Sapporo. The weeklong workshop that they attended here kicked off on 14 October, slightly later than is traditional for this conference, so that they had the chance to admire and enjoy the colourful autumn foliage. Pushing out the meeting meant that the academic year had already started in many universities, but that did not quash attendance: The

conference attracted over 900 delegates. A wide range of excellent posters and presentations were delivered at the meeting, and following on from previous IWN workshops, talks were divided into four topics: In this case growth; optoelectronic properties and characterisation; optical devices; and electronic devices.

This year's meeting showcased the large volume of work, both from industry and academia, that is focusing on the development of bulk nitrides. The benefits of having readily available bulk substrates are already widely appreciated, with the absence of lattice mismatch freeing device makers and developers from problems associated with high dislocation densities and low radiative recombination efficiencies. However, these advantages come with a penalty – high substrate prices, which stem from high fabrication costs.



As-grown AlN boule, formed by physical vapour transport. Epi-ready AlN wafers are fabricated directly from these boules

The good news is that prices could tumble, thanks to significant leaps in progress made by many groups using various approaches. It will be interesting to see which one of these methods establishes itself as the best – this is sure to be one of the hot topics in future conferences.

One strong contender to driving down costs is the sodium flux method. A team at Osaka University, Japan, are pioneers of this approach, and at the IWN meeting Yusuke Mori described how he and his co-workers had learnt to yield low-dislocation-density, high-quality GaN from a poor-quality seed crystal.

This team has recently employed two technologies that have led to the fabrication of centimetre-sized bulk GaN single crystals with dislocation densities below 10^3. The first is described as necking, and involves forcing a GaN crystal to grow through a small hole in a sapphire plate placed over the GaN seed – dislocations propagating through this aperture bend and terminate at sample edges. The other is to coalescence multiple GaN crystals without generating dislocations at their boundaries.

Improvements in AlN also featured at the most recent IWN meeting, with wide bandgap materials developer HexaTech unveiling its low-defect-density, free-standing AlN. This company that is based in Morrisville, NC, produces these pieces of AlN via an iterative Boule expansion process, using AlN substrates as seed crystals. The process is scalable, with crystal quality maintained over many generations of boules (average defect density is less than 10^3 cm^{-2}).

One of the areas of improvement for these crystals is their level of transparency, which is hampered by sub-band transitions that are attributed to carbon point defects. However, this does not prevent Hexatech's AlN from providing a platform for impressive UV LED performance. Device structures produce an internal quantum efficiency of 70 percent, which is claimed to be the highest ever figure for this class of LED.

Arguably the most famous LED developer of devices built on native substrates is Soraa, a start-up founded by Shuji Nakamura, Steven DenBaars and James Speck from the University of California, Santa Barbara (UCSB). The firm's chief technology officer, Mike Krames, claims that their GaN-on-GaN approach has two big advantages over traditional LEDs: Dislocation density in the epilayers is three orders of magnitude less than that for GaN grown on sapphire; and droop, the decline in device efficiency as current is cranked up, diminishes by 15-25 percent. In February 2012, this west-coast outfit launched it MR16s flagship LED, which is based on this homoepitaxial technology and delivers 2400 cd at 12 W. This is claimed to produce a similar lumen output to a 50 W halogen lamp.

To spur widespread deployment of LED lighting, chip costs must fall. One way to do this is to reduce the growth temperature, possibly by switching from MOCVD to pulsed sputtering deposition (PSD), a technique that enhances surface migration. Hiroshi Fujioka from the University of Tokyo outlined this technology, explaining that it has produced device-quality III-nitrides at room temperature. According to him, PSD can be scaled up relatively easily, it allows fabrication on large area substrates, and thanks to the low growth temperatures associated with this technique, it is ideal for forming high indium-content devices, such as long wavelength LEDs and solar cells. The team have used PSD to form full-colour RGB LEDs on a metal foil and mica sheets.

GaN on anything?

Growth of GaN on substrates such as these also reduces LED chip costs, and for that reason it is currently attracting significant attention. Another low-cost platform is glass, which is widely used in the thin-film PV industry and has, amongst its attributes, large size and transparency. The main challenges associated with the growth of single-crystalline GaN films on glass are the low melting point of the substrate and the lack of a well-defined global epitaxial relationship between it and the epitaxial layer. However, it is possible to address these issues by first depositing a titanium pre-orienting layer. Researchers at the Samsung Advanced Institute of Technology, Korea simply evaporate titanium onto glass, and use this layer to provide an intermediary for epitaxial growth of GaN. This determines a common *c*-direction for the epitaxial layer, but in-plane rotation between different GaN islands occurs. Up until now, it has proved impossible to get them to coalesce, so deposition creates an array of randomly rotated GaN islands.

Growth of this GaN film is a two-step process that begins with the growth of a low-temperature GaN nucleation layer on the titanium pre-orienting film. A SiO_2 hole mask is added, before high-temperature GaN growth selectively allows certain grains to grow through the mask and forms GaN pyramids aligned with the *c*-axis. Each pyramid remain un-coalesced and functions as an individual micro-LED, delivering emission characterised by excellent uniformity.

Auger falls out of favour

In the on-going debate surrounding the physical origin of efficiency droop, it seems that Auger recombination is no longer the most popular explanation for its cause – many at IWN 2012 now seem to side with the view that carrier leakage out of the active region is the primary cause of this mysterious malady. One of the first team's to argue that this is the culprit is Fred Schubert's team from Rensselear Polytechnic Institute, NY, and at the meeting they detailed their analytical model for efficiency droop in LEDs. According to them, this model provides excellent agreement with experimental values.

Support for carrier leakage is coming from, amongst others, a partnership between the National Taiwan University and UCSB. Yuh-Renn Wu from NTU described efforts to understand the effects of nanoscale composition fluctuations in InGaN quantum wells, as found by atom probe measurements. Wu claims that although the indium fluctuations boost radiative recombination via enhanced local carrier confinement, they also lead to shallower junctions within the quantum well that result in greater electron overflow. He and his co-workers argue that it is possible to account for droop entirely by just considering charge leakage.

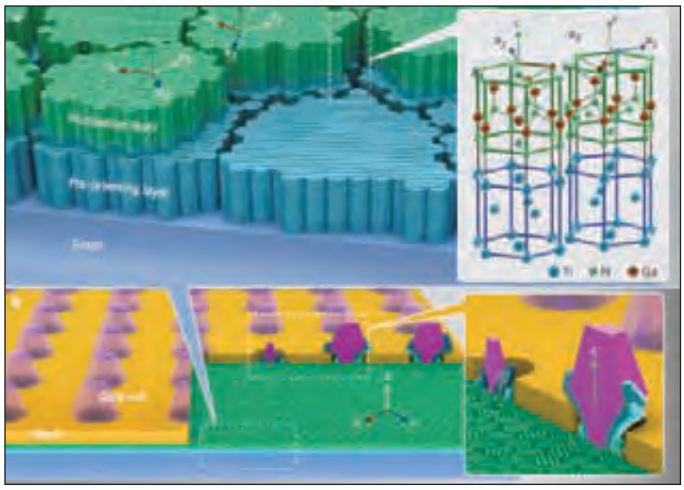
Different planes

Another highlight of the workshop was the talk given UCSB's James Speck, who detailed his team's progress in non-polar and semipolar GaN materials and devices. He began by reminding the audience of the biggest problem inherently associated with fabricating devices on *c*-plane GaN: Due to the polar nature of GaN, devices suffer from large internal fields that drive electrons and holes apart due to the quantum confined Stark effect (QSCSE) and ultimately limit radiative recombination efficiencies. To yield devices with respectable efficiencies, wells must not be too thick, which adversely affects the LED's droop behaviour.

Speck explained that to overcome the limitations imposed by the QCSE, researchers have turned to GaN growth on nonpolar and semi-polar planes. Devices grown on such planes benefit from either reduced or no electronic polarisation, but they produce broad luminescence linewidths and low efficiencies at higher wavelengths – these are areas for improvement.

Speck spoke of the benefits of selecting optimal semi-polar planes, such as $(20\bar{1}1)$ and $(11\bar{2}2)$, which show a high tendency for indium uptake. The downside of growth on semi-polar planes is that it often results in dislocation slip on the inclined basal plane, as well as the generation of misfit dislocations at heterostructure interfaces. However, despite the challenges, Speck and his co-workers have fabricated blue laser diodes on $(11\bar{2}2)$ semi-polar planes on relaxed buffer layers, which effectively suppress the effect of misfit dislocations near the active region.

A unique feature of the non-polar *m*-plane is that it intrinsically emits highly polarised light, which could find utility in a wide range of applications, such as efficient colour displays and quantum encryption. Until now, techniques for increasing LED light extraction, such as surface roughening or pattering, have paid the penalty of halting polarised light emission. But it is possible to combine high light extraction with polarized emission by building photonic crystal nonpolar LEDs. Speck's team has just made the first device of this kind.



Schematic representation for the growth of a GaN pyramid array on a glass substrate

Laser and LED performance continues to improve on every plane of GaN. Nichia used conventional GaN substrates to launch its first green laser diodes in August 2010, and it has subsequently increased their output power and wavelength. The first lasers emitted 50 mW at 510 nm, while at the IWN meeting they showcased 80 mW, 515 nm variants.

Novel nitrides

One way to improve the versatility of the nitrides is to increase the number of alloys that are available. A new entrant to the nitride portfolio is scandium nitride, which has been pioneered by Michelle Moram's team from Imperial College, UK. She explained that one of the strengths of scandium, compared with other transition metals, is that it is soluble in the nitrides across the entire composition range. What's more, it retains both a direct band gap and the wurtzite structure at low scandium fractions.

The London-based team have investigated the growth and properties of MBE-grown ScGaN and ScAlN alloys. At low scandium contents, a hexagonal structure is maintained and growth occurs mostly in a three-dimensional mode, with coalescence beginning at film thicknesses of 300 nm or more. According to Moram, although growth challenges remain, ScN is on track as a potential new member of the existing nitride family, thanks to its wide range of accessible lattice parameters and bandgaps.

These efforts, plus those of others in the nitride community, are helping to enhance the performance of GaN-based devices, whether they are grown on native material or low cost substrates, such as glass. More progress will be unveiled at next international nitride conference – the tenth International Conference on Nitride Semiconductors, which will be held on the outskirts of Washington DC in late August.

Slashing LED chip costs with large-scale silicon

By far the best way to slash the cost of LEDs so that this form of lighting can take over is to grow the devices on 200 mm silicon. On this platform, the big challenge is to address the thermal and lattice mismatches that can introduce distortions and imperfections in the GaN-on-silicon epiwafers. The good news is that it is possible to form high-quality, device-grade epilayers that are free from a low-temperature AlN layer and SiN interlayers with *in-situ* monitoring and growth optimisation, says Sudhiranjan Tripathy from IMRE, Singapore.

When one of your light bulbs fails and you head down to your local hardware store to pick up another, you may be faced with a greater choice than ever before. If your government is yet to ban the incandescent bulb, you can pick up a pack of these, which deliver great colour quality but are incredibly inefficient. Next to these you'll probably spot a range of compact fluorescents, which offer far better efficiency and last much longer, but may not be dimmable and will require careful disposal, due to the mercury they contain. And last but by no means least, you could find a new type of product on the shelves – the LED light bulb. It promises a lifetime of up to 50,000 hours, which is far longer than its rivals; it has an efficiency that exceeds the compact fluorescent; and its compatible with your dimmer switch. But it has an eye-watering price tag – expect to pay around $20 or more for a 60 W equivalent.

The primary culprit for this off-putting price tag is the high cost of the battalion of blue-emitting, GaN-based LED chips inside the bulb, which excite a yellow-emitting phosphor to create white light via colour mixing. To slash the cost of these GaN chips and make solid-state lighting more compelling, several groups of researchers around the world are developing devices built on large silicon substrates.

Switching to this platform will trim production costs on two fronts: The sapphire and SiC substrates that are widely used today are relatively expensive, and 200 mm silicon-based wafers can be processed cheaply in under-utilized 200 mm foundries dotted around the globe.

Efforts to unlock the promise of GaN-on-silicon LEDs are on going at several chipmakers, including Osram, Bridgelux-Toshiba and Samsung. Many of the researchers at these firms are trying to improve the epitaxial quality on large area silicon, because this is the biggest barrier to device commercialisation. It is essential to have an exceptional AlN nucleation layer and excellent intermediate buffers for the growth of high-quality InGaN/GaN multi-quantum wells (MQWs) on silicon. On top of this, a high level of homogeneity is required in the active layers to ensure good binning data. At the Institute of Materials Research and Engineering, A*STAR (Agency for Science, Technology and Research), Singapore, we have been focusing on these issues and have had noteworthy success. We have grown and characterized GaN-based blue LED structures on 200 mm diameter (111)-oriented silicon substrates, and followed this with an in-depth characterization study of LED epilayers by high-resolution X-ray diffraction (HRXRD) and scanning transmission electron microscopy (STEM).

In addition, we have produced prototype LED chips with impressive light emission characteristics. Bright blue emission from our chips that are formed on 200 mm silicon underlines the great potential of this GaN-on-silicon technology.

Managing the strain

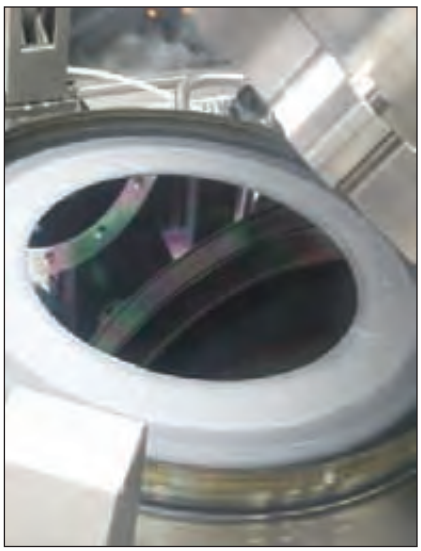
Producing high-quality nitride films on 200 mm silicon is challenging, because significant differences in the lattice constants and thermal expansion coefficients of GaN and silicon induce a high threading dislocation density in the epilayer. These imperfections drive down internal quantum efficiency, but they can be quashed with strain-management technologies that improve the homogeneity of the active layer emission efficiency.

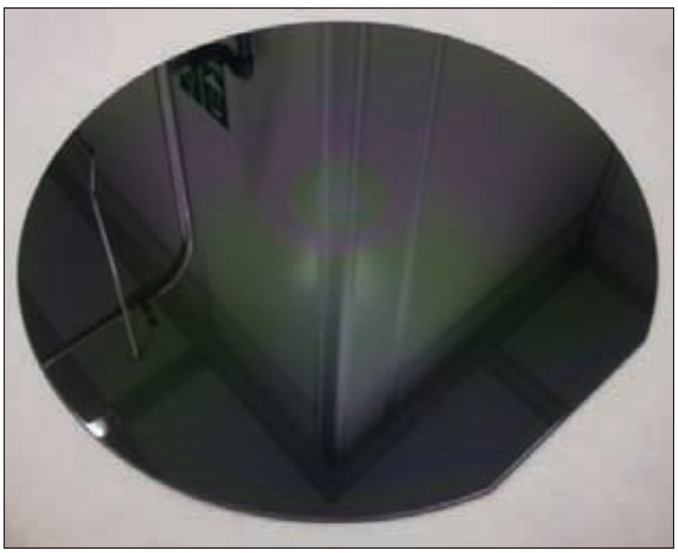
The best route to relieving the stress in epilayers and realizing crack-free GaN-based heterostructures is to use a carefully selected combination of a buffer and interlayers. For example, a low-temperature AlN nucleation layer, graded AlGaN buffers and Al(Ga)N/GaN superlattices.

One of the consequences of stress is that it causes wafer bow, which must be less than 50 μm to allow the material to be processed in 200 mm foundries that were originally built for CMOS technologies. To meet this requirement, the thickness of the buffer and the intermediate layers should be adjusted while monitoring, *in-situ*, wafer curvature and reflectance. In order to realize efficient LEDs, the device structure grown on top of this must include InGaN/GaN multi-quantum wells with a high degree of uniformity and sharp interfaces.

We have been working towards all of these goals by developing GaN–on-silicon growth processes in a refurbished Aixtron 19 x 2-inch closed coupled showerhead MOCVD reactor. This tool, which is capable of deposition on a single 150 mm or 200 mm substrate, is equipped with the latest *in-situ* reflectance and curvature monitoring tool, a LayTec Epicurve TripleTT interface.

In our opinion, *in-situ* control can significantly improve the quality of multilayer devices, such as an LED. We have found that the EpiCurve TT system, which provides simultaneous curvature, temperature and reflectance measurements, is a great tool that





Engineers at IMRE have carried out the development of GaN-on-silicon epitaxial wafers using a modified CCS reactor. (Top left) The Aixtron MOCVD tool being used for the development of GaN-on-silicon product at IMRE-Singapore. (Top right) The usage of the reactor for conventional GaN-on-sapphire 19 x 2-inch mode epitaxy. (Bottom left) The same chamber with a 200 mm, deep-pocket susceptor for GaN-on-silicon epitaxy (Bottom right) A 150 mm diameter GaN-on-silicon epiwafers, which is also developed at IMRE using the same reactor

is capable of working with the narrow viewport geometries that must be used for process optimization near the reactor centre – this is the case for single wafer epitaxy. The three EpiTT sensor heads provide simultaneous detection at three reflectance wavelengths: 950 nm for emissivity-corrected pyrometry; 633 nm for thick layers, such as GaN buffers; and 405 nm for thin layers, such as InGaN/GaN MQWs (see Figure 1).

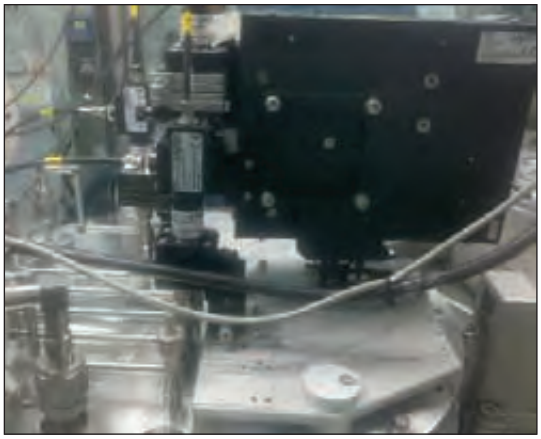
Our epitaxial process development has been carried out with on-oriented silicon (111) substrates that are loaded directly inside the chamber without any chemical treatment. These substrates are either 1.5 mm or 1.0 mm thick, and they sit in specially designed deep-pocket susceptors. Prior to growth, a high temperature bake-out process cleans the reactor chamber, before the substrate is loaded on the wafer carrier and heated to 950-980 °C under hydrogen gas for several minutes. This removes the native oxide from the silicon surface.

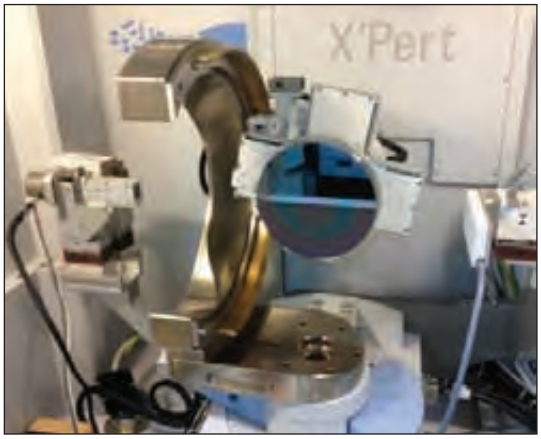
Growth of the LED epiwafers begins with deposition of a thin AlN seed, and then the reactor temperature is ramped up for the growth of a thicker AlN layer – this is more than 600 nm thick in the case of 1.5 mm-thick silicon substrates. Thick, step-graded $Al_xGa_{1-x}N$ intermediate buffer layers are interlaced to reduce strain, before a 1.0 μm-thick undoped GaN layer is added on top of this structure, followed by an *n*-type GaN layer with a silicon doping concentration of 5 x 18 cm^{-3}, an InGaN/GaN MQW active region and *p*-type, magnesium-doped GaN cap.

Deposition of this structure – typically eight blue-emitting quantum wells and a 150 nm-thick *p*-type GaN capping layer that is activated at the end of the growth process – shows that it is possible to carry out uninterrupted growth of an LED stack that is free from any interlayer between AlGaN and the top MQWs layers. This avoids the use of a lower-temperature AlN layer that aids strain management but has its downsides: A longer total deposition time; and a shortening of the lifetime of the heater, which is ramped up and down in temperature more often, and is used in longer growth runs.

The cost of these LED epiwafer growth processes are minimised when nucleation, buffer and all interlayer growth take place as fast as possible and yield material with good crystalline quality. Do this, and epiwafers costs are comparable to those associated with production on sapphire. Ideally, the GaN layers on silicon are as thin as those on sapphire, to reduce costs, while the levels of defect density are similar to the incumbent epiwafers.

It is crucial to optimise the starting growth conditions for the AlN nucleation layer – these vary with the diameter and thickness of the substrate. When we moved from smaller sizes of silicon substrate to those with a 200 mm diameter, we





*(Right) In-situ growth monitoring has been carried with a LayTec tool that comprises three EpiTT sensors for reflectance and curvature measurements. This is mounted on top of the showerhead. (Below) The epitaxy development of GaN-on-silicon is complemented by the 200 mm HRXRD mapping tool for fast reciprocal space mapping and X-ray reflectivity analysis for LED and power electronics projects at A*STAR. (Below right) Epiwafers with a thin GaN layer on silicon have a symmetrical growth profile*

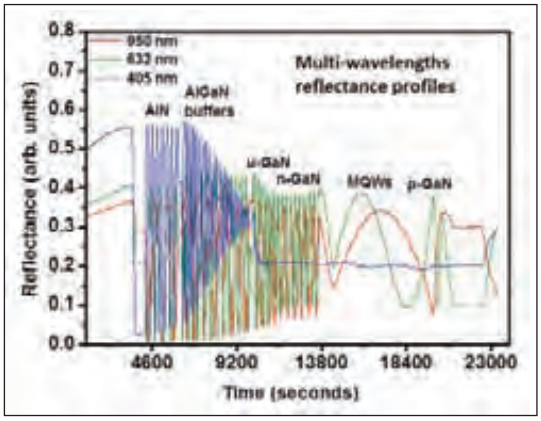


Figure 1. (a) Reflectance profiles of epilayers measured by LayTec probing tool, which features EpiTT sensors for three wavelength reflectance measurements

found that the AlN layer must be thicker. To obtain high crystal quality AlN at a high growth temperature, we adjusted the three zone heater settings in the reactor. The primary purpose of this AlN layer is to create a sufficient degree of concave wafer bowing at a high growth temperature. Get this right and it offsets the compressive strain that comes from the AlGaN/GaN layers to yield epiwafers with a bow below 50 μm after cool down.

This level of bowing produced by the nitride stack, which is about 5 μm thick, is acceptable for post-growth device processing. However, the majority of silicon foundry-processing tools are designed to work with silicon substrates with a thickness of just 750-800 μm. One way to be compatible with this preference is to thin the 1.5 mm substrates, but a more elegant alternative is to turn to thinner substrates. In the latter case the wafer bow is far more pronounced, and we must carry out further developmental work with strain-engineered epitaxy to minimise this deformation.

The encouraging news is that we have had success with LED growth on silicon substrates with a thickness of 1 mm, which may be more acceptable to silicon foundries. Reducing substrate thickness from 1.5 mm to 1 mm limits the growth of a very thick high-temperature AlN layer, because this would introduce a higher concave bow and ultimately prevent the thick uninterrupted growth of a crack-free LED stack. So, for deposition on 1 mm-thick silicon, we embed a thin AlN or aluminium-rich AlGaN interlayer within the LED stack.

Thanks to this modification, we avoid epilayer cracking and severe wafer bowing. Inserting this interlayer is not trivial, and it is crucial to optimise its growth temperature and thickness to prevent a high density of interfacial misfit dislocations. What's more, in order to produce high-brightness LED chips, the growth of the very thick layers of GaN requires graded silicon doping, where we also avoid the use of several low-temperature interlayers.

X-ray analysis

We have scrutinised the crystal quality of our LED epiwafers with a PANalytical MRD high-resolution X-ray diffractometer. This is suitable for full 200 mm wafer mapping and offers a simultaneous fast reciprocal mapping capability. The resulting HRXRD spectra reveal GaN (0002), AlN (0002) and AlGaN (0002) reflections, plus satellite fringes that bare the hallmarks of sharp InGaN/GaN MQW interfaces (see Figure 2).

The full-width-at-half-maximum (FWHM) of the (002) rocking curve for LED epiwafers on 1.5 mm-thick silicon has a minimum average value of about 415 arcsec. Crystal quality declines towards the edge of the wafer – the FWHM is ranges from about 410 arcsec at the centre of the wafer, to 480 arcsec on the edge. Variations in the FWHM of the (102) rocking curve are more pronounced, ranging from 610-750 arcsec, and relate to the extent of epiwafer bow. One cause of the relatively high (102) linewidth is the constant silicon-doping concentration in the *n*-GaN layer – this slightly reduces compression at the growth temperature due to the absence of strain-compensating interlayers.

However, although these linewidths are not incredibly low, they still suggest that the GaN crystal quality of a thick epistructure with uninterrupted GaN layering is good. With more exotic epitaxy based on interlayers or AlGaN buffer concentration tuning, thicker LED epilayers may lead to much narrower rocking curve linewidths.

Growth of LED epi-stack on 1 mm-thick silicon using a low-temperature interlayer led to a (002) rocking curve FWHM of about 475 – 480 arcsec.

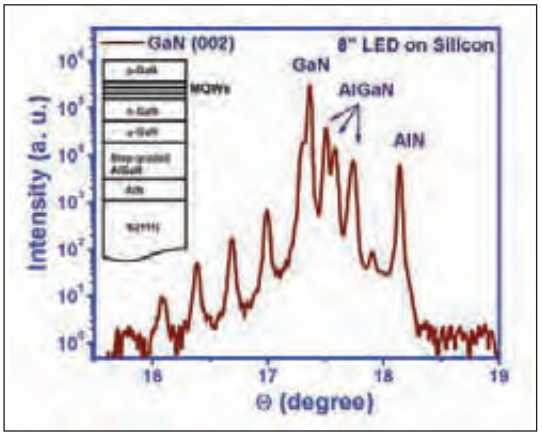


Figure 2. HRXRD spectrum of the full InGaN/GaN LED structure on 1.5 mm-thick silicon substrate. The (002) and (102) rocking curve FWHM at wafer edge and wafer centre are studied for crystal uniformity. The satellite peaks represent high quality interfaces with the inset showing the schematic of the LED structure

This wafer suffered from substantially more bowing than that formed on 1.5 mm-thick silicon, and HRXRD rocking curves for the (102) direction had a FHWM of 860 – 870 arcsec. This value is governed by the silicon-doping concentration, which is slightly higher near the edge of the wafer, leading to a higher edge dislocation density.

More detailed analyses of rocking curves on different planes across the wafer has led us to estimate that the screw dislocation density is less than 5.0 x 10^8 cm^{-2} in the LED layers grown on 1.5 mm-thick substrates. This figure is similar to that obtained with STEM observations and etch pit density measurements on our GaN-on-silicon epiwafers.

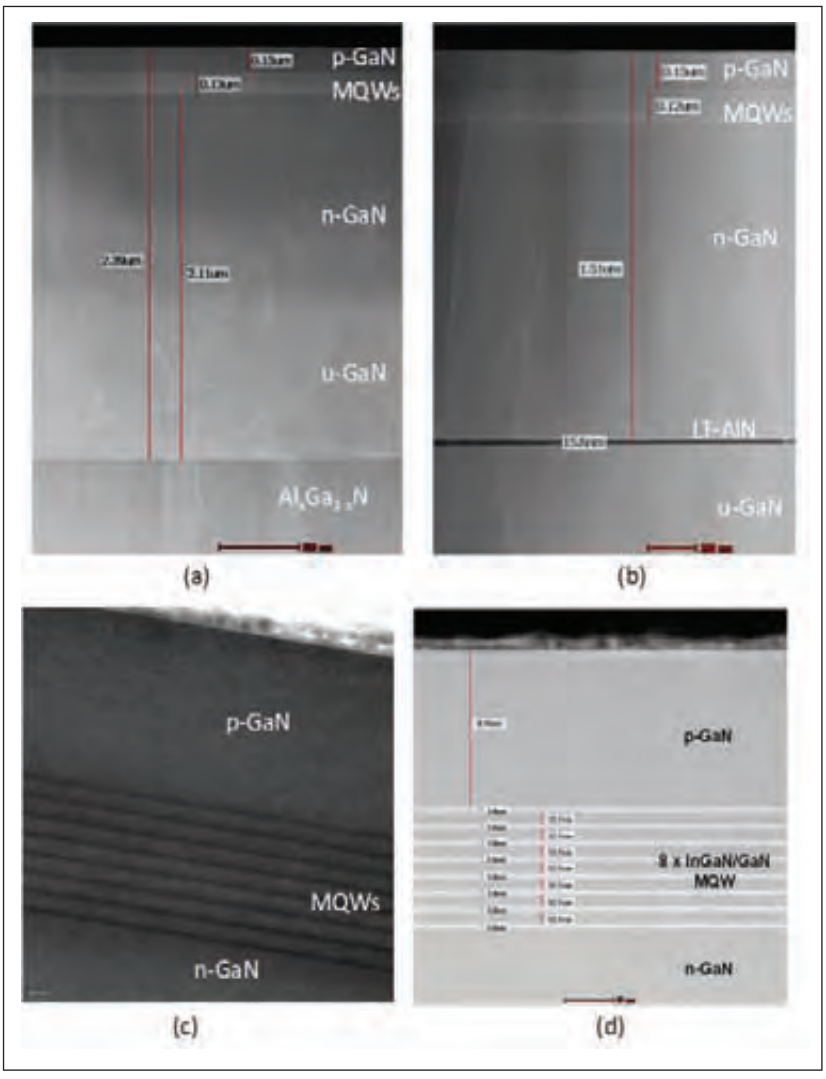


Figure 3. HAADF-STEM images of an LED structure on a 200 mm silicon (111) substrate. (a) The LED structure grown on 1.5 mm-thick silicon with AlN/AlGaN buffers and thick uninterrupted growth of GaN without any interlayer shows LED layers with a low screw dislocation density at MQWs. (b) The LED structure grown on 1.0 mm-thick silicon (111) with a low-temperature AlN interlayer. (c) Bright field TEM image of MQWs on 1.5 mm-thick silicon embedded between n-GaN and p-GaN layers. (d) HAADF-STEM image of MQWs showing uniform well and barrier thicknesses with sharp interfaces

Under the microscope

The indications from the HRXRD spectra of high crystal quality in the active region tally with what is observed in cross-sectional TEM images and high-angle annular dark-field (HAADF) STEM images (see Figure 3). Cross-sectional TEM reveals high-crystal-quality MQWs with sharp interfaces, and HAADF STEM images confirm this and reveal a low threading dislocation density in the active region. Imaging also shows that the top of the *p*-GaN layer, which includes a slightly higher magnesium concentration, is smooth. The concentration of this dopant must be increased to roughen the surface and ultimately boost light extraction. Micro-photoluminescence (PL) measurements across the 200 mm wafers reveal that variations in peak wavelength from the centre of the wafer to its edge, evaluated in terms of a standard deviation, are less than 1.8 percent.

We have also mapped the electroluminescence (EL) spectral homogeneity of the epiwafers to gauge the optical quality of the MQWs prior to LED chip processing (see Figure 4). EL spectra from these wafers show a variation in peak wavelength within 15 nm from the wafer centre to the extreme of the wafer edges. Blue-shifted emission occurs at the wafer edges, due to expected differences in temperature profile during the growth of quantum wells. The EL peak wavelength deviates by less than 1.5 percent, highlighting the promise of this process for manufacturing blue LED chips. Further improvements in uniformity may be possible through tighter control of heater zone settings in the reactor during active layer growth. Low-temperature measurements show blue wavelength PL quantum efficiency in the range of 75-80 percent from these active layers on thicker silicon substrates.

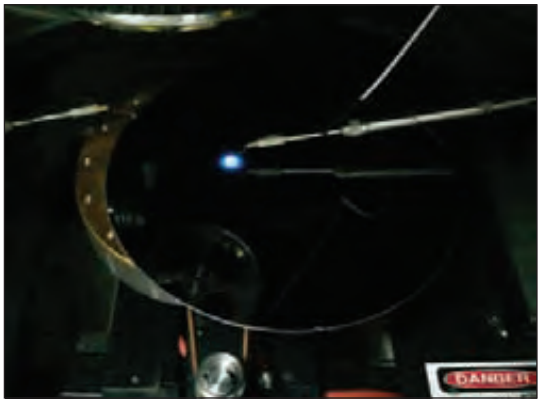
These epiwafers have been processed into 1 mm by 1 mm LEDs, with multi-mask photolithography and inductively-coupled plasma etching employed to define the device architecture. To allow standard lithography and etch tools to be used, the 1.5 mm-thick silicon substrate is back-thinned to 1.0 mm. Etching with BCl_3 and Cl_2 gases exposes the underlying *n*-type GaN. Ni/Au-based *p*-contacts and Ti/Al/Ti/Au-based *n*-contacts are added to create lateral LED chips. Bright blue emission at 455 nm emanates from these LEDs. When subjected to repeatable current cycling up to 200 mA, these devices show no EL degradation, thanks to efficient heat dissipation from the active junctions through the underlying thick silicon substrate. Cranking up the current produces a continual increase of integrated EL intensity, demonstrating the high

crystalline quality of the active layers. One of the biggest downsides of the substrate is that it absorbs blue light, so the silicon must be removed to create a thin film LED, which combines superior brightness with better electrical performance. We are working on approaches to produce this type of chip, and we have already developed processes to attach LED layers to another material. This can be a copper metal that is attached after layer transfer from a bulk silicon substrate, or a bonded high-conducting *p*-type silicon host substrate. A thermal conductive copper metal host has been explored in our research, where we transfer our LED epilayers from silicon by a dry layer transfer process. After depositing *p*-metal contacts, back-reflecting mirrors and electroplated metal layers, we remove the silicon substrate and the resistive nitride buffer layers.

Typical plots of current-voltage for our thin film LED chips (see Figure 5) showcase their potential for high-power operation. With a proper tuning of the doping in the nitride layers, the forward voltage can be lowered so that high-power LED operation would be feasible using such GaN-on-silicon technology.

Removing the substrate used for growth is now a common process. Many LED makers liberate the epilayers from a conventional sapphire or patterned sapphire substrate by laser lift-off to yield high efficacy LEDs. In the silicon industry, substrate removal is common too. It is a simplified, mature, back-end process. However, to carry out this process, engineers need a reasonably flat LED epiwafer with a significantly low wafer bowing.

When we use AlGaN intermediate buffers, we have found that the concentration of the aluminium in these layers must be optimized to prevent post-process cracking of LED active layers, which can occur during substrate thinning and nitride buffer removal. Get this right, optimise the doping and incorporate surface roughening, and it is possible to realize a high radiant flux on a large silicon platform.



A typical bare epiwafer probing shows bright blue emission from a 200 mm diameter epiwafer prior to LED chip processing

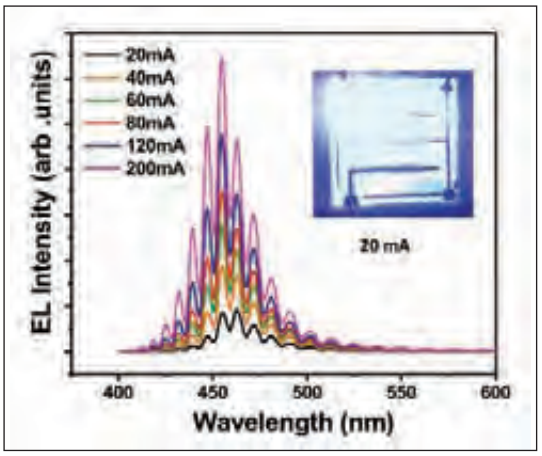


Figure 4. The EL spectra of 1 mm LED chips recorded under different injection currents showing peak emission at 455 nm. The multiple peaks are caused by Fabry-Pérot cavity reflections under the EL micro-probe. The inset shows the typical emission from an LED driven at 20 mA

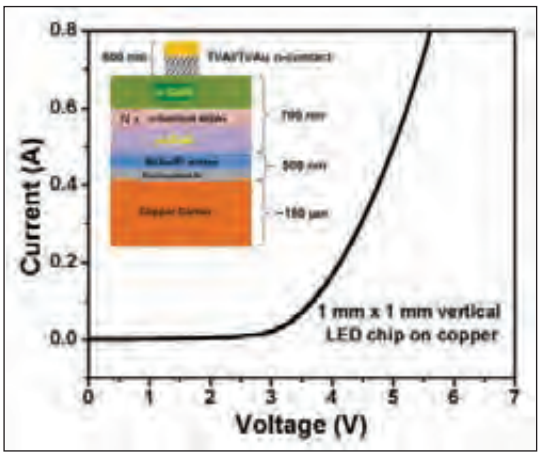


Figure 5. The current-voltage plot of a thin film LED structure fabricated using a GaN-on-silicon approach where the LED layers are cited on a thermal conductive copper host by a layer transfer process

Our efforts showcase the potential of blue LEDs on 200 mm silicon, a format that can unlock the door to affordable solid-state lighting. Fulfilling this promise requires the development of a stable foundry process, which delivers yields that are ideally superior to those associated with 150 mm sapphire and silicon substrates. One way to get there is to embark on more joint programs that unite the expertise in academia with that found in industry. We will participate, and hope that many others do too.

The team at IMRE Singapore led by Sudhiranjan Tripathy involves members: M. Krishna Kumar, S. B. Dolmanan, Y. Dikme, Vivian K. X. Lin, H. R. Tan, R. S. Kajen, L. K. Bera and S. L. Teo. The research team acknowledges support from Exploit Technology Pte Ltd and the TSRP GaN-on-Si Program of Science and the Engineering Research Council of A*STAR. Technical discussion with Armin Dadgar from the OVG-University-Magdeburg is also gratefully acknowledged.

Further reading

III–V Compound Semiconductors: Integration with Silicon-Based Microelectronics, CRC Press, T. K. Li, M. Mastro, and A. Dadgar, Parkway NW (2010). T. Egawa et. al., J. Phys. D: Appl. Phys. ***43*** *354008 (2010). D. Zhu et al., J. Appl. Phys. 109 014502 (2011). E. Llado et al., J. Appl. Phys.* ***108*** *114501 (2010). S. B. Dolmanan et. al., Electrochem. Solid State Lett.* ***14*** *H460 (2011).*

Chipmakers prepare for automated 150 mm processes

To bring down the cost of solid-state lighting, chipmakers must move to more efficient, automated, high-yield manufacturing on larger substrates. Foundations to support such a move are moving quickly into place: Wafer geometries and marking conventions for 150 mm sapphire are largely set, and work on standards for equipment hardware and software interfaces are well underway, writes Paula Doe from SEMI.

One of the hallmarks of an industry that is expanding and maturing is that it sets up standards to simplify and streamline the supply chain. This has certainly been the case in the high-brightness (HB) LED industry. Through the same SEMI standards process that developed the manufacturing interoperability standards for the semiconductor, display and PV industries, the LED makers have now largely come to consensus on the basic physical characteristics of 150 mm sapphire substrates, and are starting to wrestle with standards for classifying and counting defects.

"Having a standard will help us to improve the substrate supply," says Iain Black, Philips Lumileds Vice-President of manufacturing engineering, and co-chair of the SEMI HB-LED standards committee. "It lets suppliers focus on what's important to improve their product."

One downside of standards is that they typically take time to put together. The first manufacturing standards for the semiconductor and display industries took years to develop, but the photovoltaic and LED sectors have been able to build upon the past experience and make far more rapid progress.

In November 2011, LED industry stakeholders first got together to collaborate on cost saving opportunities through the SEMI International Standards process. They quickly formed an LED standards committee with task forces addressing sapphire wafers, factory automation interfaces, environmental health and safety, assembly and packaging, and sapphire wafer impurities and defects. There are currently more than 125 participants from the major device makers, equipment makers, and materials suppliers around the world participating in this LED manufacturing standards effort, which has already borne much fruit.

The 150 mm wafer standards comming from this specifies physical geometry like thickness, edge profile and fiducials (objects that provide a point of reference when imaging the wafer); systems and conventions for unique wafer marking; and basic quality requirements, such as the extent of warp and the surface condition. This standard includes 1.0 mm and 1.3 mm thicknesses, with notches and flats, as all four permutations are widely used today. However, with time it is likely that the industry will move towards smaller notches that take the role of fiducials, and thinner wafers.

Differentiating defects

The next major goal for the standards committee is to figure out which wafer defects matter the most for device yields. To do this, a consensus must be reached on how to measure and define these imperfections, so different labs and fabs are talking about the same things. Progress on this front will not just help to improve 150 mm wafers – it will also be applicable to other sizes of sapphire.

Results from an initial survey of experts found general agreement on the importance of multiple types of defects, ranging from surface micro-pits, scratches and cracks; to crystal purity, sub-grains in the crystal structure, and bubbles and gases in or on the wafer. This group is now participating in regular teleconferences to discuss the best way to define and measure these defects. Wider input from the industry is sought by this task force, which aims to forge consensus on basic acceptable commercial levels of tolerances for various types of defect.

The chair of this LED task force on inspection and measurement is Luke Glinski, product manager, sapphire materials, at GT Advanced Technologies. According to him, although there is no doubt that wafer surface quality impacts device yield, it is not clear what the best way is to measure and quantify the size and distribution of these micro pits and scratches or bubbles, and what levels are acceptable.

GT's own analysis of the impact of sapphire quality on epiwafer yield found that sub-grains and bubbles mattered, but colour, purity of the bulk crystal, and etch pit density did not. Sub-grains in the crystal structure, caused by stresses in growth, can cause ridges and valleys during wafer sawing. They are identified subjectively by visual inspection and quantifying them is incredibly tricky.

"It's a young industry," says Glinski. "We're still working these things out. The biggest difficulty is lack of data – it's not clear what's important." However, he is confident that this will change as the team works together. "The companies driving this effort are the companies that have the data on what matters. It will allow suppliers to tighten up on tolerances that matter, and loosen up on tolerances where it's not important."

David Reid, Chief Operating Officer of Chongqing Silian Optoelectronics and a co-chair of the SEMI HB-LED standards committee agrees: "It's important to find the right level of inspection that works for the industry, but not spend time and money on things that don't matter."

Philips Lumileds sees more advantages than disadvantages in sharing some of its 150 mm production learnings with the industry through the SEMI standards effort. "We've put considerable effort into our specs to upscale the capabilities of the supply chain," says Black. "Others can reap the benefits of this work. If we are able to establish decent standards, everyone knows what to chase, and it will drive supply chain capability there much more readily."

Ahead of the curve?

Ideally, standards are set before a product enters mainstream production. With 150 mm sapphire, it initially appeared that the standard would only just make this deadline. However, it now looks like this standard will be well in place, because investment in next-generation sapphire production capacity has been pushed out. At present, there is still plenty of excess 2-inch and 4-inch capacity, with prices of the latter recently plummeting. According

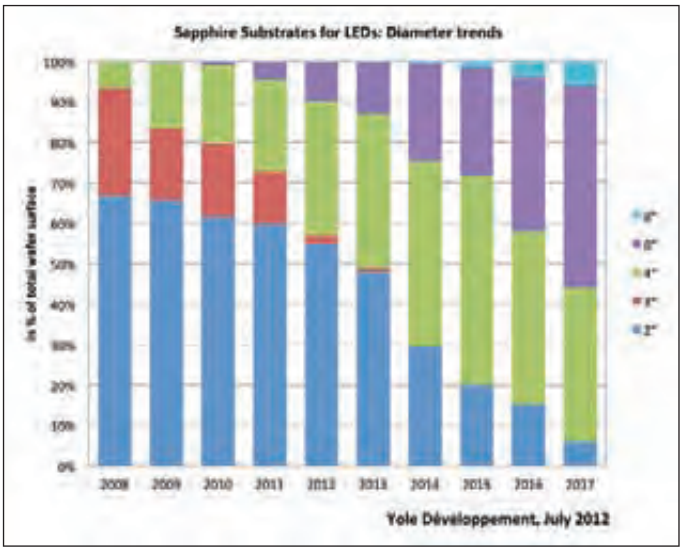
to Eric Virey, senior analyst for LEDs at Yole Développement, 4-inch sapphire sold for typically $45-$50 this summer, making production on this sized platform very competitive.

There are also uncertainties within the industry, which are causing some companies to delay decisions to migrate to larger wafers. Some are also waiting to see if GaN-on-silicon will be soon become a viable option. Others, meanwhile, are reluctant to dispense with the significant boost in brightness that comes from patterning sapphire substrates – this is now used on some 80 percent of all sapphire. However, it very challenging to realize the same high yields when manufacturing LEDs on patterned 150 mm sapphire.

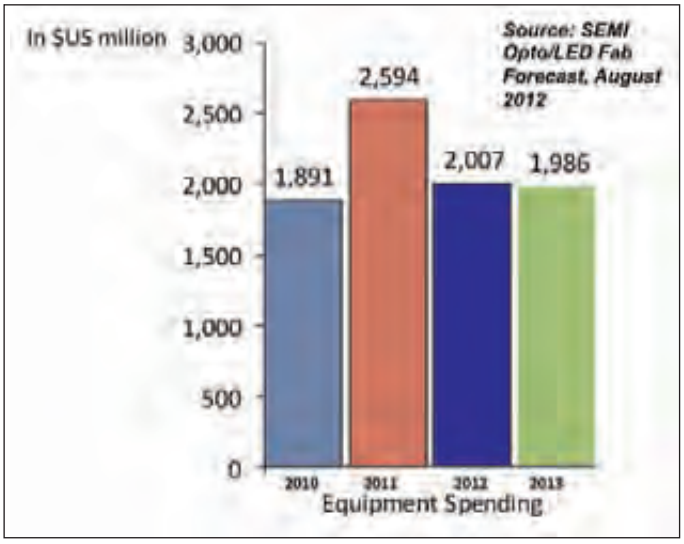
Despite these concerns, the industry will certainly move towards 150 mm sapphire within a few years. This platform will be a key ingredient in tightly controlled, automated high-volume fabs that will drive down chip costs to a level that will allow the LED to take over the general lighting market.

According to Yole, 150 mm will pass 25 percent of production on sapphire by 2014 and 50 percent by 2017. Sales should be spurred by falling prices, which have already tumbled from more than $350 a year ago to $220-$270 in summer 2012. While 2012 contract prices are still around $250, most LED makers are targeting prices below $200 in 2013, projects Virey.

Although substrate costs are only a small fraction of the total bill of materials, larger wafers can lead to more efficient production, because they allow better throughput of more LEDs in each process pass. Virey believes that 150 mm wafers could help to reduce front-end processing costs by a quarter compared to 4-inch wafers, per unit surface area, if yields are the same. And yields are in fact much better, according to Black, because the more modern 150 mm equipment has much better process control and throughput. That's not surprising, given that the semiconductor industry moved on from 4-inch wafers two decades ago.



According to market analyst Yole Développement, 150 mm sapphire will dominate the market by 2017



LED fab equipment spending has recently dropped a little, and it is expected to be around $2 billion in the coming years

Interfacing equipment

Alongside classifying defects and determining their impact, the other major goal, in terms of standards, is to determine common equipment interfaces for automated production. "The verge of the transition to 6-inch is the point when companies are starting to think about how adopting some of the automation and process control from the semiconductor industry could help a lot to bring down costs," notes Julie Chao, Chongqing Silian Optoelectronics VP of technology, and co-chair of the wafer standards task force.

Sales of equipment for LED manufacturing are vastly overshadowed by the long established semiconductor equipment market, which has annual sales of $40 billion. Sales of tools for LED production have surged recently thanks to subsidies in China, but these incentives are now by no means as attractive as they once were, and according to SEMI's LED fab database, total sales will return to a more sustainable level of about $2 billion per year. Shipments of new fab equipment will be widely dispersed around the globe.

Given the size and maturity of established semiconductor infrastructure, it makes sense for the LED sector to take as much advantage of this as possible, because this will help the solid-state lighting industry to develop automated production with its tight process control. Production experts must look closely at what needs to be changed and what doesn't, so that high custom costs for the small market are kept as low as possible, while enabling efficient volume production at improved yield.

Typically, these discussions are driven by equipment and material makers, who see common issues and have the best grasp of the technical details. However, at a later stage, input is sought from many device makers. This can happen at the SEMI standards meetings.

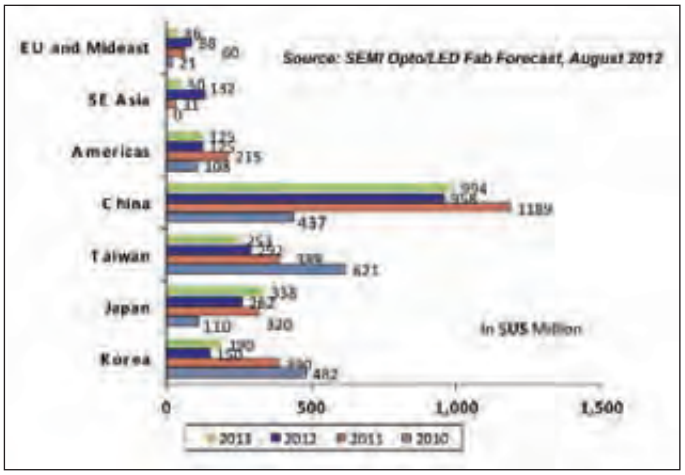
"SEMI standards committees are about the only place where the major equipment and material suppliers are all in the same room at the same time discussing common solutions for the industry — it's a unique situation for direct competitors," says Chris Moore, CEO of SemiLab AMS, and another co-chair of the standards committee. Equipment developed for handling 150 mm silicon will have to be adapted to accommodate sapphire, because this is thicker and has a more pronounced bow. This includes different cassettes for automated handling and transport between tools.

The automation standards task force has decided to make no change to the external dimensions of standard 25-wafer cassettes, because this will allow the same storage racks and other assorted infrastructure to be used. However, the thicker, more bowed sapphire wafers will need fewer, wider pockets inside the cassettes to allow enough room for robotic handlers to move them easily in and out of the slots.

Discussions are ongoing regarding the optimum number of pockets. If 16 wafers slots are used, this maximizes cassette capacity for best throughput, but it also means that the majority of equipment software used to handle and track wafers requires revision to handle the new spacing. Switching to 12 or 13 wafer slots instead – every other space of the 25-wafer cassettes – is easy to handle with current software, but necessitates that batch equipment, like MOCVD tools, is fitted with another port for most efficient loading.

Using a combination of the two sizes (12 or 13 and 16) is possible, but it would require the addition of extra steps to shuffle the wafers from one size of cassette to the other, and it would also complicate storage and transport issues. The wafer automation taskforce is currently soliciting input from across the industry on the preferred way forward.

Another issue is to determine the best software for getting the data to monitor yields out of the equipment. Automation software experts are looking at the issue and their view is that a system based on SECSII/GEM will best serve the LED sector data needs,



China dominates LED fab equipment spending, but total sales to this nation are now in decline

Sales of equipment for LED manufacturing are vastly overshadowed by the long established semiconductor equipment market, which has annual sales of $40 billion. Sales of tools for LED production have surged recently thanks to subsidies in China, but these incentives are now by no means as attractive as they once were

both now and in the future. However, there may come a time when Interface A is needed, due to demands for higher bandwidth for enhanced engineering data.

It is clear that those within the LED industry will need to customize SECSII/GEM so that it can track multiple wafers on each graphite process tray within the MOCVD tool by wafer, position and process. The software working group is now considering whether the simpler 200 mm-version of SECSII/GEM, which is commonly used on smaller-wafer tools, has enough capability for the levels of data needed to track LED production. The alternative is to tap into the more advanced capabilities of the 300 mm-version of the software. This task force is currently polling users on what data they most need out of the tools.

Armed with that information, equipment suppliers will be able to extract and format that data in a consistent way to feed into the device makers' analysis systems. Doing this will reduce the cost of the tools and simplify the integration process for everyone.

Another issue is how to extend the existing semiconductor safety standards to the LED manufacturing process, with its MOCVD tools and pyrophoric gases. A working group in Taiwan, driven by Epistar and TSMC, is specifying the best practices for installing and operating production equipment to a common worldwide standard. This effort, plus those of the other task forces, is sure to play an important role in driving LED consistency and yield up, costs down, and ultimately helping to drive a solid-state lighting revolution.

To learn more, or to join the industry volunteers from around the world working on forging consensus standards for sapphire wafer parameters, automated equipment interfaces, wafer defect measurement, safety, and other enablers of next generation low-cost LED manufacturing. Contact Paul Trio: ptrio@semi.org www.semi.org/en/Standards, alternatively please go to: https://sites.google.com/a/semi.org/hbled

Broadband LEDs enhance colour fidelity

White LEDs are efficient, robust, long lasting and dimmable, but they are often let down by a colour quality that is inferior to incandescents. How can this weakness be addressed? By introducing a range of phosphors that deliver broadband emission and ultimately enhance colour fidelity, argues Faiz Rahman from Electrospell.

Makers of TVs, smartphones and in-car navigation systems continually exploit our weakness in perceiving colours. What appears as yellow on these screens is not a single band of narrow emission, but the combination of light produced by closely packed red and green pixels. This is wonderful in one regard, because it allows us to see 'full-colour' images from screens based on just red, green and blue sources. However, it is a completely different story when a real world object is lit with artificial illumination.

In this situation, it is only possible to capture all the nuances of colours and shades by illuminating objects with light containing all possible colour components – in other words, a full-spectrum light source. Everyday objects have complicated chromatic reflectivities, so it is essential to use incident light with a broad, balanced spectrum to capture all the colour detail (see Figure 1 for several examples of ordinary objects and their surface reflection spectra).

The technology employed for lighting objects is in the midst of a revolution. Tungsten filament incandescent bulbs, the incumbent technology of the twentieth century, have recently faced strong competition from compact fluorescent luminaires, and LED-based lighting systems are just starting to make an impact. Each of these light sources offers a different quality of colour reproduction, because each technology is naturally predisposed towards a

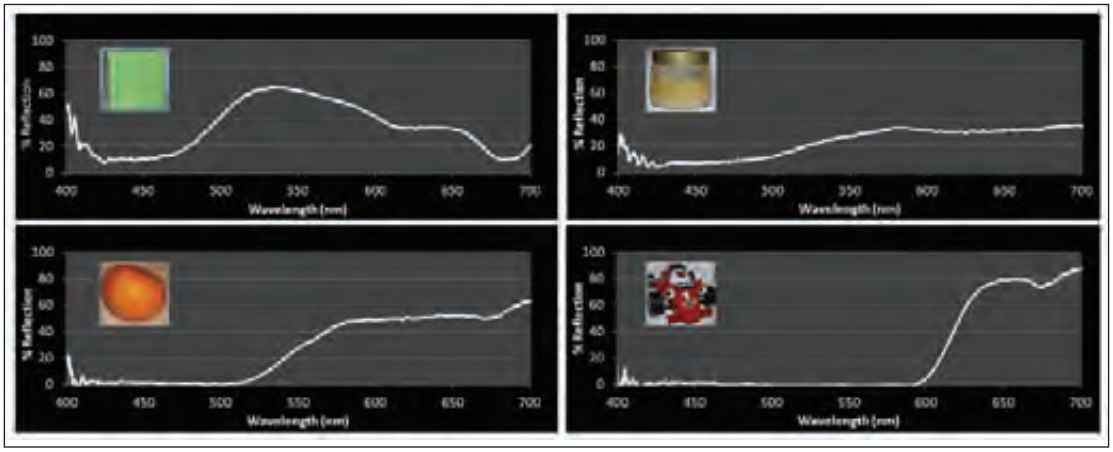


Figure 1. Surface reflection spectra of some common everyday objects. Most surface colours display complicated spectral details that cover large parts of the visible spectrum. Faithful rendering of the colours of such objects then requires a light source with a balanced spectrum that fills the entire visible region from 400 nm to 700 nm

certain spectral distribution. For example, the incandescent bulb is a thermal source that generates a black-body-like spectrum, which appears as yellowish-white light. This is pleasing to the eye and, despite its low efficiency, is still a popular technology for indoor lighting in developed countries.

Efforts to promote greater use of more efficient light sources have spurred sales of fluorescent sources, such as tube lights and cold cathode fluorescent lamps (CCFLs), which generate emission when a phosphor is excited by ultraviolet radiation. Traditionally, light from such sources has been described as 'cold white', due to the distinct bluish hue that stems from deficiencies at longer visible wavelengths.

Today, LED-based bulbs are starting to appear in hardware stores, with sales tipped to rocket in the next few years. White light is produced by using a blue InGaN LED to pump a yellow-emitting phosphor, such as cerium-doped yittrium aluminium garnet (Ce:YAG). The spectrum of light that results has a prominent blue peak somewhere in the region of 450-470 nm and a somewhat broader yellow emission. A superior, but more complex alternative is to generate white light by mixing differently coloured LEDs – usually, red, green and blue. This produces colour-tuneable light, with hues that can be adjusted to meet the wishes of the user. If the LEDs are hooked up to a microcontroller, it is possible to digitally control individual colour channels to 8 or 16 bits of precision, enabling the generation of millions of colour shades. RGB luminaires, however, require drive electronics and colour mixing optics. These are not difficult to integrate into a complete lighting system, but they do increase the cost and complexity of the final product.

Gauging colour quality

Several metrics are used to compare the quality of white light produced by the combination of blue LEDs and yellow phosphors, and the colour mixing of red, green and blue LEDs. One of the most common is the colour rendering index (CRI), which provides a measure of the ability of a given light source to produce the same reflection spectrum as that produced by an ideal light source, such as natural sunlight.

As this is a relative scale, CRI's are quoted in percentages – a light source with a CRI of 100 percent will reproduce colour details as faithfully as light from the sun, under ideal conditions. In practice, CRI values are determined by measuring the surface reflectivity of a set of coloured reference cards. Usually 16 cards are used, with the relative reflectivity for each colour in the set quoted as a separate value. These, so called, R16 values can then be combined to arrive at a single value for CRI.

More recently, approaches such as the Gamut Area Index (GAI) have been developed to address certain

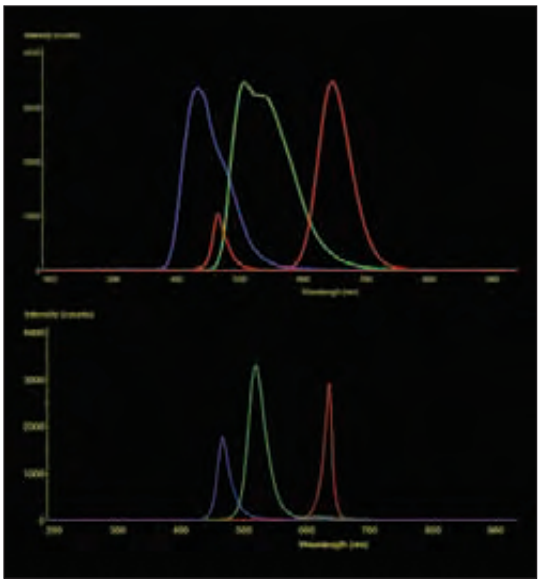


Figure 2. Spectra of Electrospell broadband RGB LEDs (top) compared with the spectra of ordinary RGB LEDs. The secondary emission from broadband red LED is residual blue pump light

flaws in the CRI scale. Combining these two approaches is now considered satisfactory for quantifying the colour rendering properties of LEDs. The National Institute of Standards and Technology (NIST) in the US has also developed a colour-rendition quality scale called the colour quality scale (CQS), which may become the standard metric for judging illumination quality in the coming years.

The combination of a blue-emitting chip and yellow phosphor delivers the highest efficacy when it produces a cool white light. This emission, which closely resembles that emanating from a CCFL source, is not particularly pleasing to the eye. What's more, it is bad at colour rendering because its spectral makeup lacks emission at many wavelengths in the visible region.

It is possible to trade losses in efficacy for better colour rendering by using LEDs with phosphors that emit at slightly longer wavelengths. These warm-white LEDs have a reduced blue peak and significantly broader emission in the green, yellow and orange parts of the spectrum. This translates into a lower colour temperature – the spectral output is below 4000K, compared to more than 6000K for a cold-white source – and the emission is closer to the characteristics of an 'ideal' light source. However, although these devices have higher CRIs when compared with cool-white LEDs, their light still falls far short of what is needed for accurate colour rendering of real world objects.

To address this issue, at Electrospell of Glasgow, UK, we have been developing superior full-spectrum LEDs that are enabling the production of outstanding solid-state light sources. We have adopted a two-pronged approach: By combining broadband red LEDs with their green and blue cousins, we can create light sources that are suitable for making full-spectrum tuneable luminaires; and by utilising mixtures of broadband phosphors, we can generate exceptionally good white-light spectra. The phosphors that we use often contain gadolinium, europium and terbium, in combination with cerium, either hosted in an oxide or oxy-nitride matrix. This set of rare-earth ions ensures a broad, balanced emission with diminished prominence of sharp peaks (see figure 3).

The advantage of employing a multiplicity of rare-earth ions is that it creates several sets of so-called 'crystal field split' energy levels, which combine to deliver a dense set of wavelength peaks that coalesce into a flat spectrum. White light systems made from such LEDs produce CRI values in excess of 92, exceeding the benchmark for high-performance lighting systems.

Improving stability

LEDs are renowned for their long lifetimes – they range from 20,000 hours to over 50,000 hours. However, performance varies over lifespan. That's partly because powerful LEDs used for lighting generate copious amounts of heat, which must be removed quickly to prevent overheating that

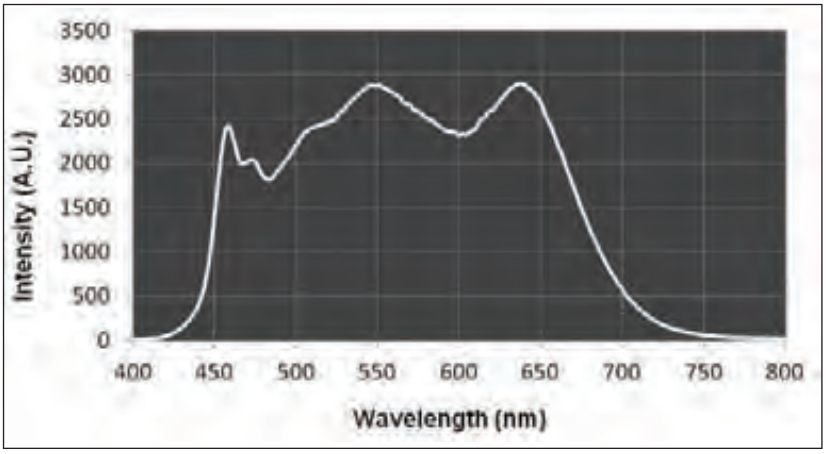


Figure 3. Spectrum of light from a full-spectrum Electrospell white LED

ultimately shortens device lifetime. A good thermal management system addresses this issue, but even with efficient heat removal, LEDs operate at least a few degrees above ambient temperature, causing variations in output over time. This includes a gradual reduction in light intensity. There is no universal definition for LED lifetime, but typically quoted values are for periods of continuous operation at full power over which device output falls by either 70 percent or 50 percent of its initial brightness.

In addition to declining output power, the colour point of an LED shifts with age due to various phosphor ageing effects, such as changes in oxidation state and thermal degradation. For commodity white LEDs, this shift can be 10 percent or more of the specified initial colour point. This means that in colour-critical applications, changes in chromaticity can be a far bigger problem than the gradual dimming of the LEDs.

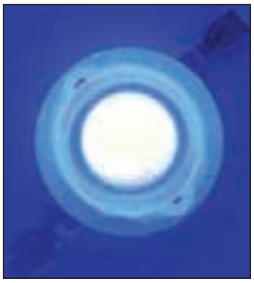
Dimming and colour shifts cannot be avoided, but they can be reduced by running LEDs at lower temperatures and switching off the system when not in use. Turning to high-quality LEDs also helps, because these are built with higher quality phosphors and other optical materials, which together trim thermal and ageing-related colour shifts so that the chromaticity shifts are reduced to only around 2 percent. Another trend is to physically separate the phosphor from the heat-generating LED chip. Turning to a remote phosphor delivers many important benefits, including a significantly longer life, increased wavelength conversion efficiency (and hence perceived brightness) and reduced colour shifts.

This architecture is appearing in several retrofit LED bulb designs, which feature a phosphor coating deposited on the bulb envelope. Product lifetimes in excess of 50,000 hours are then possible, which are limited by the electronic drive circuit that powers the LED, rather than the performance decline of a battalion of solid-state emitters. The principal applications for full-spectrum white LEDs are high-quality space illumination systems for retail and photography, where good colour rendering is essential. Thanks in part to the broadband LEDs that we are offering, solid-state lighting is finally getting up to the challenge with devices emitting light that equals or exceeds the colour rendering specifications of incandescent light sources. Today, lighting showrooms and trade fairs are demonstrating the superiority of high CRI LED lighting through real-life scene demonstrators. Another area where flat-spectrum LEDs are to make an appearance is that of backlighting liquid crystal displays (LCDs). If this class of display is to deliver great picture quality, it requires a flat backlight positioned behind the main LCD panel that can uniformly light a surface. Light from the backlight selectively passes through colour filters at each pixel of the LCD panel, creating a mosaic of multi-coloured light points that constitute an LCD image.

Flat-spectrum LEDs are better suited to this task, because these devices generate roughly equal intensities in the red, green and blue parts of the spectrum, making colour filtration more efficient and consequently the display more power-efficient. There are a handful of other applications where broadband colour LEDs can also offer an advantage over their conventional, lower CRI cousins. This includes indoor plant growth: Photosynthesis requires wavelengths from the infrared to the yellow spectral region, plus blue wavelengths. Installing white LEDs in these greenhouses fails to provide the ideal wavelength profile, and narrowband red and blue LEDs are not up to the task. What's needed are LEDs that emit broadly in the red and blue regions.

It is not just plants that appreciate wide spectrum light - human skin therapists are also considering broadband LEDs for various dermatological treatments. Other technical and industrial applications of broadband, solid-state sources include document scanners, flat-spectrum light sources for colourimetry and machine vision systems.

Thanks to the capability of LEDs to deliver a very high quality light, solid-sate lighting is already penetrating many existing and new illumination applications. However, as spectrally rich light from the new generation of white and colour LEDs establishes itself in the market place, the adoption of LEDs as the technology of choice for all lighting applications will accelerate – hastening the transition to an LED-dominated world.



Electrospell produces LEDs with a broader emission spectrum than conventional devices, thanks to the incorporation of a wide range of phosphors

LED

Solutions for High Brightness LED manufacturing

- Optical lithography and resist processing solutions
- Nano Imprint Lithography for patterned sapphire substrates PSS
- Wafer bonding for layer transfer
- Handling and processing of thin and bowed wafers

EVG®620HBL Gen II

EV Group launches second-generation
EVG®620HBL Mask Alignment System for LED Manufacturing

Updated HB-LED Manufacturing Tool Commands Unprecedented Cost of Ownership Advantages

www.EVGroup.com

EVG®

invent
innovate
implement

The key to your success

Selecting the right number of wells in nitride LEDs

Simulations suggest that increasing the number of wells is a great way to combat the mysterious malady known as droop. The optimum number of wells depends on the current density, and it could be a dozen or more, says Simon Li and Changsheng Xia from Crosslight software.

LEDs based on GaN are now starting to penetrate their third 'killer' application. At the turn of the millennium they were generating billions of dollars by backlighting the keypads and screens of handsets; more recently they have started to dominate the backlighting of laptops and TVs; and now they are just starting to emerge as the premier lighting source for homes and offices.
When LEDs are used in light bulbs, the total amount of light that they produce needs to be far more than when they backlight screens. To keep chip costs acceptable, this means that the current passing through the device must be cranked up to boost the lumen output. But this has an unwanted downside – droop, the reduction in the external quantum efficiency for reasons that are yet to be fully understood, despite the efforts of many researchers to comprehend this controversial, mysterious malady.

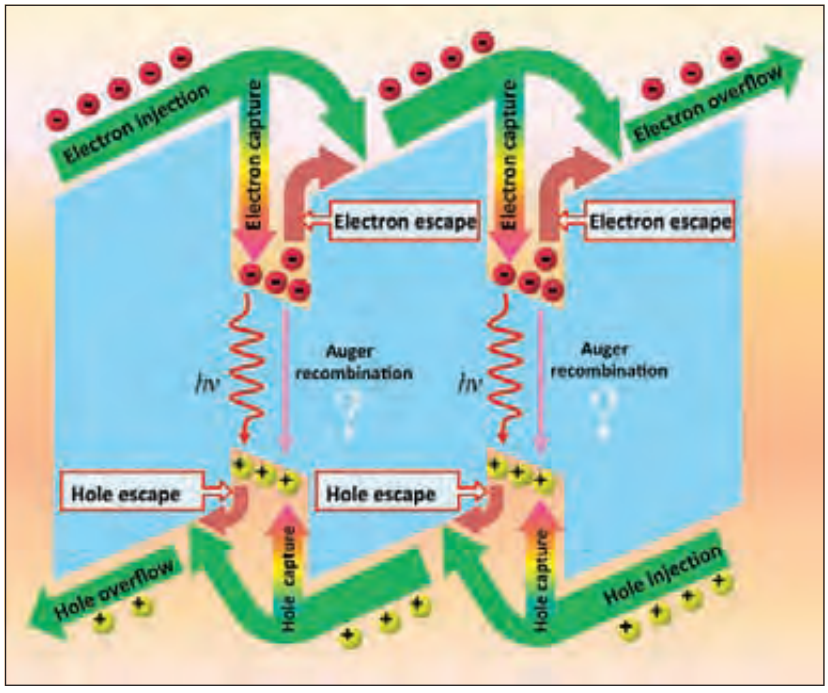


Figure 1: Various physical mechanisms, including carrier overflow and Auger recombination, can cause droop in a multiple quantum well LEDs

While these researchers continue to debate the cause of droop, LED manufacturers – and laser diode makers too, for that matter – will continue to produce devices based on a conventional active region. This design, which has been used since the 1990s, enhances device performance (and efficiency in particular) by splitting the active region into many thin layers called multiple quantum wells (MQW). The resulting structure, an interlacing of wells and barriers, confines electrons and holes quantum mechanically.

It is widely known that it is possible to enhance the efficiency of this device by inserting an electron-blocking layer (EBL) near the *p*-side of the MQW in the LED. Adding this thin layer made of a material with a wider bandgap than those employed in the active region produces a potential barrier that impedes electron flow out of the active region and into the *p*-side of the device. Overflow of electrons out of the active region is one of two popular conjectures for the cause of efficiency droop in blue, MQW LEDs; the other is a non-radiative process known as Auger recombination. Both of these theories have many followers, but they will not receive universal support until they address two major stumbling blocks: Providing a watertight explanation for droop, and accounting for benefits to LED efficiency resulting from MWQs and EBLs.

Auger versus carrier overflow

Following the argument that Auger recombination is the cause of droop is relatively easy. When an LED is turned on, its active region is populated by electrons (and holes) with a density that we can call *N*. Since the generation of light requires the interaction of an electron and a hole, the radiative recombination process goes as the square of *N*. In contrast, Auger recombination, which is a photon-losing process involving three different carriers (two electrons and one hole, or two holes and one electron), goes as the third power of *N*. This means that when the current in an LED is cranked up and carrier density rises, the increases in Auger recombination outpace those in radiative recombination. Consequently, LED efficiency diminishes at higher current densities, which is the characteristic known as droop.

Compared to accounting for droop, it is more complex to explain the benefits of MQWs and EBLs with an Auger-based theory of LED behaviour. The argument put forward by the Auger camp is that the MQW and EBL both help spread carriers more uniformly within the MQW. Thus, for the same *N*-squared photon generation, the third-power Auger loss would be smaller thanks to a more uniform carrier density. Meanwhile, those that support the overflow theory argue that a quantum well is analogous to a water bucket, with its capability to capture and hold injected carriers diminishing at higher injection. When injected carriers are not captured or held, they overflow the active region and are wasted, contributing to droop.

It is easy to explain the benefit of MQWs and EBLs with the overflow theory: Adding another well leads to recapturing and recycling of overflown carriers that were not captured by the previous quantum well; while inserting an EBL forces overflown electrons to turn back, where they will be recaptured by the MQW. Explaining droop is more tricky, with supporters of the overflow theory relying on a quantum mechanical principle that a quantized state can only hold two electrons of opposite spin. This means that a quantum well starts to saturate as more carriers are injected into it. Since both schools of thought appear to explain the main features of blue LED behaviour at various current densities, numerical simulation is needed to verify these theories quantitatively. This exercise is not only of academic significance – it is also of great practical importance, because numerical simulation can optimise fabrication and manufacturing processes.

How many wells?

It is common industrial practice to use several quantum wells in a nitride-based LED, rather than just one. Given this, it is surprising that until very recently, there were no experimental reports of how the addition of another well into the active region impacts performance. In 2011 researchers at the University of California, Santa Barbara (UCSB),broke this drought, claiming that an increase in the number of wells from six to nine decreased droop in InGaN/GaN MQW LEDs [1]. These experimental results offer a great chance to put the competing theories for droop to the test. And if simulations can replicate the real data, this suggests that they could provide a great tool for industrial design and optimization of LEDs.

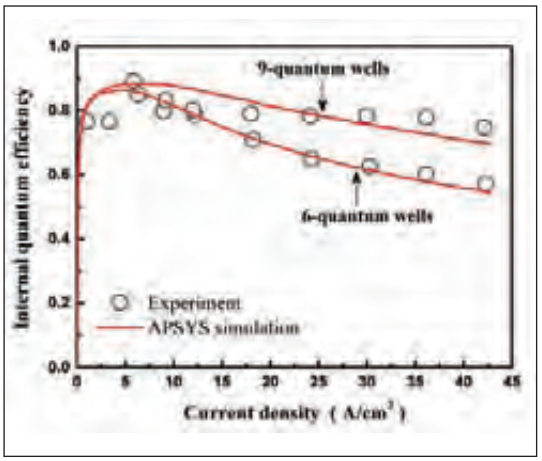


Figure 2: Modelling with Crosslight's APSYS simulation software can replicate the experimental behaviour of blue LEDs with six and nine quantum wells that were made by researchers at UCSB

At Crosslight Software Inc. – which is based in Vancouver, Canada and Shanghai, China – we have recently simulated the behaviour of the UCSB LEDs with our commercially available APSYS software. Specifically, we employed our simulation program with a non-local QW transport model to understand the optical and electrical properties of blue InGaN/GaN MQW LEDs with differing numbers of wells. The key mechanisms in this modelling effort, carrier capture and carrier overflow, are illustrated in Figure 1. Note that this model includes Auger recombination and carrier overflow, the two leading candidates for the cause of LED droop.
We have performed our simulations using both theories, that is, assuming that Auger recombination

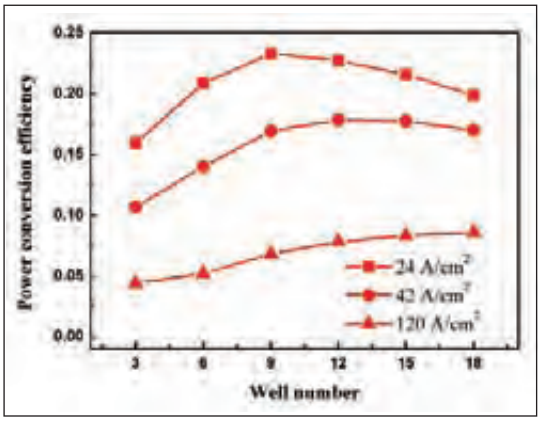


Figure 3: At higher drive currents, the optimum number of wells for high output increases

CSS-jobs.net

Dedicated exclusively to compound semiconductor, silicon semiconductor and solar recruitment

To find the right professionals with the training and experience tailored to your industry can be difficult

To be the market leader you need the best people working for you

By using CSS-Jobs.net you can reach 100,000 industry professionals globally

Find your new recruit today from the lab to the fab to the boardroom through **CSS-Jobs.net**

E: info@css-jobs.net
W: www.css-jobs.net

Supported by

CS COMPOUND SEMICONDUCTOR · S/S SILICON SEMICONDUCTOR · 化合物半导体 CS COMPOUND SEMICONDUCTOR CHINA · 化合物半導體 CS COMPOUND SEMICONDUCTOR TAIWAN · solar international · solar UK · 太阳能国际 solar China · CSS jobs .net

is dominant in one case and negligible in the other (all other parameters were adjustable within a reasonable range). We found that we could produce a good fit to the UCSB experiment using the carrier overflow theory – in that case, we have included negligible Auger recombination (see Figure 2). Details of our successful simulation have been published in the journal *Applied Physics Letters* [2].

Simulations employing Auger recombination as the dominant non-radiative process at high current densities have been far less capable of replicating the experimental data produced by UCSB. It seems that a model based on Auger recombination causes the carriers to recombine too fast at each quantum well before they can reach the next one. One consequence of this is that the optimal number of quantum wells predicted by the Auger theory was far less than that found by experiment. We have no intention of publishing the failed attempts of the Auger theory, and we note that these findings tentatively favour the supporters of overflow theory.

Our next step in this study has been to look at the impact of increasing the number of quantum wells indefinitely. To do this, we make the unrealistic assumption that growth conditions and crystal qualities are identical throughout the active region, regardless of the number of quantum wells in this structure. We found that our model based on overflow theory shows that adding more wells always leads to an increase in internal efficiency.

However, adding wells also pays a penalty of increasing the operating voltage, leading to a reduction in wall-plug efficiency. At the injection condition used in this study, the sweet spot for the number of wells is 12, but as the current through the device is cranked up, this number gets higher (see Figure 3).

In short, the message we have to makers of high-power LEDs is that their devices could probably benefit from more wells. We know that in the real world, perfection is impossible when growing many wells.

As they are added into the structure, strain is added and crystalline quality can suffer. To build this behaviour into our model, we are talking to crystal growers and planning to create simulation software that is more realistic than ever before. Once that is done, we should be able to provide a more accurate figure for the optimum number of wells in an LED.

References

(1). S. Tanaka et. al. Electron. Lett. ***47*** *335 (2011)*

(2). Chang Sheng Xia et al. Appl. Phys. Lett. ***100*** *263504 (2012)*

CSindustry awards2013

The 2013 CS Industry Awards recognise success and development along the entire value chain of the Compound Semiconductor industry from research to completed device, focusing on the people, processes and products that drive the industry forward.

- **Does your company deserve to be recognised with a CS Industry Award?**
- **Does your product represent a breakthrough in the industry and deserve to be recognised?**
- **Are you a pioneering company who has created the best opportunities for the Compound Semiconductor industry?**

We want you to nominate your process or product if you think that they deserve reward and recognition. The 2013 CS Industry Awards feature six categories:

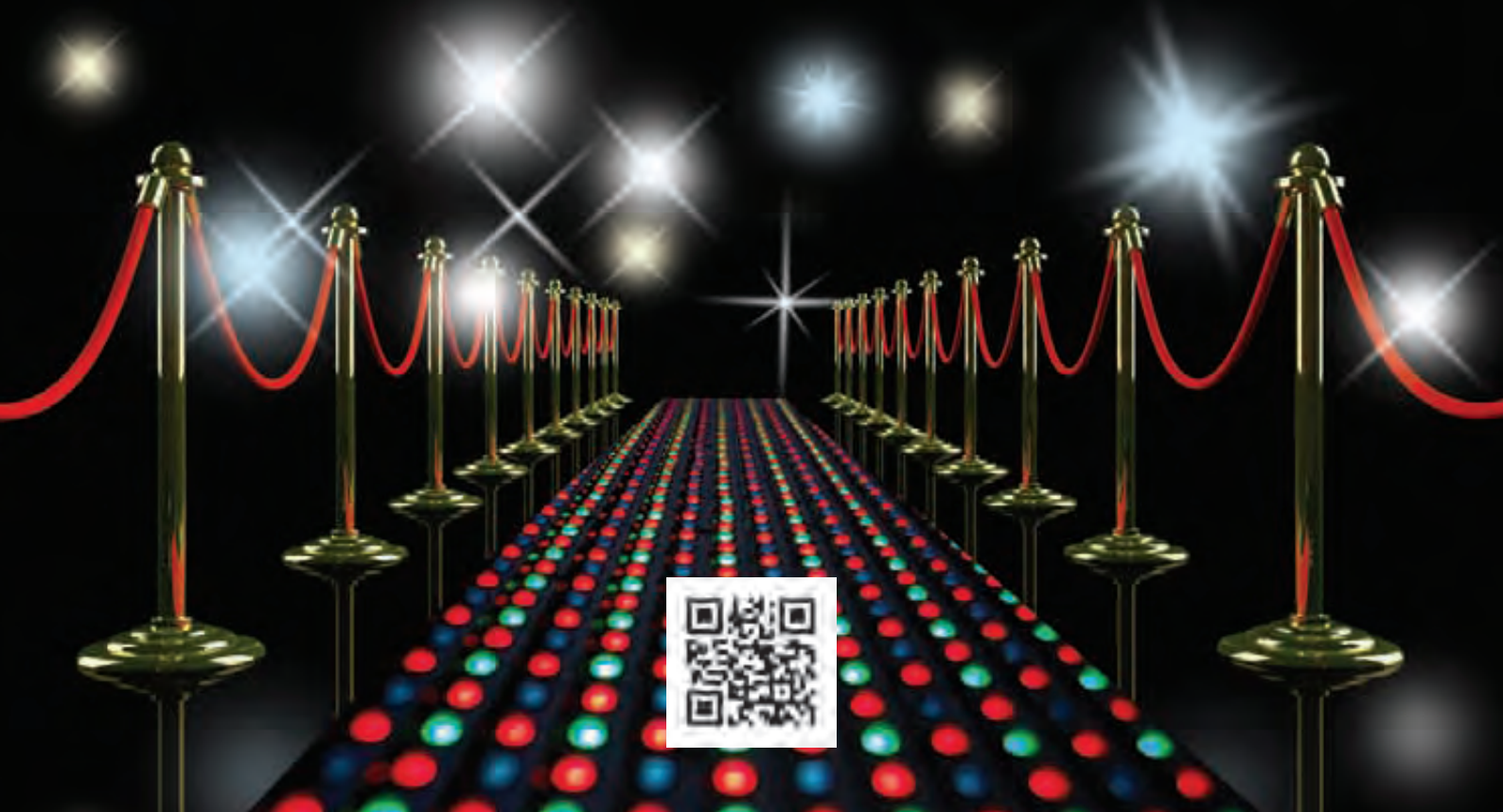
Our award categories are:

- **Substrates & Materials Award**
- **Compound Semiconductor Manufacturing Award**
- **Metrology, Test and Measurement Award**
- **Device Design and Packaging Award**
- **Most Innovative Device Award**
- **R & D Award**

We want to hear about them now. It's free and easy to nominate, simply fill in the online form at www.csawards.net, enter the details and submit.

Nominations close on 7th December 2012

For further information please contact: Jackie Cannon at jackie.cannon@angelbc.com



Electron-emitting region yields brighter LEDs

Adding an electron-emitting region based on the pairing of AlInGaN and InGaN creates brighter, more robust LEDs that are less prone to droop

A TEAM of Chinese researchers is claiming that the insertion of an electron-emitting heterostructure of AlInGaN and InGaN delivers three major benefits to the performance of GaN-based LEDs: Higher efficiency, lower droop, and substantially improved robustness to electrostatic discharge.

Adding the electron-emitter delivers a 65 percent hike in the output power of a blue LED at 20 mA, increases the value of the current associated with maximum external quantum efficiency from 2 mA to 5 mA, and upps the chances that the device will survive after being subjected to a electrostatic discharge of 2 kV from 10 percent to 82 percent.

Although there is a price to pay for all these gains, it's a very small one, according to corresponding author Yanyan Fang from Huazhong University of Science and Technology: "Since the AlInGaN is a quaternary alloy, it requires careful tailoring of the growth parameters, such as V/III source flux."

Growing such a structure is relatively simple for Fang and his co-workers, because they have a lot of experience in producing these quaternaries for UV LEDs.

Attempts to improve the performance of visible LEDs with an electron-emitting region can be traced back to the start of the millennium. These structures slow electrons before they enter the multiple-quantum-well region, so that the likelihood that these carriers undergo radiative recombination with holes increases, and the chances that they spill over into the *p*-type region falls.

The first generation of electron-emitting regions was formed from the pairing of GaN and InGaN. However, the bandstructure of this heterostructure is not ideal for capturing and re-emitting electrons with low enough energies to ensure that they are subsequently trapped in the active region. In addition, the lattice mismatch between GaN and InGaN spawns a high density of misfit dislocations.

To determine the benefits of switching from a GaN/InGaN electron-emitting layer to

one made from the pairing of GaN and AlGaInN, the team compared the performance of three different structures: One without an electron-emitting layer, and variants with electron emitting layers that consists of five pairs of undoped 1.7 nm-thick $In_{0.08}Ga_{0.92}N$, sandwiched between either a 16 nm-thick silicon doped $Al_{0.12}In_{0.04}Ga_{0.84}N$ layer or GaN of identical thickness.

All three LED epistructures start with a 2 μm-thick GaN layer on sapphire, and are followed with: A 2 μm-thick silicon-doped layer, the electron-emitting structure, an active region featuring twelve $In_{0.21}Ga_{0.79}N$ wells, a *p*-doped electron-blocking layer, a *p*-type GaN layer and a heavily doped contact layer. After thinning sapphire to 90 μm, wafers were diced into 300 μm by 300 μm chips.

"The number of quantum wells is the result of optimization, according to output power at 20 milliamps," explains Fang. "We haven't studied the relationship between the number of wells and droop, but I do believe that the appropriate number of multiple quantum wells, with enhanced electron capture rate, helps to reduce droop."

Current-voltage plots of these LEDs showed that the electron-emitting layer reduces forward voltage, probably due to improved spreading of the electrons before they enter the active region. The lowest forward-voltages occurred in devices with an AlGaInN/InGaN electron-emitting region, which has a higher value for conduction band offset. Reverse biasing at 30 V revealed another benefit of the AlGaInN/InGaN electron-emitting structure: A lower leakage current, which is thought to result from a lower dislocation density.

Evidence for reduced leakage currents comes from atomic force microscopy images of incomplete variants of all three samples. Scrutinizing epiwafers that stopped after the growth of the active region revealed that the pit density of the structure with an AlGaInN/InGaN electron-emitting region was 1.9×10^8 cm^{-2}, compared to 2.6×10^8 cm^{-2} and 3.2×10^8 cm^{-2} for the sample with an InGaN/GaN emitting region and the control, respectively.

The pits in the structure with the AlGaInN/InGaN electron-emitting region were just 95 nm in diameter, compared to 125 nm for the other two samples. Driven at 20 mA, the LED with the AlGaInN/InGaN electron-emitting region produced 21.8 mW, compared to just 17.3 mW and 13.2 mW for the devices with an InGaN/GaN electron-emitter and a standard structure.

The AlGaInN/InGaN electron-emitting region also helped to reduce droop, probably by slowing down electrons and spreading them out, so that they are less likely to spill over into the *p*-type region at high drive currents.

The chances of damage resulting from electrostatic discharge plummeted with the introduction of the AlGaInN/InGaN electron-emitting region. Subjected to a 5 kV shock, this device had a pass rate of 70 percent, compared to almost complete failure in the other two types of LED.

Benefits of the AlGaInN/InGaN electron-emitting region could soon be extended to other types of device. "We are planning to try to design and insert an electron-emitting layer into UV LEDs, to see if we can improve the efficiency," says Fang.

J. Zhang et al. Appl. Phys. Express **5** 112101 (2012)

Closing in on the monolithic blue VCSEL

Blue VCSELs could produce continuous-wave emission following improvements to the indium tin oxide current-spreading layer.

TODAY'S most powerful GaN-based VCSELs are formed using a series of complex processes to bond a pair of dielectric mirrors to an active region. That's because the more elegant, monolithic approach currently delivers inferior output powers – but this performance gap could be slashed by optimizing the indium tin oxide layer, according to researchers at EPFL, Switzerland.

This is the next step for the team that is pioneering the development of monolithic blue VCSELs, which could be used for high-resolution printing and bio-sampling. Their latest breakthrough is the creation of VCSELs on "defect-free" epitaxial distributed Bragg reflectors (DBRs) made of lattice-matched InAlN and GaN.

"Here, defect-free means that no further dislocations are introduced during the growth," says lead author Gatien Cosendey. "Therefore the dislocation density seen by the quantum wells of the active region is that of the free-standing GaN substrate used for the growth"

He points out that the device is less susceptible to over-heating when it is built with epitaxial DBRs, rather than those made from dieletrics.

Another important aspect of this team's work is the development of a current confinement scheme based on plasma treatment of the surface of *p*-GaN. Going down this route avoids the requirement for a thin dielectric aperture.

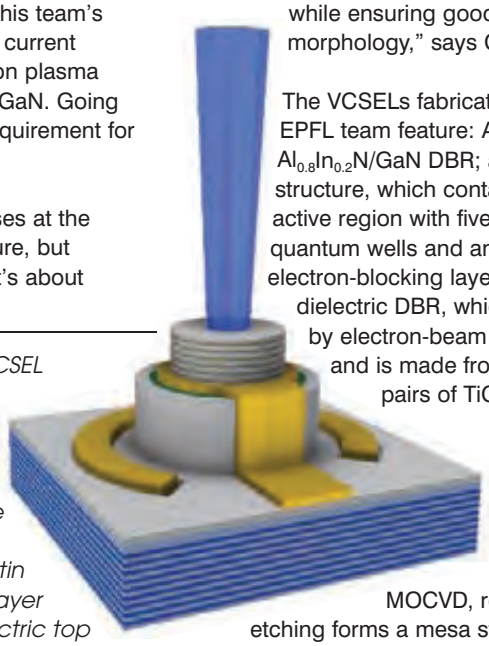
"This prevents diffraction losses at the edges of this dielectric aperture, but increases the growth time – it's about 20 hours for a 40-pair DBR," explains Cosendey.

Growth times are much shorter for VCSELs made with a pair of dielectric mirrors, but this approach requires laser lift-off, wafer bonding, high-quality polishing and cavity thickness control.

Although laser lift-off and wafer bonding are widely used in the LED industry, it doesn't follow that they are simple, high-yield steps for VCSEL fabrication. "Rough surfaces are required in LEDs to improve light extraction efficiency, while very smooth VCSEL cavity surfaces are needed to reduce diffraction losses and thus decrease lasing threshold," explains Cosendey.

According to him, one of the advantages that VCSELs traditionally have over their edge-emitting lasers is mono-mode emission. However, this is not the case in the VCSELs made by Nichia and Panasonic that sport a pair of dielectric DBRs – these devices feature long cavities that support several modes.

"On the other hand, the University of California, Santa Barbara [which also uses a pair of dielectric DBRs] has developed a photoelectrochemical etch process that allows precise control of the cavity length while ensuring good surface morphology," says Cosendey.



Right: EPFL's monolithic VCSEL combines a lattice-matched, 41.5 pair $Al_{0.8}In_{0.2}N$/GaN districted Bragg reflector with a multi-quantum well active region, an electron-blocking layer, an indium tin oxide current-spreading layer and a seven period dielectric top

The VCSELs fabricated by the EPFL team feature: A 41.5 pair $Al_{0.8}In_{0.2}N$/GaN DBR; a *pin* diode structure, which contains an active region with five $In_{0.10}Ga_{0.90}N$ quantum wells and an $Al_{0.2}Ga_{0.8}N$ electron-blocking layer; and a dielectric DBR, which is added by electron-beam sputtering and is made from seven pairs of TiO_2 and SiO_2.

After the bottom mirror and cavity are grown by MOCVD, reactive ion etching forms a mesa structure and plasma treatment defines the aperture's dimensions. The VCSEL is completed by the addition of an indium tin oxide (ITO) current-spreading layer and a dielectric DBR.

The top DBR has the potential to deliver a peak reflectivity of 99.5 percent and a very broad stopband – more than 130 nm. However, technical issues during the fabrication of the VCSEL meant that the reflectivity of this mirror was limited to 98.4 percent.

Driven at a duty cycle of 1 percent – 200 ns pulses at a 50 kHz repetition rate – VCSELs with current apertures of 4 μm, 8 μm and 12 μm exhibit threshold current densities of 130-150 kA cm^{-2}. According to the team, this lack of variation in threshold current density with aperture diameter is proof of efficiency of both the current spreading layer and the current confinement.

Cavity-mode broadening is observed below threshold, due to heating effects that would prevent lasing under continuous-wave (CW) injection.

However, calculations reveal that halving the thickness of the ITO layer, placing it at a node of the electric field and increasing the reflectivity of the top DBR could slash the current density from 140 kA cm^{-2} to just 10 kA cm^{-2}.

"This is a value much closer to the state-of-the-art thresholds reported so far," writes the EPFL team in its paper.

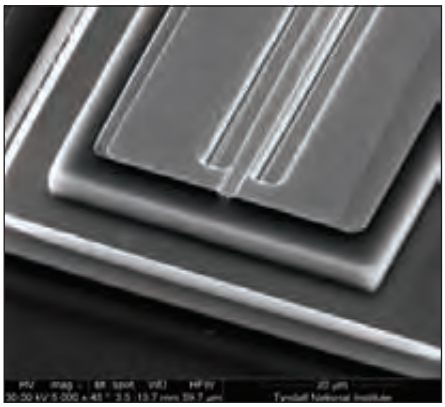
In the short term, these researchers plan to slightly modify the design of their VCSEL by introducing a shorter *p*-GaN layer so that the ITO is positioned in a node of the optical field.

"Moreover, we will reduce ITO layer thickness by half," explains Cosendey. "We think that by the combined effects of those two factors, we should reduce the threshold current density by a factor ten, which would eventually enable CW lasing."

G. Cosendey et al. Appl. Phys. Lett. **101** 151113 (2012)

Printing provides wafer-scale integration of III-V lasers on silicon

Silicon photonics and high-density data storage could benefit from a printing process that enables GaAs lasers to be attached to new platforms



An elastomeric stamp allows the transfer of an array of GaAs coupons onto silicon wafers, where they can be processed into lasers with output powers in excess of 60 mW

An international research team has used a wafer-scale printing process to transfer epitaxial GaAs coupons to a silicon wafer, before converting them into lasers.

The Fabry-Pérot ridge waveguide lasers that result produce 824 nm, continuous-wave lasing up to 100 °C and combine output powers in excess of 60 mW with modulation speeds of more than 3 GHz.

The team of researchers from Tyndall National Institute, Ireland, Semprius and Seagate, believe that their technology could aid the development of silicon photonics and also spur advances in the hard-disk drive industry.

The latter requires light sources that deliver more than 10 mW of power to a waveguide coupled to an integrated plasmonic near-field transducer, because this will allow data storage density to increase beyond 1 Tb inch^{-2}.

Various approaches have already been used to form III-V lasers on silicon substrates, including direct epitaxial growth and a variety of bonding techniques. For example, in 2006 Intel reported how it had fused an InP-based laser chip to a silicon-on-insulator patform, and more recently, the German start-up NAsP III-V has formed lasers in grooves in silicon substrates via epitaxial growth.

However, according to corresponding author Brian Corbett from Tyndall Institute, the approach that he and his co-workers take is unique in several ways.

"All lasers are processed simultaneously, on wafer, with lithographic alignment to features on that wafer," explains Corbett.

He adds that this approach makes very efficient use of the III-V material and can accommodate differences in the dimensions of the III-V wafer and the host wafer.

What's more, in principle this team's technology can transfer multiple, different die onto a new substrate, enabling the formation of complex integrated circuits. And the technique is not limited to transfer to silicon wafers – it could be used for those made from AlTiC, a material widely used in the hard-disk drive industry.

"Direct integration of the laser with the read-write head, which is built on a AlTiC substrate, would enable the introduction of heat-assisted magnetic recording at an affordable cost," writes the team in its *Nature Photonics* paper.

The laser structure used by the researchers features a 1 μm-thick $Al_{0.95}Ga_{0.05}As$ release layer, which is removed by etching in hydrofluoric acid. This allows an elastomeric stamp to transfer an array of 100 μm by 400 μm GaAs coupons onto a silicon wafer, where they bond to the host via van de Waals forces.

"It was a real bonus to find such excellent bonding," remarks Corbett. "van der Waals forces work on the proximity of adjacent atoms, so it is essential to have a perfectly clean and flat interface."

The transfer process uses material very efficiently. "Nearly 200,000 coupons could be harvested from a 100 mm diameter wafer," says Corbett. "In principle, we only need a 10 micron 'street' around each individual device. Since this is shared with the adjacent device, with a 350 micron x 100 micron 'coupon', the wasted percentage is only 12 percent."

After transferring its lasers onto silicon, engineers formed mirror facets by plasma etching to yield 370 μm-long cavities. Two types of laser were formed, with ridge-waveguide widths of either 3 μm (single transverse mode) or 6 μm (multi-transverse mode).

P-type ohmic contacts were added to the top of the ridge, and *n*-type contacts to etched recesses.

These lasers have a threshold of 17 mA, a slope efficiency from the facets of 0.8 W A^{-1}, and a bandwidth in excess of 3 GHz.

"The design we used was not optimised for high speed," says Corbett, who explains that it would be easy to modify the architecture to increase the bandwidth.

Thermal resisitivity of the laser on silicon is 20-40 K W^{-1}, which is comparable to that associated with mounting of this laser on a GaAs substrate. A silicon platform was expected to improve thermal management, thanks to a three-fold hike in conductivity, but finite-element simulations revealed that this benefit will only be realised for heat source-silicon separations of less than 3 μm - they are 4 μm in the team's laser.

Corbett and his co-workers from Tyndall are now collaborating with Seagate in a Marie-Curie funded Industry Academia Partnerships and Pathways (IAPP) project called COMPASS. This aims to improve the reliability of the lasers and their performance that they deliver at elevated temperatures. "We also have proposals on integrating III-V gain elements with silicon photonics," says Corbett.

J. Justice *et al*. Nature Photonics
DOI: 10.1038/NPHOTON.2012.204

CORPORATE PARTNERSHIP

To become a Corporate Partner, and be in Compound Semiconductor,
Contact Robin Halder T: +44 (0)2476 718 979 E: robin.halder@angelbc.com

AIXTRON
Tel: +49 241 89 09 0
Fax: +49 241 89 09 40
Email: info@aixtron.com
www.aixtron.com

Non Contact Measurements
Resistance, Resistivity
Wafer Thickness
KITEC microelectronic technologie
Tel: +49 (0)8122 86676
Fax: +49 (0)8122 86652
Email:info@kitec.de
www.kitec.de

Temescal
Tel: +1 925 245 5817
Fax: +1 925 449 4096
Email: lwarren@ferrotec.com
www.temescal.net

EPIGAN
Email: info@epigan.com
www.epigan.com

CREE
Tel: 1 800 313 5300
Fax: 919 313 5558
Email: Materials_Sales@cree.com
www.cree.com

LakeShore
Tel: +1 614 891 2244
Fax: +1 614 818 1600
Email: info@lakeshore.com
www.lakeshore.com

HIDEN ANALYTICAL
Tel: +44 [0] 1925 445225
Fax: +44 [0] 1925 416518
Email: info@hiden.co.uk
www.hidenanalytical.com

OXFORD INSTRUMENTS
The Business of Science®
Tel: +44 (0)1934 837000
Fax: +44 (0)1934 837001
Email: plasma.technology@oxinst.com
www.oxford-instruments.com

WATLOW
Tel: +49 07253 94000
Fax: +49 072539400901
Email: info@watlow.de
www.watlow.com

Bronkhorst HIGH-TECH
Tel: +31 573 4588 00
Fax: +31 573 4588 08
Email: info@bronkhorst.com
www.bronkhorst.com

CS COMPOUND SEMICONDUCTOR
www.compoundsemiconductor.net
CONNECTING THE COMPOUND SEMICONDUCTOR COMMUNITY
www.compoundsemiconductor.net

化合物半导体
CS COMPOUND SEMICONDUCTOR · CHINA
www.compoundsemiconductorchina.net

III/V-Reclaim
Tel: +49 8728 911 093
Fax: +49 8728 911 156
Email: reclaim@t-online.de
www.35reclaim.de

SiS SILICON SEMICONDUCTOR
www.siliconsemiconductor.net
CONNECTING THE SILICON SEMICONDUCTOR COMMUNITY
www.siliconsemiconductor.net

UMC
UNITED MINERAL & CHEMICAL CORP.
MBE Specialists
Tel: +1 201 507 3300
Fax: +1 201 507 1506
Email: inquiry@umccorp.com
www.umccorp.com

SPTS
Tel: +44 1633 414000
Fax: +44 1633 414141
Email: enquiries@spts.com
www.spts.com

CS International
Incorporating CS Europe
www.cs-international.net
www.cs-international.net

AkzoNobel
Tel: +31 33 467 6656
Fax: + 31 33 467 6101
Email: metalorganicsEU@akzonobel.com
www.akzonobel.com/hpmo

evatec
process systems
Tel: + 41 81 720 1080
Fax: 41 81 720 1161
www.evatecnet.com

Vistec
Tel: +49 (0) 3641 65 1900
Fax: +49 (0) 3641 65 1922
www.vistec-semi.com

Instrument Systems
light measurement
Tel: +49 (089) 45 49 43 - 0
Fax: +49 (089) 45 49 43 - 11
Email: info@instrumentsystems.com
www.instrumentsystems.com

BRUKER
Tel: +49 721 50997-0
Fax: +49 721 50997-5654
Email: info@bruker-axs.de
www.bruker-axs.com

LOGITECH
Materials Technologists & Engineers
Tel : +44 (0)1389 875444
Fax : +44 (0)1389 890956
Email: info@logitech.uk.com
www.logitech.uk.com

Lehighton Electronics, Inc.
Tel: 1-800-535-1112
1 610 377-5990 (outside the USA)
Fax: 1-610-377-6820
Email: lei@lehighton.com
www.lehighton.com

Submit your Lab & Fab article

Research is the foundation for the growth of the Compound Semiconductor industry.

If you want to highlight the important breakthroughs that you make, submit your latest research stories to SuWestwater@angelbc.co.uk

It is imperative that Compound Semiconductor remains a timely resource for this industry, so we are only interested in highlighting very recent work reported in academic papers.

Therefore, please only consider writing a short piece highlighting your work if you have a journal paper that has been accepted and about to appear in press, or a paper that has been published within the last month.

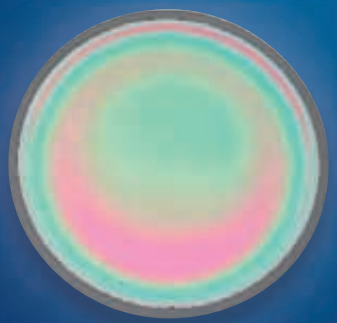
For further details of what we are looking for, see www.compoundsemiconductor.net/csc/labfab-news.php

AIXTRON

200mm GaN-on-Si Batch Reactor

5x200mm

AIX G5+



AIX G5+ for GaN-on-Si

- Dedicated technology package
- Compatible with the AIX G5 HT platform
- Enables Si-style mass manufacturing
- Builds on planetary technology:
  Excellent and symmetric uniformities,
  controlled bow behavior,
  using standard Si substrates.

AIXTRON SE · info@aixtron.com · www.aixtron.com

ALWAYS ONE STEP AHEAD

News Digest Contents

LEDs

SemiLEDs annual losses more than triple

To improve revenues, the company will focus on qualifying more III-nitride products and increasing sales in Taiwan

SemiLEDs Corporation has announced its financial results for the fiscal fourth quarter and year end 2012, ended August 31st, 2012.

Revenue for the fourth quarter of fiscal 2012 was $5.5 million, a 3 percent increase compared to $5.3 million in the fourth quarter of fiscal 2011.

"The LED market is improving; China has started to release funding for new LED projects and our new products are gaining acceptance," says Trung Doan, Chairman and CEO of SemiLEDs. "While things are improving, we believe the best course of action is to remain focused on our operations in Taiwan. We are focused on getting our products qualified for our customers and ramping up sales of our products, and we look forward to calendar year 2013 as a turning point of SemiLEDs," concludes Doan.

All numbers quoted below are on a GAAP basis.

Net loss attributable to SemiLEDs stockholders for the fourth quarter of fiscal 2012 was $24.6 million, or a net loss of $0.90 per diluted share, compared to net loss attributable to SemiLEDs stockholders of $13.6 million, or a net loss of $0.50 per diluted share, for the fourth quarter of fiscal 2011.

Revenue for fiscal 2012 was $29.3 million, a 14 percent decrease compared to $33.9 million for fiscal 2011.

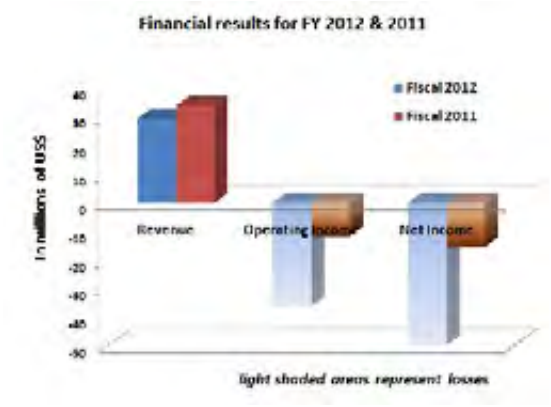
Net loss attributable to SemiLEDs stockholders for fiscal 2012 was $49.5 million, or a net loss of $1.80 per diluted share, compared to net loss attributable to SemiLEDs stockholders of $16.1 million, or a net loss of $0.88 per diluted share, for fiscal 2011.

Gross margin for the fourth quarter of fiscal 2012 was negative 55 percent, compared with gross margin for the fourth quarter of fiscal 2011 of negative 93 percent. Operating margin for the fourth quarter of fiscal 2012 was negative 296%, compared with negative 228 percent in the fourth quarter of fiscal 2011.

Margins for the fourth quarter of fiscal 2012 were negatively impacted by reduction in revenues, an impairment charge on the company's long-lived assets of $7.5 million and a charge to bad debt expense of $1.4 million on accounts and notes receivable from China SemiLEDs.

Fourth quarter results reflect the Company's reduction of the carrying amount of its investment in China SemiLEDs to zero, compared to the third quarter ending balance of $8.7 million. The reduction reflects primarily the company's recognition of its proportionate share of an impairment charge on China SemiLEDs' long-lived assets related to the increased likelihood that shareholders of China SemiLEDs would fail to agree to and implement a restructuring plan for China SemiLEDs.

SemiLED's cash and cash equivalents were $47.2 million at the end of the fourth quarter of fiscal 2012, compared to the third quarter ending balance of $62.9 million. The firm also had short-term investments of $8.8 million at the end of the fourth quarter of fiscal 2012, consisting of time deposits with initial maturities of greater than three months but less than one year. Cash used in operating activities was $5.2 million in the fourth quarter of fiscal 2012.



SemiLEDs chips and components are primarily used for general lighting applications, including street lights and commercial, industrial and residential lighting, along with specialty industrial applications such as ultraviolet (UV) curing, medical/cosmetic, counterfeit detection, and horticulture. The company sells blue, green and UV LED chips.

Soraa & ESNYC to aid LED lighting compatibility

The gallium nitride (GaN) on GaN substrate LED supplier will manage and run the testing of a panel comprised of an array of transformers and dimmers and Soraa's 12VAC LED MR16 lamps

In an effort to remove barriers to the rapid adoption of LED lighting, Soraa will sponsor the lighting industry's first PlugFest in conjunction with the Illuminating Engineering Society of New York City at its annual "Control This!" event.

The day long ESNYC's Control This! 2012 event expo and seminar series will be held on December 5th at the Metropolitan Pavilion in New York City, and will showcase state-of-the-art lighting control systems and energy management systems.

"Incompatibility between LED lamps and fixtures with existing control gear and dimmers designed for traditional light sources-incandescent, halogen, or fluorescent--is one of the biggest hurdles facing the lighting industry today. I applaud Soraa and IESNYC's efforts to solve this challenge by holding the first ever Lighting PlugFest," says Paul Gregory, founder and president of the award-winning architectural lighting design firm Focus Lighting, Inc. of New York City.

"PlugFests are a mainstay of high tech industries, and Lighting PlugFest at Control This! is destined to revolutionise the way lighting practitioners and OEM vendors of LED lamps, fixtures, transformers, and dimmers test the interoperability between products from different manufacturers and accelerate the growth of the entire industry," comments Control This! 2012 Co-Chair Meg Smith, LC, IES, LEED AP, co-chair of the IESNYC education committee, and senior project manager, Philips Lighting Solutions and Services.

Soraa will manage and run the testing using a custom-built testing panel comprised of an array of commonly used transformers and dimmers and Soraa's 12VAC LED MR16 lamps and also accommodates participating companies' transformers, dimmers, and 12VAC LED lamps or fixtures.

"Manufacturers benefit because Lighting PlugFest addresses compatibility -an obstacle to widespread LED lamp adoption; designers benefit because they can specify with confidence; and end users benefit because they will know that product combinations work,"adds Eric Kim, CEO of Soraa. "This event is all about ensuring a positive LED lighting user experience."

GE Lighting expands LED fixture portfolio with Albeo acquisition

GE's move will help its customers move rapidly towards an all-LED building envelope in new construction and retrofits, including retail, commercial and industrial high-bay applications

GE Lighting, inventor of many of the major lighting technologies, including one of the first visible LEDs 50 years ago, has signed an agreement to acquire Albeo Technologies Inc.

Established in 2004, Albeo is a privately held LED fixture manufacturer based in Boulder, Colorado.

"The addition of Albeo Technologies' immensely talented team and its award-winning LED fixture

portfolio enhances GE Lighting's ability to serve as a trusted advisor to enterprise customers around the world," says Maryrose Sylvester, president and CEO, GE Lighting. "This acquisition is a big boost for GE customers moving aggressively toward an all-LED building envelope in new construction and retrofits, including retail, commercial and industrial high-bay applications."

Albeo Technologies' 4-Bar H-Series High-Bay LED Fixture

GE offers commercial, industrial and municipal customers a range of legacy lighting solutions and LED systems for architectural, indoor, outdoor, signage, retail and transportation applications.

Albeo's LED systems, high-bay, low-bay, linear, surface mount and under cabinet fixtures, are at work in commercial, warehouse, industrial, cold storage, office, data centre, food processing, parking garage, school, sporting and correctional settings.

Its solutions have helped to illuminate a range of "all-LED" facilities, including one of the world's 10 largest data centres. Albeo's' products have been recognised with 16 independently judged awards, including six from the U.S. Department of Energy.

The firm says its LED portfolio satisfies urgent demand for energy-efficient high-bay lighting products.

"Today's news is significant for what it enables customers to do with lighting," says Jeff Bisberg, Albeo Technologies' co-founder and CEO. "Joining GE vastly expands the universe of customers with access to our breakthrough LED solutions and it profoundly empowers our research and product development capability. Our team takes great pride in the fact that we're now part of the company behind the invention of the LED."

Through the acquisition, GE accelerates its ability to offer customers a more complete and integrated LED solution.

"Some of our biggest customers told us they wanted a GE-quality solution for high bay," notes Sylvester. "This acquisition accelerates our development of cutting-edge technologies that brings customers the energy-efficient solutions they need. That's what customers get at the end of the day, a refined, highly modular and scalable platform that delivers the GE quality they've come to expect."

Albeo Technologies' products are available through existing distribution channels and now through GE's global distribution network.

AlGaAs LEDs speed up Toshiba`s IC MOSFETS in IC photocouplers

Combining aluminium gallium arsenide (AlGaAs) with a silicon device reaps the benefits of both technologies

Toshiba America Electronic Components (TAEC) has added the TLP700A and TLP705A to its family of photocouplers.

The new photocouplers are housed in small packages (SDIP6), half the size of conventional 8 pin DIP packages, and consist of an AlGaAs infrared LED, optically coupled to an integrated high-gain, high-speed photodetector IC chip.

Toshiba says its TLP700A can directly drive a middle-capacity IGBT or power its MOSFETs.

With a guaranteed transmission delay skew, ideal for designing dead time for inverters, this product achieves a shorter transmission delay time, roughly half of the firm's previous model.

With improved peak output current and operating ambient temperature, the TLP700A is suitable for use in high temperature environments. The device also complies with the reinforced insulation class of international safety standards.

The TLP700A can be used in a wide range of products, including industrial devices, digital home appliances, measurement devices, and control devices. Its small packaging can contribute to a smaller footprint and cost reduction.

The TLP705A can directly drive a small-capacity IGBT and power MOSFETs.

Using a new LED with excellent longevity, the TLP705A has better output current, variation in transmission delay time, and transmission delay skew characteristics than those of the existing model.

Toshiba's new IC complies with the reinforced insulation class of the international safety standards, and can be used in a wide range of products - including industrial devices, digital home appliances, measurement and control devices.

According to Joseph Tso, business development manager for Toshiba's optoelectronics discrete business unit, "Toshiba's new photocouplers provide a smaller footprint solution for applications that require safety standard certifications, while also contributing to cost reductions."

The Toshiba TLP700A and TLP705A are available now.

Seoul Semi reveals LED chips in popular power packages

The firm's nitride MJT series enables lighting manufacturers to deliver fixture level performance up to 100 lumens per watt. Also, the MJT series is designed on widely used 5630 and 3528 packages and improves compatibility with conventional dimmers

A big advantage of Seoul Semiconductor's the MJT series is that its 5630 and 3528 packages offer LED lighting manufacturers easier production with the standard (module) size and enable lighting fixtures to deliver world-class performance up to 100 lumens per watt.

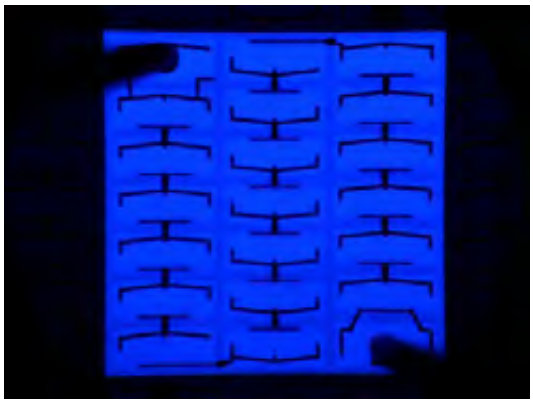
MJT (Multi-Junction Technology)

MJT, or "Multi Junction Technology", can be driven at a higher voltage than conventional DC LEDs.

While high voltage LEDs in the market are designed with complicated circuit connecting many LED chips physically, MJT uses multiple cell integrated chips to produce various voltage types.

Unlike the conventional method that requires complicated circuitry to connect multiple LED chips, the MJT series is designed to operate at various voltage levels, which allow operation at high voltage levels using only one LED chip of which cells connected by multi-junction technology.

Using one LED chip, rather than multiple LED chips, reduces the failure rate and optimised chip design help to achieve 100lm/W light efficiency on lighting fixture level.



A chip of MJT series designed by multi Junction technology; several cells are connected by junctions as a chip

The MJT is claimed to require the least amount of circuitry to be highly compatible with conventional dimmers. This reduces the cost for the system (LED and driver).

MJT series 5630 (left), 3528 (right) package

Seoul Semiconductor's John Bae says, "Since the high price of LED lighting is a major hindrance to extend LED market, LED lighting designers make an effort to develop higher performance and lower cost LED lightings for end users to

reduce payback period. MJT series meets those demands by reducing the over all system costs. This trend is also followed by the global top lighting manufacturers".

Seoul Semiconductor's MJT mid power series runs at 19V, 22V and 32V and offers a wide range of colour temperatures (2700K-6500K). They are also optimised for general LED lightings such as A19, PAR and down lights.

Georgia Tech-CNRS to grow nitride alloys with Aixtron reactor

The 3 x 2-inch CCS tool will be used to grow nitride R&D materials for light emitting sources, solar cells and sensors

Aixtron's existing customer, UMI Georgia Tech-CNRS in Metz, France, has ordered a new MOCVD system from the firm.

The 3 x 2-inch Close Coupled Showerhead (CCS) system will be dedicated to the growth of nitride alloy R&D materials for light emitting sources, solar cells, sensors and other applications.

Aixtron Europe's service support team has installed and commissioned the new reactor in a dedicated cleanroom at the Georgia Tech-Lorraine campus in Metz.

3 x 2-inch Aixtron CCS reactor

According to Professor Abdallah Ougazzaden, Director of UMI Georgia Tech-CNRS, "We are very familiar with Aixtron MOCVD systems, so this was a straightforward decision to make. The CCS system perfectly matches our R&D plans in respect of GaN, InN, BN and related alloys for light emitting sources, solar cells, sensors and other applications, depending on how the semiconductor market evolves."

"We formed a strong relationship with Professor Ougazzaden in France and Professor Russell Dupuis from Georgia Tech in the US, both of whom have excellent teams covering all aspects of MOCVD nitride R&D," Aixtron's COO Bernd Schulte adds. "The Georgia Tech-CNRS International Joint Unit (UMI*) produces excellent scientific output and is actively involved in national and international research programs focusing on secure networks and innovative materials for optics and electronics."

The Georgia Tech-CNRS International Joint Unit, or "UMI", is an international research unit established between the Georgia Institute of Technology and CNRS (Centre National de la Recherche Scientifique) to further collaborative research in the fields of telecommunications and innovative materials.

Programs include optoelectronic techniques for signal encryption and secure transmission for optical and wireless systems, nonlinear optics, new materials and nanostructures for photonics and electronics, multifunctional materials, the ultrasonic characterisation of materials, and the development of new ultrasonic sensors.

Soraa's GaN on GaN lamps applauded by IES

The firm's gallium nitride based "Vivid LED" and "Outdoor LED" MR16 lamps have been independently praised for their low energy consumption, consistency and efficiency

Soraa's "perfect spectrum" GaN on GaN LED MR16 Vivid and Outdoor lamps have been recognised by the Illuminating Engineering Society (IES) Progress Committee as providing important advancements in the science of light.

The accepted products are part of the 2012 IES Progress Report, which presents significant developments and improvements in the lighting industry over the past year.

“We are very pleased that our GaN on GaN LED Vivid and Outdoor MR16 lamps have been recognised by the IES Progress Committee for their outstanding quality and performance,” says Eric Kim, CEO of Soraa.

A superior alternative to halogen 50W MR16 lamps, Soraa’s Vivid LED MR16 lamps feature full spectrum light; a CRI of 95 and R9 of 95 (higher than most halogen lamps). The firm also maintains that they produce no UV or IR light and last up to 10 times longer than equivalent halogen lamps.

Soraa VIVID MR16 lamp

These lamps use 75 percent less energy as they run at a cooler temperature and produce a much more consistent and efficient beam. The Vivid LED MR16 lamps are compatible with existing lamp fixtures and lighting infrastructure and are suited to demanding display applications in museums, galleries, designer retail, and premier hotels and resorts.

The Outdoor LED MR16 lamps are specifically designed and tested to operate in difficult environments. Suitable for use in outdoor fixtures, or indoors in enclosed recessed or small non-ventilated track fixtures, the Outdoor LED MR16 lamp is suitable for use in many applications where lamp reliability and quality of light are as important as saving energy. They are designed to replace standard 40W MR16 halogen lamps.

The Progress Report submittals, which consist of new products, applications, research, design tools, and publications, are reviewed by the IES Progress Committee, which is responsible for monitoring developments in the art and science of lighting worldwide.

The committee is made up of lighting industry professionals who possess expertise in varied areas within the field. Each submittal goes through a comprehensive judging process and is evaluated for uniqueness.

SunLED unveils right angled domed LEDs

Light bleeding and overshadowing often encountered in nitride LEDs, can be resolved by using the new domed architecture

SunLED has developed a new right angle package in its 1206 domed, bi-polar red & green LEDs.

The traditional domed 1206 package is now available in a right angle version in the XZMDKSGK55W-7RA series.

The domed lens package provides a narrow viewing angle of 30 degrees which allows a brighter intensity output and eliminates any light bleeding issues. Typical issues with side fire LEDs when designed on arrays are light bleeding, overshadowing or dim light outputs. These issues can be resolved by using this new domed package.

Red & green dies/chips are proportionally mounted in the centre under the encapsulated domed epoxy lens allowing uniform light output for both colours and achieving the maximum intensity possible. This 3.2 x 1.6 package is suitable for use in network devices, consumer electronics, medical equipment, hand held products and icon/text indications. The lens protrusion of the device is 1.8mm and it has a moisture sensitivity level of 3.

SunLED established in 1989, manufactures optoelectronic products. The firm offers a broad line of LED lamps, surface mount LEDs, and LED displays. SunLED produces more than 320 million LEDs every month to support customer's demands.

Everlight expands LED signage portfolio

The firm's five new 3-in-1 full colour nitride LEDs and lamps for indoor, semi-outdoor and outdoor applications, combine performance with efficiency

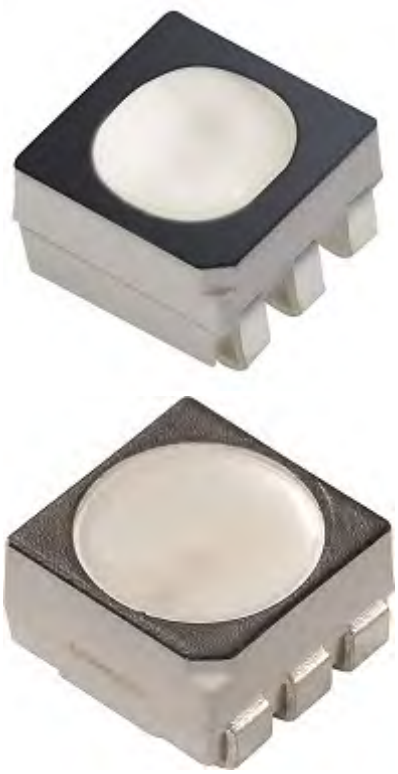
Taiwanese firm, Everlight Electronics has extended its signage LED portfolio with five new products for indoor, semi-outdoor and outdoor applications.

Two new compact SMD Chip type LEDs, the 18-038 (1010 package) and the 19-037A (1616 package) are ideally suited for indoor LED applications. Both the 18-038 (1 x 1 x 0.5 mm) and the 19-037A (1.6 x 1.6 x 0.9 mm) LED series are much smaller than lead frame type components, thus enabling smaller board sizes, reduced package and storage space and a higher packing density, resulting in smaller equipment.

SMD LED 18-038 Chip SMD LED 19-037A Chip

Everlight says they represent the next level of SMD LED technology by implementing a black PCB which enhances the contrast and an advantageous solution for high contrast and high resolution indoor signage displays.

Two new SMD PLCC type LEDs add to Everlight's Hong LED family, designed for advanced indoor (HN0325) or semi-outdoor (HN0507) LED signage display applications. The Hong series LED package provides a good solution when a clear view of the signage display is required on boards of any size. Using 3-in-1 full colour, SMD PLCC LEDs offer a smaller pixel pitch between two LEDs to create a high resolution and better contrast thanks to their black surface design.



SMD PLCC LED HN0325 SMD PLCC LED HN0507 for advanced indoor use for semi-outdoor use

The 3474AH series LED lamps, which come in a 3mm oval package, feature an extensive wide viewing angle of 110° and UV curable epoxy with enhanced chemical resistance. They are thus suited to outdoor applications and have been specifically designed for passenger information signs. The 3474AH LED lamps have matched radiation patterns ensuring consistent colour mixing in red, green and blue mixed-colour applications.

Everlight 3474AH signage LED lamps in red, green and blue

Everlight has an LED signage board on display at the electronica conference in booth A3.307.

Sample are available on request and are currently in mass production.

Everlight to exhibit LEDs for different applications

The Taiwanese company will present its most updated series of LED packages for infrared and sensor, general lighting, TFT LCD backlight, signage and intelligent digital display applications

Everlight Electronics, a player in the global LED industry, is showcasing various new series of LED components at electronica 2012 in Munich, Germany.

This year, Everlight presents its most updated series of high efficient LED packages for infrared and sensor, general lighting, TFT LCD backlight, signage and intelligent digital display applications.

Everlight maintains its concept of “The Right LED for the Right Application” in order to provide the best performance and quality for different usage. Furthermore, by using the most efficient LED products, Everlight seeks to help create an ECO-friendly environment for coming generations.

For infrared sensor applications in mobile devices, Everlight is revealing its latest innovative APM-16D25-11-DF8 which combines an ambient light and proximity sensor with an integrated IR transmitter in a compact DFN package.

To optimise the sensitivity, the package includes a lens which was designed based on a highly precise optical simulation with 1 million light rays to produce an accurate model.

Everlight is also presenting the high efficiency white mid power LED series 62-227B and 62-217B. These top view LEDs provide high efficiency, high CRI, high luminous flux output, high current capability, but low power consumption. These features, a wide viewing angle and a compact form factor make this package an ideal LED for all lighting applications.

The signage LED portfolio has been extended to include five new products for indoor, semi-outdoor and outdoor applications. Two new SMD Chip type LEDs are ideally suited for indoor LED applications with highly compact board sizes. Two new SMD PLCC type LEDs, additions to the “Hong” LED family, were designed for advanced indoor or semi-outdoor LED signage display applications.

Using 3-in-1 full colour SMD PLCC LEDs offers a smaller pixel pitch between two LEDs to create a high resolution and better contrast with its black surface design. A high performance LED Lamp, the 3474AH Series in a 3mm oval package, features an extensive wide viewing angle of 110° and UV curable epoxy with enhanced chemical resistance to perfectly fit for outdoor applications.

At Electronica Stand A3.307, Everlight will exhibit a large 2.40m (L) x 1.20m (W) LED video display consisting of 24 signage module/display pieces that uses 450,000 of Everlight’s newly announced SMD Chip type LED of the 18-038 Series.

The new ELMM-457SURCB/A3 is a through-hole 140 dots 4x5x7 matrix display driven by packaged IC for use in intelligent devices such as POS systems.

To fulfil the requirements of high brightness and compact size for a new TFT LCD backlighting technology called corner emitting backlight technology, Everlight is launching a new high quality 99-826 LED package as the light source for internal and external devices.

Osram`s nanochip technology brightens the light

The company's latest semiconductor LED light sources are used in the automotive sector, the entertainment industry and the security environment

At this year's electronica fair Osram Opto Semiconductors will be highlighting its role as a complete supplier of semiconductor lighting solutions.

This international exhibition of components, systems and applications will provide an opportunity to see the new Displix LED for the first time. This LED has been designed specifically for outdoor displays.

Osram Displix LED

Osram will also be showcasing the Oslon LX LED, which is intended for daylight running lights for small automobiles, and a prototype of the smallest ever LED for vehicle forward lighting, the Oslon Compact.

The German manufacturer will use the Munich fair to highlight its expertise in lighting for the automotive sector. Osram Opto will be presenting a new generation of LED light sources for interior and exterior applications and also some infrared emitter diodes.

These can be used a number of applications including in night vision devices to aid road safety. They are claimed to automatically increase the brightness of interior lighting and make the driving experience more comfortable.

All the semiconductor light sources will be viewable in their particular applications.

A forward lighting system will be used to demonstrate how the various functions such as high beam, low beam, daytime running light, fog lights and night vision can be implemented with different LED types.

Osram says its complete product portfolio will be on show.

Aixtron hosts MOCVD short course in China

The course focussed on LED production and included costs, opportunities and potential in the industry

At this year's China SSL Conference, Aixtron hosted an MOCVD seminar along with the China Solid State Lighting Alliance (CSA), with presentations by leading industry experts.

More than 200 decision-makers from industry and research took part.

The China SSL conference is one of the largest annual events in the solid state lighting industry, where top industry elite and key government representatives meet.

"Prices for LED bulbs as replacements for 40W incandescent bulbs in some countries are below the US $10mark", remarks Bernd Schulte, COO & Member of the Aixtron Executive Board (pictured left), in his presentation.

"This is good news, because it will significantly expand the market for LED lighting. The question now is how to reduce manufacturing costs even further, which turns the focus onto MOCVD as a decisive manufacturing step."
"I am convinced that we can only achieve quality and cost efficiency by constantly improving the reactor design and through maximum process control. If we continue to strictly focus on these areas and, at the same time, help our customers to migrate to silicon wafers of up to 8 inches in diameter, we will be able to achieve a considerable further reduction of production costs," he continues.

"China has the potential to become the world's biggest market of end consumers for LEDs over the next few years," notes Tim Wang, General Manager of Aixtron China Ltd. "Over the past few months we have realigned and restructured our China organisations to be more customer focused. Our Demo & Training Centre is currently experiencing strong demand for supported process demo, training and development, which shows us that our customers recognize the benefit we have created for them locally."

Everlight LED components pass LM80 testing

Everlight has introduced several low, mid, and high power LED lighting components which have passed the LM80 test. This will enable the company to strengthen its concept of "The Right LED for The Right Application."

Standardisation has become a key factor in LED adoption in the global lighting market.

Apart from environmental concerns, safety, performance standards, reliability and lifetime testing are key.

LM80 is the lighting standard by which all major LED manufacturers are complying with for lumen maintenance testing.

It is a standardised test method of at least 6,000 hours and at certain controlled conditions that is required of all lighting LEDs so that each LED tested, regardless of manufacturer, can be judged against other tested LEDs on an equal scale and compared.

As one of the largest LED manufacturers in the world and with lighting as its main focus, Everlight says its current lighting LEDs will be fully tested by 2013.

So far, five of the more popular Everlight Lighting LEDs have already completed LM80 testing. These LEDs range from low power (PLCC 3528 and 3020) to mid power (PLCC 5630) to high power (Ceramic 3535 and 3045) series.

Kingbright reveals compact bi-colour SMD LED chips

Each III-nitride LED has 4 pins and each colour can be controlled individually

Kingbright is introducing a new compact top view bi-colour chip-type SMD LED, the APB3227.

APB3227 LED

The 3227 package has an industry standard SMD (surface mount) 1210 footprint (3.2 x 2.7 x 1.1 mm), and features various output options. As every LED has 4 pins, each colour can be controlled individually.

Available in a wide range of colour combinations and lens options, this package is ideal for front panel indicators, backlighting and many more applications.

Kingbright manufactures SMD LEDs and Displays, Circuit Board Indicators, High Brightness LEDs, Through-Hole LEDs and Displays and other LED related products. The company has four manufacturing plants in Shenzhen, China.

Osram Displix multichip LEDs withstand extreme conditions

The robust LEDs are suited for use in high-contrast displays in outdoor applications

Osram Opto Semiconductors has released Displix black and Displix blackprint multichip LEDs.

The most important target applications for these LEDs are in large-format outdoor displays, for example at rock concerts, at sporting events or for perimeter advertising.

These robust high-contrast high-power LEDs can withstand high humidity levels, wide fluctuations in temperature and even torrential rain.

Depending on specific customer requirements, the high-power Displix black/ blackprint SMT LEDs offer excellent contrast and high brightness or good contrast and very high light intensity

The high-quality multichip LED is available as Displix black in a black package with a black reflector and as Displix blackprint in a white package with black overprinting and white reflector.

Osram says the Displix black offers excellent contrast even in direct sunlight and also precise colour rendering even after a long operating time. Their brightness values are also impressive. The typical light intensity at the Illuminant D65 white point (at a colour temperature of 6504 Kelvin), is 1450 millicandela (mcd) at an operating current of 20 milliamps, which appears very bright in the black package.

Under the same operating conditions Displix blackprint is even more intense at 2950 mcd with good contrast.

Both Displix versions come in a 4.5 x 4.5 x 2.1 mm package and contain three chips with typical wavelengths of 625nm (red), 528nm (green) and 470nm (blue). This means that individual LEDs do not have to be combined into an RGB cluster. This reduces the pixel spacing and improves the resolution for the same area.

Soraa & Ushio sign global LED lamp distribution agreement

The partnership is part of Soraa's worldwide strategic sales initiative. The company's gallium nitride on gallium nitride LED lamps will be available throughout many east Asian countries and Europe

Soraa has announced that as of November 1st, the company's full spectrum GaN on GaN LED MR16 lamps will be available through Ushio group companies and its subsidiaries.

Soraa MR16 LED lamp

The lamps will be available in Japan, China, South Korea, Hong Kong, Taiwan, Singapore, and Europe.

Ushio, the largest distributor of MR16 lamps in Japan, will sell Soraa's LED MR16 lamps under the brand name Superline LED, a co-branded Ushio and Soraa product.
Soraa, co-founded by LED pioneer Shuji Nakamura, is fulfilling Nakamura's original vision of bringing the highest quality, energy efficient LED light to the world.

"This agreement is an indication of what's to come for Soraa as we solidify our worldwide presence.

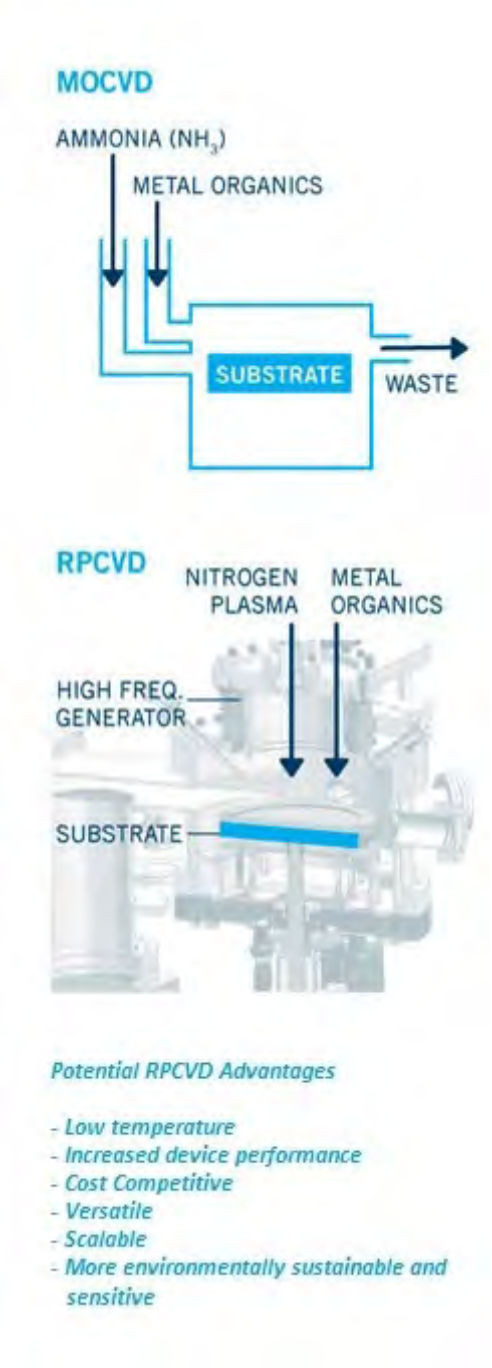
The partnership with Ushio allows us to introduce the company's products in several new markets, including Japan, where high quality of light is a leading consideration in purchasing replacement LED MR16 lamps," says Eric Kim, CEO of Soraa.

"Ushio recognises both the superior quality of light that Soraa's LED MR16 lamps produce and the elegance of the product design itself. We are honoured that a company with the history and expertise of Ushio has chosen our products."

A superior alternative to halogen MR16 lamps, Soraa's LED MR16 lamps feature full spectrum light; a CRI of 95 and R9 of 95, (higher than most halogen lamps); produce no UV or IR; last up to 10 times as long; use 80 percent less energy; run cooler; produce a much more consistent and efficient beam; and are compatible with existing lamp fixtures and lighting infrastructure.

"The lighting market in Japan and many other countries has been in need of a high-quality LED replacement option for halogen lamps," comments Akihiko Sugitani, Corporate Senior Vice President of Ushio, Inc. "Soraa's LED lamps will awaken many people to the possibilities of LED technology with its beautiful light and stylish design."

Japanese stores are internationally renowned for high standards of quality and design excellence in all aspects of the retail experience, especially lighting. A leading Japanese department store recently installed Soraa's LED MR16 lamps in a number of locations and Soraa says the reaction has been outstanding.



BluGlass drives down defects in GaN films grown by RPCVD

The independently verified impurity levels in gallium nitride grown by the Australian company are comparable to those grown in MOCVD grown layers

Sydney based BluGlass has announced it is now able to produce GaN with industry acceptable impurity levels using its low temperature Remote Plasma Chemical Vapour Deposition (RPCVD) technology.

BluGlass' RPCVD grown GaN layers are now demonstrating reduced levels of impurities of carbon, hydrogen and oxygen. The company says they are now on par with the industry standard process, MOCVD, for its GaN layers.

The impurity levels were measured by Evans Analytical Group (EAG), an independent, global materials characterisation company, using Secondary Ion Mass Spectrometry (SIMS).

EAG has confirmed that BluGlass has demonstrated carbon, oxygen and hydrogen

impurities at levels less than 1x1017 atoms cm-3.

This is a significant step forward that BluGlass believes will help enable the demonstration of industry equivalent electrical properties in RPCVD grown films to reach its proof of concept milestone.

The company is now seeking to optimise the*p*-GaN layer in order to show the advantages of RPCVD to customers. BluGlass aims to show improved LED device efficiency over the current industry standard MOCVD produced devices.

Showa Denko to split and transfer GaN LED business

In the transfer of its gallium nitride LED business to TS Opto, SDK will transfer 70 percent of common shares in TS Opto to Toyoda Gosei. This will, make TS Opto a joint venture between the two companies and help accelerate LED development

Showa Denko K.K. (SDK) has decided to split and transfer its GaN LED epitaxial wafer/chip business to its wholly owned subsidiary TS Opto Co., Ltd. (TS Opto).

SDK and TS Opto have concluded an absorption-type company split agreement.

Since this is a case of “simplified absorption-type company split” involving SDK and its wholly owned subsidiary, part of the details are omitted from the scope of disclosure.

The use of GaN LEDs, including LCD TV/PC backlight and illumination, means their demand is expected to grow in the coming years. As the market requires more energy-saving and lower-cost product, it is necessary for GaN LED manufacturers to improve LED brightness and production efficiency while expanding supply capacity.

SDK had already reached a basic agreement with Toyoda Gosei Co., Ltd., to establish a joint venture in order to strengthen the business. This time, SDK has decided to transfer its GaN LED business to TS Opto effective December 1st, 2012 through an absorption-type company split. SDK will transfer 70 percent of common shares in TS Opto to Toyoda Gosei on the same date. This will make TS Opto a joint venture between SDK and Toyoda Gosei. The absorption-type company split is a measure to achieve the afore-mentioned goal.

TS Opto will deliver 19,400 common shares to SDK at the time of the absorption-type company split.

While SDK has issued Euro-Yen convertible bonds with warrants (with a subordination clause) due 2014, this transaction will have no influence on share options and bonds with share options, for SDK.

Following the split, there will be no increase or decrease in the amount of SDK’s capital stock.

With regard to the rights and obligations pertaining to SDK’s GaN LED business, TS Opto will succeed to rights and obligations as defined in the absorption-type company split agreement.

As for the liabilities TS Opto will assume following the absorption-type company split, SDK believes that there will be no problem with regard to their discharge.

Osram unveils multimarket LED automotive lights

The Oslon LX LED can be used to provide affordable LED solutions for the high end to subcompact automobile market

With the Oslon LX, Osram Opto Semiconductors is offering a new LED component for widespread application in the automotive sector.

The focus here is on the essential functions of brightness and quality so these new white LEDs are affordable even for installation in subcompact vehicles.

They will be used mainly for daytime running lights and fog lights and will provide visual and technical enhancements to automobiles right down to the low price segment.

LED light with high light output and high energy efficiency can now be installed in low-end vehicles thanks to the Oslon LX LED

Experience has shown that it always takes some time before the price of high-tech applications falls to such an extent that they are of interest to the mass market.

Osram Opto has now reached this important threshold in LED automotive lighting. The new Oslon LX LED is based on the interplay between tried and tested package and converter technologies on the one hand and a new chip technology on the other. This new technology offers the usual high quality standards and light output typical of all the LED products from the Regensburg company.

What makes the Oslon LX LED stand out from the crowd, however, is its focus on the essential objective of producing a large amount of light at an affordable price. Oslon LX is ideal for applications in which high light output and high energy efficiency are crucial factors – such as fog lights and daytime running lights. Low beam and high-beam applications are also possible, however, with a combination of several LEDs.

The Oslon LX LED is based on the latest UX:3 chip technology with a tried and tested silicon converter.

At a temperature of 250C (in the chip) the LED produces 125 lumen from a current of 350 mA; at a higher temperature of around 1000C, it achieves a luminous flux of 100 lumen.

The LED lens has a beam angle of 120 degrees. This means that the new LED meets the established standard for reflector solutions in automobiles and that the systems used in the compact subcompact segments can be retained. In common with the other highly successful LEDs from Osram Opto Semiconductors, the package for the Oslon LX is compact, measuring only 3 x 3 mm². The solder pad design is identical to that for the other Oslon automotive components.

The LED's correlated colour temperature is 6500 K and it has a maximum current of 1000 mA. The thermal resistance is Rth 9.5 K/W.

"The combination of high quality and low price means that LED designs can be introduced in more and more vehicle classes", says Florian Rommen, Marketing Manager at Osram Opto Semiconductors. "Oslon LX is therefore an LED for everyone. It rounds off our celebrated Oslon family with an attractive product for the lower price segment on the automotive market."

The Oslon LX will be showcased for the first time at electronica 2012, at booth A3.107.

Cree reveals highest-efficacy LED arrays for lighting

The firm's four new III-nitride CXA LED arrays deliver high performance and are easy to use

Cree has launched its new CXA LED Arrays, boasting high lumen output and high efficacy in a family of single, easy-to-use components.

Optimised to simplify designs and lower system cost, Cree's newest CXA LEDs can deliver system-level performance ranging from 500 to 5000 lumens and up to 146 LED lumens per watt, enabling applications ranging from LED replacement lamps to commercial downlights.

CXA LED Arrays are available in EasyWhite colour temperatures, providing the LED industry's best color consistency for designs that use only one LED. The CXA LED Arrays are designed to be used as a single component in an LED design - emulating the single-filament appearance of traditional lighting products. One component means simplified design, manufacturing and inventory management - enabling lighting manufacturers to shorten time to market and reduce manufacturing costs.

"We switched to Cree's new CXA1507 LED Array because it delivers higher performance over other LED arrays," said Jason Lee, president of Gama Illuminer. "The easy-to-use package of the CXA1507 LED Array with well-designed features and small optical source made design and manufacturing simple."

CXA1507 LED CXA2530 LED

The new CXA family offers four new CXA LED Arrays (CXA1507, CXA1512, CXA2520 and CXA2530) delivering different lumen levels in two packages and optical sizes (minimum 80 and 90 CRI available).

"Cree is the only LED manufacturer that can deliver industry-leading performance in all LED packages," said Mike Watson, Cree senior director marketing, LEDs. "The CXA1512 LED Array can deliver over 1900 lumens at 120 lumens per watt in a very small 9mm optical source size. Other LED arrays may come close to this level of performance, but not in this small of a form factor. The CXA1512's small size is critical for enabling low system cost in a wide range of lighting applications, from narrow-beam spotlights to wide-area lights."

Cree XLamp CXA LED Array samples are available now and production quantities are available with standard lead times.

Veeco MOCVD systems popular with HC SemiTek

China's LED chip manufacturer has purchased several reactors from Veeco to mass produce gallium nitride based products

HC SemiTek Corporation has purchased additional Veeco TurboDisc MaxBright GaN MOCVD Systems. The firm will use the reactors for the for high volume production of LEDs for display and general lighting applications.

The order, placed in the third quarter of 2012, was for Veeco's new High Performance (MHP) version of the system.

Rong Liu, President of HC SemiTek, states, "Veeco's MOCVD products offer stable process and have already helped us to successfully produce high quality, high brightness LEDs. The addition of MaxBright MHPs to our manufacturing line will allow us to ramp additional production quickly, due to the seamless process transfer from our existing Veeco toolset."

Jeff Hawthorne, Veeco's Senior Vice President, MOCVD, adds, "We are pleased HC SemiTek has once again chosen Veeco's MOCVD technology for their production requirements. The MaxBright MHP helps drive our customers' productivity and yield, while reducing manufacturing costs."

The MaxBright MHP MOCVD system is designed to manufacture high quality, high brightness LEDs. Veeco says it provides as much as 20 percent within-wafer wavelength uniformity improvement, enhanced serviceability and a 15 percent increase in footprint efficiency as compared to the MaxBright.

Interiror of Veeco's TurboDisc MaxBright MHP GaN MOCVD System

Higher yields are achieved from improved thermal and flow capability. This system leverages Veeco's production-proven Uniform FlowFlange technology and automation expertise by combining multiple high throughput MOCVD reactors in a modular 2- or 4-reactor cluster architecture.

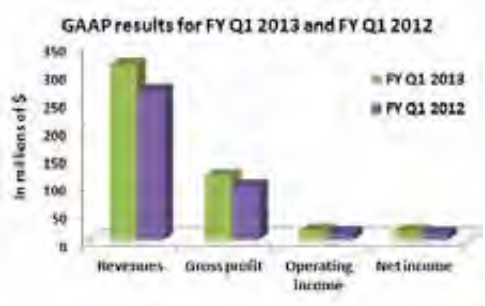
HC SemiTek Corporation, formerly Wuhan HC

SemiTek Co., Ltd., is an LED chip supplier based in Wuhan, China, and is committed to R&D, production and sales of high-quality LED chips, mainly in GaN-based blue and green LEDs.

Cree bounces back with revenues up 17 percent

The LED and power device chip manufacturer's quarterly net income increased 26 percent year-over-year to $16.1 million

Cree, Inc. has announced revenue of $315.8 million for its first quarter of fiscal 2013, ended September 23rd, 2012.



This represents a 17% increase compared to revenue of $269 million reported for the first quarter of fiscal 2012 and a 3% increase compared to the fourth quarter of fiscal 2012.

GAAP net income for the first quarter was $16.1 million, or $0.14 per diluted share, an increase of 26% year-over-year compared to net income of $12.8 million, or $0.11 per diluted share, for the first quarter of fiscal 2012.

"We started the year strong in our fiscal first quarter with record revenue and non-GAAP earnings per share at the high end of our target range," notes Chuck Swoboda, Cree chairman and CEO.

"Overall company backlog is stronger than it was at this point last quarter, although visibility is still limited and the macroeconomic environment remains a headwind. Our results are beginning to demonstrate the enormous leverage we have in our fully integrated vertical lighting model."

Gross margin increased 200 basis points from Q4 of fiscal 2012 to 36.8% on a GAAP basis.

Cash and investments increased $71.8 million from Q4 of fiscal 2012 to $816.3 million. Accounts receivable (net) increased $10.0 million from Q4 of fiscal 2012 to $162.3 million, with 46 days sales outstanding.

Inventory decreased $9.2 million from Q4 of fiscal 2012 to $179.7 million and represents 81 days of inventory.

Business Outlook:
For its second quarter of fiscal 2013 ending December 30, 2012, Cree targets revenue in a range of $320 million to $340 million with GAAP gross margin targeted to be 37.5%+/-. Its GAAP gross margin targets include stock-based compensation expense of approximately $2.6 million.

Operating expenses are targeted to increase by +/- $7 million on a GAAP basis. The tax rate is targeted at 22% for fiscal Q2. GAAP net income is targeted at $13 million to $19 million, or $0.12 to $0.16 per diluted share. The net income targets are based on an estimated 116 million diluted weighted average shares.

NYC`s Central Park perked up by Cree LEDs

The new LED lighting is estimated to reduce energy usage by 62 percent compared to metal halide lighting

The New York City Department of Transportation (NYC DOT) recently completed the installation of nearly 1,600 LED luminaires that light walkways and grassy areas in Central Park.

The new luminaires from Spring City Electrical feature Cree XLamp XP-G LEDs in each fixture and were produced using an advanced light engine from

Heatron.

DOT officials estimate the new LED lighting will reduce energy usage by 62 percent and deliver annual maintenance savings of nearly $30,000 compared to metal halide lighting.

The NYC DOT initiated the project in collaboration with the U.S. Department of Energy (DOE) GATEWAY demonstration program to improve the park environment for local citizens and visitors and to significantly lower energy and maintenance expenses for the city.

“Located in the heart of Manhattan, Central Park presented a unique lighting challenge,” says James Brodrick, DOE Lighting Program Manager. “For walkways in general, it’s important to measure both horizontal and vertical illuminance. The former to monitor available light for paths and to determine how much is distributed onto the adjacent grass and the latter to determine whether the illumination is sufficient to identify approaching pedestrians.”

Addressing the challenge head-on, Spring City Electrical joined forces with Heatron and Cree to deliver the new fixtures. The luminaires, which Spring City projects to have an estimated 75,000-hour lifespan, are being placed on existing 9 foot tall cast iron posts and are spaced about 80 ft apart along the paved walking trail.

“Spring City’s engineering capabilities and old world craftsmanship are well represented in the Central Park LED installation,” adds Chris Rosfelder, vice president sales and marketing, Spring City Electrical.

“We are very pleased with the performance of Cree’s XP-G LEDs in our luminaire systems. Cree LEDs are consistently among the highest performing LEDs in the industry. And Heatron is really the glue that brings us all together – their OEM leadership enables us to leverage the best LED technology in the industry.”

Spring City, a manufacturer of decorative LED luminaires and cast lampposts, maintains a large design library and advanced data processing providing you full submittal drawings and specifications in minimum time.

Heatron, Inc., is an innovator in lighting integration and helps OEMs reduce costs, speed time to market and ensure superior quality and performance, by leveraging the engineering disciplines of optical, electrical and mechanical design, with expertise in thermal management.

Heatron offers various levels of integration ranging from design and manufacture of component level LED light engines to turnkey lighting solutions designed for a range of uses including indoor and outdoor lighting, healthcare, transportation, entertainment and industrial applications.

The U.S. Department of Energy’s GATEWAY demonstration program features high-performance LED lighting products in real-world applications. The results of DOE demonstrations provide potential buyers with data on product performance and cost effectiveness as well as critical hands-on technology experience before they make large scale purchases.

Optogan`s HBLEDs now in mass production

The company’s high-power III-nitride based X10 modules Chip-on-Board LEDs reduce the manufacturing costs of energy-efficient light sources

On 15th October, LED manufacturer Optogan started mass production of high-power X10 modules in St. Petersburg, Russia.

Based on scalability, flexibility and lean processing, the X10 modular LED based Chip-on-Board solution significantly reduces the manufacturing costs of energy-efficient light sources.

Power, W	10	40	90	160	250
Luminous flux	1 100	4 400	9 900	17 600	27 500

“The opening of the X10 production line with a production capacity of 40,000 units per month will

make LED technology accessible to a wider range of customers in the near future," said Vladislav Bougrov, the Executive Vice-President of Optogan, during the opening ceremony.
The compact X10 LED has a module efficiency over 110lm/W, and an optimal price and convenient size for mounting. Optogan has already produced modules consisting of 72 items that can be easily divided into LED elements of smaller sizes and power.

Optogan X10 LED module consisting of 72 items

The flexible X10 starts with a single unit of 10W. The biggest X10 module can provide maximum luminous flux of nearly 80,000 lumens with a power consumption of 720W.

The X10 can be used for various applications. These include halogen lamp analogues, light fittings, single designer lamps, fixtures with reflectors, as well as high power industrial or street lights. The ceramic base and product material selection is based on long life performance by design.

Optogan`s X10 patented design was developed jointly with the Russian Innovation Centre "Skolkovo".

The pilot sample of the X10 was originally introduced in 2011.

"It's great that, thanks to the material and technical base of the Innovation Centre Skolkovo our breakthrough technology does not stagnate in the laboratory, and only after a year goes to the mass market. It is a high contribution for the hi-tech industry,"emphasised Bougrov.

Optogan says its X10 module is a new generation of integrated solutions like LED Chip-on-Board, which are the main focus of technological development of the global LED industry.
At the opening ceremony, Bugrov explained that Optogan strives "to make the transition from a single breakthrough LED, which is already implemented in the technology Chip-on-board, to the integrated lighting system, including the assembly of LEDs on a single substrate, the circuit elements and the power control (driver), as well as the primary optics. Such a breakthrough is possible due to the continuous research, conducted at the Optogan`s research and development centre".

Opening ceremony, speech given by Vladislav Bugrov, executive VP of Optogan (on the right); next to him Oleg Arshinov, Production Manager

Bougrov added, "Full integration, in particular, will significantly reduce the cost of the production process, significantly decreasing the price of LED light sources in the future".

GSU selects Meaglow plasma source

The system will be used for the development of group III-nitride compound semiconductor materials

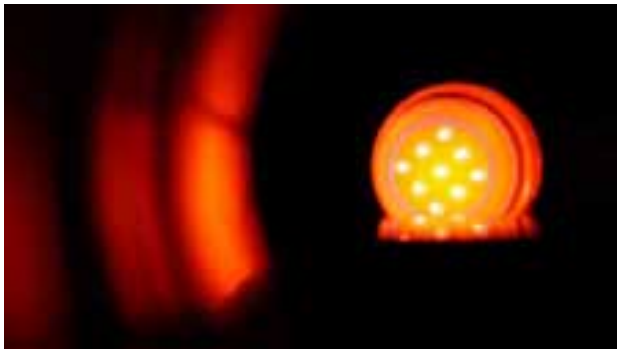
Meaglow has announced that Georgia State University (GSU) has received shipment of its patent pending hollow cathode plasma source.

The installed Meaglow plasma source extends the growth processing parameter space of GSUs presently utilised in low-pressure MOCVD reactors. This upgrades the tool so that it can produce type III-nitride materials under normal low-pressure growth conditions.

Meaglow hollow cathode plasma source

Meaglow's plasma source fosters a plasma-assisted gas phase and surface chemistry that provides a new path for the integration of dissimilar materials for ternary and quarternary III-nitride alloys.

Research in Dietz's group at GSU will study the migration enhanced afterglow chemistry and growth dynamics for III-nitride epilayers and nanocomposites. They will support Meaglow's effort in commercialising the growth technology.



Meaglow hollow cathode in use

Meaglow has previously applied its hollow cathode plasma source technology via its migration enhanced afterglow technique in the deposition of high indium content InGaN. More recently, the source has been demonstrated in a yellow LED in the green gap.

Meaglow is now focused on commercialising its hollow cathode plasma technology, and is fielding inquiries from partners interested in plasma source solutions for MBE or any surface modification to materials.

Osram gives laser projectors the green light

The firm's direct emitting green laser diodes are ideal for miniature projectors for mobile devices like smartphones and cameras

Osram Opto Semiconductors is now offering its first direct green diode lasers.

The company's two compact laser diodes have an optical output of 30 and 50 milliwatts (mW) and a high beam quality.

Osram believes they represent a milestone in the development of miniature projectors for mobile devices such as smartphones and cameras. Projection units for laser shows, point lasers and line lasers will also benefit from the new technology.

Direct green diode lasers are a big step towards powerful pico projectors. Hopefully it will mean that the laborious way of producing green light by doubling the frequency of infrared lasers will no longer be needed.

What's more, the new technology is claimed to enable high colour rendering and excellent contrast but this is a work still in progress.

Direct green emitting PL 520 laser diode

The wavelength of the new PL 520 laser diode of 515-530nm produces precisely the right green for projection applications. Its optical output is 50mW and its efficiency is typically 5 to 6 percent at present.

The PL515 offers an output of 30mW in a wavelength range of 510 to 530nm. With a package

diameter of just 3.8 mm the laser diodes enable the dimensions of projection units to be reduced considerably.

"The commercial breakthrough for compact laser projectors is closer than ever before," says Stephan Haneder, Marketing Manager for Consumer Lasers at Osram Opto Semiconductors.

The lasers have a high beam quality with a narrow beam that spreads out only slightly thanks to its small divergence angle. In the case of pico projectors, which project the laser light with a MEMS mirror (micro-electromechanical system) without any other optics, the size of the light point determines the image resolution.

The beam quality is particularly important in this case. Both laser diodes operate in single mode, which means they emit only a single transverse oscillation mode.

Direct emitting lasers can be easier to modulate than other lasers, such as frequency-doubled infrared lasers. This is an important property for MEMS-based projectors in which the colour components per pixel result from the emission time of the laser diode. There is also no need to adjust the focus of the projection image. Osram says the image is always sharp, even on curved surfaces.

Osram believes the single mode lasers open up new possibilities as light sources for laser shows. Their high beam quality enables extremely fine structures to be displayed even over large distances. The projectors also benefit from the high thermal stability and small size of the lasers.

Green diode lasers are also ideal as point or line lasers for measuring distances. The human eye is most sensitive in the green spectrum so they offer another important advantage over red laser light. For the same laser output, and therefore the same laser safety class, green light is perceived more easily by the eye than the red light that is usually used. This means that distance metres, such as those used by builders, can be used over larger distances.

By launching one of the first direct emitting green laser diodes Osram Opto Semiconductors is underlining its leading position in lasers based on indium gallium nitride. The green laser is the result of years of intensive development work in Regensburg.

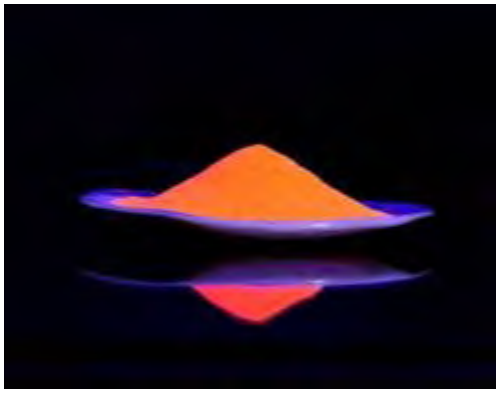
It has been developed as part of the MOLAS project sponsored by the German Ministry for Education and Research and involving technologies for ultra-compact and mobile laser projection systems. In 2010, researchers at the company received the Karl-Heinz-Beckurts Award for development work on the green laser.

Energise LEDs with Intematix` Ruby phosphors

The firm's new red nitride phosphors bridge the gap in the colour spectrum and create quality light in the most demanding applications. They are suited to general lighting and backlighting of displays

Intematix has released the Ruby series of red nitride phosphors that it says enable exceptional efficacy, colour rendering and reliability for high-power LEDs.

Red makes everything more appealing. The addition of the right red to create white phosphor blends makes colours appear richer, vibrant and more natural.



Intematix Ruby phosphor

These phosphors, backed by Intematix U.S. patent No. 8,274,215, are ideal for applications such as general lighting and backlighting for LCD TVs.

"Building on a decade of innovative work in phosphor, our substantial investments in materials and process research led to this breakthrough in both moisture stability and quantum efficiency where customers need it most," says Yi-Qun Li,

Chief Technology Officer for Intematix.

“These properties of our Ruby red nitride help ensure that customers will see long lifetimes and consistent performance across the operating conditions of their LEDs for all lighting applications.”

Red nitride phosphors fill crucial gaps in the colour spectrum and create quality light in the most demanding applications. Intematix believes its red nitrides in combination with the firm’s GAL phosphor enable near-perfect colour rendering up to 98 CRI. Intematix red nitrides used in blends with GAL phosphors also enable 100 lm/W efficacy in warm white packages.

Intematix’s U.S. Patent No. 8,274,215 is the 18th U.S. patent issued to the company in the area of LED phosphors and the 71st U.S Patent overall.

Intematix also has over 300 pending patent applications covering LED phosphor and lighting technologies on a world-wide basis.

The Ruby series expands the company’s wide range of phosphors, adding to its portfolio of nitride, silicate, aluminate, and garnet phosphors.

Cree unleashes its next generation colour LEDs

The new LEDs double the lumens-per-dollar compared to the firm’s XB series and aim to accelerate the adoption of LED lighting

Cree is marketing its new XLamp XB-D colour LEDs and XLamp XM-L multi-colour LEDs.

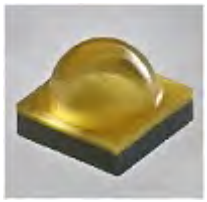
The firm says these LEDs provide lighting manufacturers with discrete and multi-colour LED options to more cost-effectively address a wider spectrum of applications such as architectural, vehicle and display lighting.

Cree XLamp XB-D colour LEDs extend the double lumens-per-dollar performance of the XB package to colour LEDs, delivering up to 40 percent higher maximum light output than XP-E colour LEDs.

The combination of performance and the small size of XB-D colour LEDs enable better colour mixing and lower system cost through fewer LEDs. They are now available in colour as well as existing white colour temperatures ranging from 2700K to 6200K and support a full range of colours in the single XB footprint.

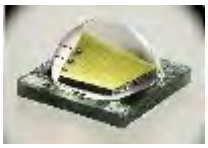
Cree believes its XLamp XM-L colour LEDs are the brightest and smallest multi-coloured LED of its power class, delivering red, green, royal blue and white in one LED at twice the lumens-per-dollar of the MC-E colour LED. The XM-L colour LED is 60 percent smaller than the MC-E LED, reducing the distance between LED die, to create a small optical source for excellent optical control, efficient colour mixing and simplified design.

“We are excited that Cree is offering a higher performance multi-colour LED,” says Michael Johnson, vice president of engineering, The Black Tank. “The smaller and brighter XM-L colour LED allows us to improve system performance and lower system cost.”



XLamp XB-D LED

XLamp XB-D colour LEDs deliver up to 1416 mW for royal blue, 92 lumens for blue, 198 lumens for green, 210 lumens for red and 261 lumens for red-orange, all at 1A in the 2.45mm x 2.45mm footprint.



XLamp XM-L LED

XLamp XM-L colour LEDs deliver up to 89 lumens for royal blue, 214 lumens for green, 229 lumens for red and 272 lumens for white at 1A in the 5mm x 5mm footprint.

Cree XLamp XB-D and XM-L colour LED samples are available now and production quantities are available with standard lead times.

HexaTech & Tokuyama UV-C LEDs raise the bar

The companies have demonstrated dramatic improvements in power and efficiency for UV-C LEDs. These aluminium nitride based LEDs are suited for use in water and surface disinfection

The rapidly accelerating interest in LEDs for disinfection applications operating at UV-C wavelengths requires a solution with high output power, high efficiency and long lifetimes.

HexaTech, along with Tokuyama Corporation of Tokyo, have demonstrated exceptional output power and dramatic internal quantum efficiency (IQE) improvements. These results raise the bar to what is possible with the technology, and enable commercially available high performance, high reliability UV-C LEDs.

The devices were used by coupling HexaTech's low dislocation density bulk AlN substrates with Tokuyama's hydride vapour phase epitaxy (HVPE) and device fabrication. Tokuyama was able to produce UV-C LEDs with over 25mW of output power at 265nm, and IQEs greater than 70 percent.

"This collaboration demonstrates that when combining HexaTech's market-leading bulk substrate quality, with Tokuyama's high quality HVPE and excellent device fabrication, breakthrough, record-setting results are possible", notes Joe Grzyb, HexaTech CEO. "It further highlights our commitment to working with our customers to bring the best in AlN technology to market."

"Working together with HexaTech and their substrates, Tokuyama has made great improvements in the performance of our UV-C LEDs, accelerating the process for their commercial availability," states Toru Kinoshita, Chief Research Engineer at Tokuyama Corporation.

Since their inception, UV-C LEDs have held the promise of a compact, highly efficient, long-life light source for sterilisation and purification applications.

However, most commercially available products currently struggle with limited output power, efficiency and device lifetimes. A key requirement for improving these limitations is to drive the device defect density down, for which IQE is a key measure and is critically related to the underlying bulk material quality.

"As HexaTech's own device development has shown, using our high quality, low dislocation material, we are able to produce UV-C LEDs with record-setting reliability and lifetimes, exceeding more than 600 hours of accelerated testing, with virtually no degradation", comments Baxter Moody, HexaTech Director of Device Development.

HexaTech is a manufacturer of single crystal AlN substrates. This substrate material will enable long life UV-C LEDs for disinfection applications, deep UV lasers for biological threat detection. It also enables high voltage power semiconductors for smart grid and efficient power conversion.

The company's current product lines include single crystal and polycrystalline AlN substrates. Long life UV-C LEDs and high voltage power devices based on AlN substrates are also in development.

Founded in 2001 by a team of industry experts in III-nitride semiconductors, HexaTech has successfully solved complex material science and engineering challenges to commercialise high quality bulk AlN for volume production.

Tokuyama group is producing and selling mainly chemical products but is also in the electronics materials market. The firm was founded in 1918 and has 5600 employees.

Telecoms

Strategy Analytics: Tuneable antennas enhance smartphones

Skyworks, RFMD, Avago, TriQuint and Murata, to compete in this segment using GaAs, CMOS, RF MEMS and voltage-dependent dielectric variable capacitor technologies

Compact, integrated antenna tuners were used in several popular smartphones in 2011, the first of a wave of such tuners from Peregrine Semi, RFMD and others.

The Strategy Analytics report, "Outlook for Active Antennas & Tunable Components in Cellular Phones" reviews the prospects for tuneable RF components, comparing the different approaches and suppliers, and provides an upbeat forecast of the market through 2017.

Christopher Taylor, Director of the Strategy Analytics RF & Wireless Components market research service says, "Mobile devices that support 4G, 3G and 2G in multiple bands have complex RF front-ends, with compromises in antenna performance that can degrade calls, as Apple learned last year. Tuneable components can reduce dropped calls and improve battery life, while simplifying the cellphone."

Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor market research service adds, "Antennas with tuneable impedance match will emerge as an important piece of the cell phone RF front-end, and we expect antenna specialists including Ethertronics and Skycross, in combination with front-end component suppliers including Skyworks, RFMD, Avago Tech, TriQuint and Murata, to compete aggressively in this segment using GaAs, CMOS, RF MEMS and voltage-dependent dielectric variable capacitor technologies."

Stephen Entwistle, VP of the Strategy Analytics Strategic Technologies group concludes, "The new 'antenna tuner' product category will bring success to some new entrants such as WiSpry and inevitably shake up the existing order among cellphone RF front-end component vendors."

Infinera & Nissho demonstrate 8Tb/s transmission over dispersion shifted fibre

The indium phosphide (InP) PIC provider and its Japanese partner says that this is a milestone for delivery of high capacity optical transmission over DSF fibre

Infinera, along with Nissho Electronics, have successfully demonstrated the Infinera DTN-X platform delivering 8 Terabits per second (Tb/s) capacity using production ready super-channels across 800 kms of ITU-T G.653 Dispersion Shifted Fibre (DSF).

The demonstration at the NET Frontier Centre marks a significant achievement for delivery of high capacity optical transmission over DSF fibre.

This illustrates the value that high performance 100 Gigabit per second (Gb/s) coherent optical technology can have in leveraging DSF assets for service providers.

DSF fibre, deployed throughout Japan, has proven to be a challenge in deploying high-capacity dense wavelength division multiplexing (WDM) transport technology due to low chromatic dispersion in the C-Band, making it difficult to achieve high capacity optical transmission over long distance economically.

As a result, capacities have been severely limited and have had to utilise expensive L-band technology to achieve long haul quality performance from the DSF fibre.

Infinera's DTN-X platform, built upon 500 Gb/s InP Photonic Integrated Circuits (PICs) and the second generation FlexCoherent Processor offering software-configurable coherent modulation, offers long haul 500 Gb/s super-channels which feature world class Polarisation Mode Dispersion (PMD) compensation performance.

This next generation platform demonstrated that it could successfully transmit 8Tb/s of super-channel capacity on the C-Band over 800 kms of challenging DSF fibre. This enables network operators to leverage existing fibre plant investments while also being able to operate the latest multi-Terabit, long-haul next-generation WDM transmission technologies. This same capacity extends to well over 2,500 kms when using QPSK on the Infinera DTN-X with non DSF fibre, which is in use in much of the world.

Infinera also demonstrated the FlexCoherent capabilities of the system, to show the ability to software-select different modulation formats including QPSK and BPSK to optimise both reach and capacity.

This trial validates that service providers globally can deploy the latest high capacity optical transport solutions on existing DSF fibre economically. The demonstration also shows 100GbE service provisioned in less than 100 seconds, showcasing the simplicity of DTN-X and its ability to activate services much faster than conventional solutions.

“This test truly demonstrates the value of the DTN-X platform to service providers with DSF assets,” says Kimitaka Sato, Executive Officer at Nissho. “In the past, service providers may not have been able to run even multiple 10 Gb/s transmission over this kind of fibre. Infinera’s solution proves that we can run the very latest super-channel technology at 8Tb/s on DSF, which is impressive.”

“This trial is unique because it not only achieves world class reach and capacity over a very difficult type of optical fiber, it shows how quickly capacity can be turned up for service providers today,” continues Dave Welch, Infinera Co-founder, Executive Vice President and Chief Strategy Officer. “This capability can be combined with our recently introduced Instant Bandwidth™ solution on the DTN-X to allow service providers to compete more effectively and achieve a success-based business model.”

Infinera claims it is the first company to deliver 500 Gb/s long-haul super-channels based on the PIC and FlexCoherent Processor, scaling transport capacity without scaling operational complexity.

Shipping since Q2’12, the Infinera DTN-X has received purchase commitments from 16 operators globally, including Cable&Wireless Worldwide, DANTE, PIPE Networks, Telefonica International Wholesale Carrier, Cyprus Telecommunications Authority and TeliaSonera International Carrier.

Skyworks board restructures to push product portfolio

The RF device manufacturer has made leadership changes to enhance focus and drive its products forward

Skyworks Solutions is restructuring its executive management team to increase collaboration between its front-end solutions and high performance analogue teams.

The firm aims to drive development of next generation solutions and set the stage for further market outperformance.

Liam Griffin, who previously served as executive vice president and general manager of Skyworks’ high performance analogue business, has been promoted to executive vice president and corporate general manager.

This newly created role encompasses responsibility for all of Skyworks’ business units and is designed to enhance product line performance, leverage organisational synergies and best capitalise on market opportunities.

Prior to his leadership role in high performance analogue, Griffin served as the Company’s senior vice president of sales and marketing where he gained in depth knowledge of Skyworks’ broad product portfolio.

“Skyworks is enabling mobile connectivity across some of the world’s most exciting communications platforms including smartphones, tablets and e-readers,” says David J. Aldrich, president and chief executive officer of Skyworks.

“We are capturing more content per platform than ever before and rapidly expanding our footprint in complementary new vertical markets such as automotive, medical and home automation. With our customers demanding higher levels of analogue

and RF integration and placing greater value on total solutions, we are proactively driving alignment across all Skyworks teams to create a more integrated and rapid development cycle for our next generation products. Liam's track record of success makes him the ideal person for this key leadership role."

As part of the realignment, Gregory Waters will be leaving Skyworks following a transition period.

"We thank Greg for his instrumental role in building Skyworks' front-end solutions franchise and are grateful for his many contributions over the years. We wish him well in his future endeavours," Aldrich concludes.

JDSU awarded by Huawei as an excellent core partner

The firm was recognised for its optical transport and transmission solutions that support the evolution to smarter and faster networks

Huawei, one of the world's top telecom solutions providers, granted JDSU the 2012 Excellent Core Partner Award at its recent core partner convention held in Shenzhen, China.

The award is the highest honour given by Huawei to any of its base of approximately one thousand suppliers.

JDSU received the award for its innovative network technology, focus on high quality, and consistent on-time delivery.

JDSU provides a wide array of solutions to Huawei that include optical components, modules and transmission products for the development of Self-Aware Networks that support more flexible network management and higher data rates.

Many of the firm's products are based on its III-V compound semiconductor technology.

"Receiving the Huawei Excellent Core Partner Award is a great honour for JDSU and we will continue to collaborate with Huawei to keep increasing the performance of optical networks around the world," says Alan Lowe, president of Communications and Commercial Optical Products at JDSU. "This award also reflects our growing impact in Asia Pacific that is a result of the dedication, customer focus and hard work by the talented JDSU team in the region."

During the Huawei partner convention, JDSU also presented on the topic of collaboration in a panel session.

JDSU has offices throughout China that are located in Beijing, Chengdu, Guangzhou, Shanghai, Shenzhen and Suzhou. The company also has locations across other parts of Asia Pacific that include India, Japan, Southeast Asia and South Korea.

In 2010, JDSU received the Excellent Core Partner Award from Huawei for its service and solutions including Reconfigurable Optical Add Drop Multiplexor and tuneable XFP products.

Flexible, low-voltage circuits using CdSe nanocrystals

Scientists say that cadmium selenide nanocrystal devices can move electrons 22 times faster than in amorphous silicon

Electronic circuits are typically integrated in rigid silicon wafers, but flexibility opens up a wide range of applications.

In a world where electronics are becoming more pervasive, flexibility is a highly desirable trait, but finding materials with the right mix of performance and manufacturing cost remains a challenge.

Now a team of researchers from the University of Pennsylvania has claimed that nanoscale particles, or nanocrystals, of the semiconductor cadmium selenide (CdSe) can be "printed" or "coated" on flexible plastics to form high-performance electronics.

The research was led by David Kim, in the Department of Materials Science and Engineering in Penn's School of Engineering and Applied Science and the work was published in the journal *Nature Communications*.

"We have a performance benchmark in amorphous silicon, which is the material that runs the display in your laptop, among other devices," Kagan, a co-author of the publication, says. "Here, we show that these cadmium selenide nanocrystal devices can move electrons 22 times faster than in amorphous silicon."

Besides speed, another advantage cadmium selenide nanocrystals have over amorphous silicon is the temperature at which they are deposited. Whereas amorphous silicon uses a process that operates at several hundred degrees, CdSe nanocrystals can be deposited at room temperature and annealed at mild temperatures, opening up the possibility of using more flexible plastic foundations.

Another innovation that allowed the researchers to use flexible plastic was their choice of ligands, the chemical chains that extend from the nanocrystals' surfaces and helps facilitate conductivity as they are packed together into a film.

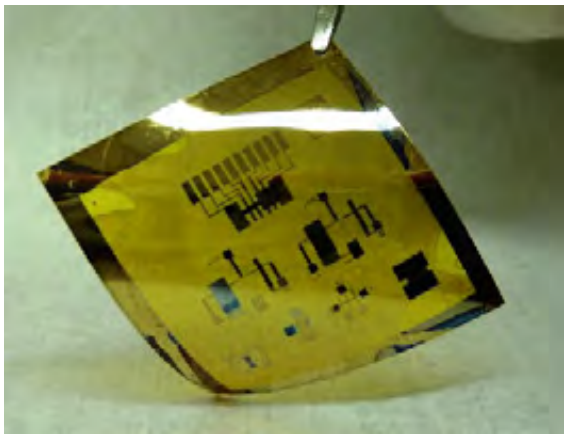
"There have been a lot of electron transport studies on cadmium selenide, but until recently we haven't been able to get good performance out of them," Kim says. "The new aspect of our research was that we used ligands that we can translate very easily onto the flexible plastic; other ligands are so caustic that the plastic actually melts."

Because the nanocrystals are dispersed in an ink-like liquid, multiple types of deposition techniques can be used to make circuits. In their study, the researchers used spincoating, where centrifugal force pulls a thin layer of the solution over a surface, but the nanocrystals could be applied through dipping, spraying or ink-jet printing as well.

On a flexible plastic sheet a bottom layer of electrodes was patterned using a shadow mask, essentially a stencil, to mark off one level of the circuit. The researchers then used the stencil to define small regions of conducting gold to make the electrical connections to upper levels that would form the circuit.

An insulating aluminium oxide layer was introduced and a 30nm layer of nanocrystals was coated from solution. Finally, electrodes on the top level were deposited through shadow masks to ultimately form the circuits.

"The more complex circuits are like buildings with multiple floors," Kagan says. "The gold acts like staircases that the electrons can use to travel between those floors."



Flexible circuit fabricated in the Kagan lab. (Photo: David Kim and Yuming Lai)

Using this process, the researchers built three kinds of circuits to test the nanocrystals performance for circuit applications: an inverter, an amplifier and a ring oscillator.

"An inverter is the fundamental building block for more complex circuits," Lai, another co-author of the paper, comments. "We can also show amplifiers, which amplify the signal amplitude in analogue circuits, and ring oscillators, where 'on' and 'off' signals are properly propagating over multiple stages in digital circuits."

"And all of these circuits operate with a couple of volts," Kagan says. "If you want electronics for portable devices that are going to work with batteries, they have to operate at low voltage or they won't be useful."

With the combination of flexibility, relatively simple fabrication processes and low power requirements, these cadmium selenide nanocrystal circuits could pave the way for new kinds of devices and pervasive sensors, which could have biomedical or security applications.

"This research also opens up the possibility of using other kinds of nanocrystals, as we've shown the materials aspect is not a limitation anymore," Kim points out.

More details of this work can be accessed in the paper, "Flexible and low-voltage integrated circuits

constructed from high-performance nanocrystal transistors," by David K. Kim *et al* in *Nature Communications,* 3, Article number 1216,. DOI: 10.1038/ncomms2218

The research was supported by the U.S. Department of Energy and the National Science Foundation.

AlGaAs LEDs speed up Toshiba`s IC MOSFETS in IC photocouplers

Combining aluminium gallium arsenide (AlGaAs) with a silicon device reaps the benefits of both technologies

Toshiba America Electronic Components (TAEC) has added the TLP700A and TLP705A to its family of photocouplers.

The new photocouplers are housed in small packages (SDIP6), half the size of conventional 8 pin DIP packages, and consist of an AlGaAs infrared LED, optically coupled to an integrated high-gain, high-speed photodetector IC chip.

Toshiba says its TLP700A can directly drive a middle-capacity IGBT or power its MOSFETs.

With a guaranteed transmission delay skew, ideal for designing dead time for inverters, this product achieves a shorter transmission delay time, roughly half of the firm's previous model.

With improved peak output current and operating ambient temperature, the TLP700A is suitable for use in high temperature environments. The device also complies with the reinforced insulation class of international safety standards.

The TLP700A can be used in a wide range of products, including industrial devices, digital home appliances, measurement devices, and control devices. Its small packaging can contribute to a smaller footprint and cost reduction.

The TLP705A can directly drive a small-capacity IGBT and power MOSFETs.

Using a new LED with excellent longevity, the TLP705A has better output current, variation in transmission delay time, and transmission delay skew characteristics than those of the existing model.

Toshiba's new IC complies with the reinforced insulation class of the international safety standards, and can be used in a wide range of products - including industrial devices, digital home appliances, measurement and control devices.

According to Joseph Tso, business development manager for Toshiba's optoelectronics discrete business unit, "Toshiba's new photocouplers provide a smaller footprint solution for applications that require safety standard certifications, while also contributing to cost reductions."

The Toshiba TLP700A and TLP705A are available now.

Infinera tops global long-haul 100G market share

The firm's indium phosphide (InP) based DTN-X platform has been awarded for its strength in bandwidth demands driven by video, high speed data and cloud-based services

The Dell'Oro Group has ranked Infinera as number one for the third quarter of 2012 in the global long-haul 100G market as measured by the number of long-haul 100G ports sold .

The Dell'Oro Group tracks the telecommunications market and is known as a source for market information about the networking and telecommunications industries.

The firm's "Optical Transport Report" identifies market leaders in various segments of the optical communications equipment market each quarter.

The November 16th, 2012, edition of the report shows that in the third quarter of 2012, the first quarter Infinera began recognising revenue from the new DTN-X platform.

Infinera got to number one in the worldwide long-haul 100G wavelength market. In this context, the

long-haul 100G wavelength market is measured by the number of long-haul 100G ports recognised for revenue in the quarter.

The report shows that Infinera accounts for 38 percent of the long-haul 100G ports sold in the third quarter of 2012, and also shows that Infinera accounts for 22 percent of all long-haul 100G ports sold since the long-haul 100G market emerged in 2010.

The Dell'Oro Group forecasts the global 100G dense wavelength division multiplexing market to grow at greater than 120 percent each year for the next five years.

Infinera's DTN-X platform is designed for global network operators facing increasing bandwidth demands driven by video, high speed data and cloud-based services.

For these operators the DTN-X provides a simple, scalable, and efficient solution that integrates five Terabits of OTN switching capacity with market-leading 100G transport capacity. The DTN-X enables optical transport network operators to deploy 100G wavelengths by delivering 500G long-haul super-channels.

Colt Technology deploys 100 GbE Infinera platform across Europe

The firm's indium phosphide (InP) based DTN platform will be used to bring together Europe's major business areas

Infinera has made available 100 Gigabit Ethernet (GbE) services to its customers, using its DTN platform over Colt's long distance network.

Colt can now offer 100GbE services across its infrastructure combining 20 Colt carrier neutral data centres and a highly scalable long distance network that brings together Europe's major business areas. These comprise a 39 metropolitan area networks and 18,000 directly connected buildings.

As Colt strategically expands its data centre and network infrastructure, investing where customers need its services, Infinera's DTN platform enables Colt to efficiently expand its network capabilities.

With Infinera's DTN platform capability embedded in Colt's long distance network, the company can continue to respond to the increasing demand for high bandwidth scalable Ethernet services from wholesale carriers and enterprise customers in the finance and media sectors.

The Infinera DTN platform, built with InP photonic integrated circuits (PICs), offers Colt operational simplicity and scalability. By deploying a PIC-based solution, Colt directly benefits from reduced sized equipment using less power, reduced costs and improved reliability, thereby resulting in lower capital and operational expenses while operating a more flexible long-haul optical network.

"As the company continues to transform from a traditional B2B telecoms operator to a provider of integrated IT and network services, enhancing our Ethernet services capabilities is key to delivering an end to end service experience that matches our customer's agenda," says Luke Broome, CTO at Colt. "Our use of the Infinera DTN to deliver 100GbE services on our long distance network will support customers with the highest performance demands in achieving their business priorities."

"Colt plays an integral role in providing critical network and IT services throughout Europe," adds Chris Champion, vice president, EMEA sales at Infinera. "We are pleased that Colt has chosen us to deliver high speed optical Ethernet services to their customers."

Colt first deployed the Infinera DTN in 2009. The availability of 100GbE services is the culmination of a development project that included an early successful first trial in 2010 over the Colt London to Frankfurt route. Colt's leadership in Ethernet services was recently confirmed by the Metro Ethernet Forum for its award winning Ethernet capabilities for the 8th consecutive year.

Silicon carbide advances graphene electronics

A new technique could potentially allow the fabrication of entire integrated circuits from graphene without the need for interfaces that introduce resistance

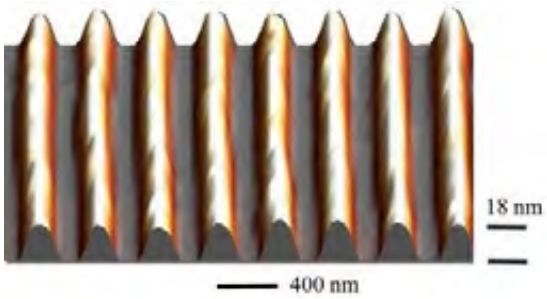
By fabricating graphene structures atop nanometre-scale "steps" etched into silicon carbide (SiC), researchers say they have for the first time, created a substantial electronic bandgap in the material suitable for room-temperature electronics.

Use of nanoscale topography to control the properties of graphene could facilitate fabrication of transistors and other devices, potentially opening the door for developing all-carbon integrated circuits.

Scientists have measured a bandgap of approximately 0.5 electron-volts in 1.4 nm bent sections of graphene nanoribbons. The development could provide new direction to the field of graphene electronics, which has struggled with the challenge of creating bandgap necessary for operation of electronic devices.

"This is a new way of thinking about how to make high-speed graphene electronics," says Edward Conrad, a professor in the School of Physics at the Georgia Institute of Technology. "We can now look seriously at making fast transistors from graphene. And because our process is scalable, if we can make one transistor, we can potentially make millions of them."

Researchers don't yet understand why graphene nanoribbons become semiconducting as they bend to enter tiny steps - about 20 nm deep – that are cut into the SiC wafers. But the researchers believe that strain induced as the carbon lattice bends, along with the confinement of electrons, may be factors creating the bandgap. The nanoribbons are composed of two layers of graphene.



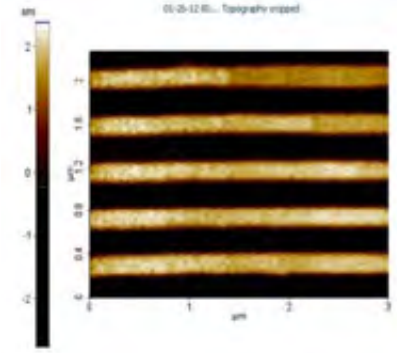
Perspective atomic force microscope (AFM) view of graphitised trenches that are 18 nm deep

Production of the semiconducting graphene structures begins with the use of e-beams to cut trenches into SiC wafers, which are normally polished to create a flat surface for the growth of epitaxial graphene. Using a high-temperature furnace, tens of thousands of graphene ribbons are then grown across the steps, using photolithography.

During the growth, the sharp edges of "trenches" cut into the SiC become smoother as the material attempts to regain its flat surface. The growth time must therefore be carefully controlled to prevent the narrow SiC features from melting too much.

The graphene fabrication must also be controlled along a specific direction so that the carbon atom lattice grows into the steps along the material's "armchair" direction. "It's like trying to bend a length of chain-link fence," Conrad explains. "It only wants to bend one way."

The new technique permits not only the creation of a bandgap in the material, but potentially also the fabrication of entire integrated circuits from graphene without the need for interfaces that introduce resistance. On either side of the semiconducting section of the graphene, the nanoribbons retain their metallic properties.



Atomic force microscope (AFM) top view of side wall graphene nanoribbons showing their long range order

"We can make thousands of these trenches, and we can make them anywhere we want on the wafer," said Conrad. "This is more than just semiconducting graphene. The material at the bends is semiconducting, and it's attached to graphene continuously on both sides. It's basically a Schottky barrier junction."

By growing the graphene down one edge of the trench and then up the other side, the researchers could in theory produce two connected Schottky barriers - a fundamental component of semiconductor devices. Conrad and his colleagues are now working to fabricate transistors based on their discovery.

Confirmation of the bandgap came from angle-resolved photoemission spectroscopy measurements made at the Synchrotron CNRS in France. There, the researchers fired powerful photon beams into arrays of the graphene nanoribbons and measured the electrons emitted.

"You can measure the energy of the electrons that come out, and you can measure the direction from which they come out," says Conrad. "From that information, you can work backward to get information about the electronic structure of the nanoribbons."

Theorists had predicted that bending graphene would create a bandgap in the material. But the bandgap measured by the research team was larger than what had been predicted.

Beyond building transistors and other devices, in future work the researchers will attempt to learn more about what creates the bandgap - and how to control it. The property may be controlled by the angle of the bend in the graphene nanoribbon, which can be controlled by altering the depth of the step.

"If you try to lay a carpet over a small imperfection in the floor, the carpet will go over it and you may not even know the imperfection is there," Conrad explains. "But if you go over a step, you can tell. There are probably a range of heights in which we can affect the bend."

He predicts that the discovery will create new activity as other graphene researchers attempt to utilize the results.

"If you can demonstrate a fast device, a lot of people will be interested in this," Conrad said. "If this works on a large scale, it could launch a niche market for high-speed, high-powered electronic devices."

The research, conducted at the Georgia Institute of Technology in Atlanta and at SOLEIL, the French national synchrotron facility, has been supported by the National Science Foundation' Materials Research Science and Engineering Centre (MRSEC) at Georgia Tech, the W.M. Keck Foundation and the Partner University Fund from the Embassy of France.

Further details of this work have been published in the paper, "A wide-bandgap metal-semiconductor-metal nanostructure made entirely from graphene," by J. Hicks *et al* in *Nature Physics* (2012). DOI: 10.1038/nphys2487

Integra unveils GaN on SiC devices for S-Band radar

The two gallium nitride on silicon carbide modules are suited to weather radar and surface ship radar. S-band radar is also used in some communications satellites, especially those used to communicate with the space shuttle and the international space station

Integra is launching two internally pre-matched, GaN high electron mobility transistors (HEMTs) for S-band radar.

The IGN2729M500 operates over the 2.7 - 2.9 GHz instantaneous frequency band. Under 300μs/10% pulse conditions it supplies a minimum of 500 W of

peak output power with typical performance of 560 W, typically 12 dB gain and over 60 % efficiency. The device is rated for peak output power of 500 W with 10% duty factor and average power of 50W.

The IGN3135M130 operates over the 3.1–3.5 GHz instantaneous frequency band. Under 300µs / 20 % pulse conditions it supplies a minimum of 130 W of peak output power with typical performance of 150 W with 12dB gain. The device is rated for peak output power of 130W with 20% duty factor and average power of 26W.

When appropriately rated, both HEMTS are operable under a wide range of pulse widths and duty factors. Specified operation for both devices is with Class AB bias. All devices are 100% screened for large signal RF parameters in a fixed tuned broadband matching circuit / test fixture.

RFMD`s latest module unites silicon and GaAs technologies

The firm's latest module utilises gallium arsenide HBT and pHEMT technologies for Smart Metering/ Smart Energy applications

RF Micro Devices is marketing the RFFM6903 front end module (FEM).

The module integrates the firm's GaAs HBT, GaAs pHEMT and silicon CMOS technologies.

RFMD's highly-integrated RFFM6903 FEM meets or exceeds the system requirements for AMI/AMR smart meter applications operating in the 868MHz - 960MHz frequency band.

The FEM supports multiple applications, including Smart Energy/advanced metering infrastructure (AMI), portable battery-powered equipment, and general 868/915MHz ISM band systems.

The feature-rich RFFM6903 integrates a +30.5dBm power amplifier (PA) with a Tx harmonic output filter in the transmit path, a Tx path bypass mode with harmonic filter, and a low-noise amplifier (LNA) with bypass mode in the receive path and is packaged in a 6mm x 6mm x 1mm laminate package.

The RFFM6903 also includes a low insertion loss, high isolation, single-pole three-throw (SP3T) switch and separate Rx/Tx 50 Ω ports that simplify matching and provide input and output signals for both the Tx and Rx paths. In the receive path, the Rx chain provides 16dB of typical gain with only 5mA of current and an excellent noise figure of 1.7dB.

Rohan Houlden, general manager of RFMD's Wireless Connectivity business unit, says, "The RFFM6903 is ideal for advanced metering systems requiring high efficiency and minimum output power of 1 Watt. The high level of integration and industry-leading form factor minimise the footprint and reduce the number of discrete components and manufacturing assembly costs. The fully-integrated front end module design approach shortens customer design time and accelerates time-to-market, while delivering industry leading product performance."

The RFFM6903 is now available for sampling and mass production.

Anadigics extends GaAs hybrid line amplifier family

The firm's new modules are produced using the firm's gallium arsenide MESFET technology. They are claimed to offer excellent ruggedness to provide industry-leading reliability

Anadigics, an innovator in radio frequency (RF)

solutions, has launched four new hybrid line amplifier power doubler modules, for CATV infrastructure networks.

The company's rugged hybrid line amplifier modules are optimised for demanding applications by delivering exceptional electrical performance and reliability. To maximise flexibility and ease of use, the hybrid line amplifier modules include passive components in a pin compatible SOT-115J package.

"We have expanded our hybrid line amplifier module product line with new products that provide superior ruggedness and RF performance," says Tim Laverick. "In addition to new modules for 870 MHz systems, we are introducing 1GHz hybrid modules with outstanding distortion characteristics. This level of performance combined with our proven track record of delivering industry-leading reliability provides manufacturers with a compelling solution for distortion-free video and audio, while minimizing field failures and costly truck rolls."

The ACA2786, ACA2788, ACA3748, and ACA3754 24 V line amplifier power doublers use the firm's MESFET technology to provide high output power, linearity, and reliability for 1 GHz and 870 MHz applications.


ACA2786 ACA3753

The new hybrid line amplifier modules are designed to provide the highest electro-static discharge (ESD) rating and withstand the largest ringwave transient for greater ruggedness.

Anadigics' hybrid line amplifier module family is offered in a wide range of gains and output power levels, while using the industry standard SOT-115J package to provide greater design flexibility across systems.

The low composite triple beat (CTB), composite second order (CSO), and cross modulation distortion exhibit optimal performance in a fully-loaded spectrum. With a positive slope cable equivalent, the controlled gain limits also minimise lot-to-lot variation, ensuring uniformity.

The devices have a high tolerance to ESD for enhanced ruggedness in outdoor applications and are manufactured using Anadigics' GaAs MESFET process for a high mean-time-to-failure.

Anadigics Hybrid Line Amplifier Key Specifications:

Part Number Frequency Band Gain Noise Figure

ACA2786 40 MHz to 1 GHz 25 dB 4.0 dB
ACA2788 40 MHz to 1 GHz 28 dB 3.5 dB
ACA3747 40 MHz to 870 MHz 25 dB 5.0 dB
ACA3748 40 MHz to 870 MHz 25 dB 5.0 dB
ACA3753 40 MHz to 870 MHz 28 dB 3.5 dB
ACA3754 40 MHz to 870 MHz 28 dB 3.5 dB

Samples of Anadigics' hybrid line amplifier modules are available now.

RFMD adds to its family of linear GaN power transistors

The gallium nitride transistors are optimised for broadband applications requiring linear back-off operation or reduced spurious performance

RF Micro Devices has production released two highly linear GaN RF unmatched power transistors (UPTs).

RFMD says the RFHA3942 (35W) and RFHA3944 (65W) deliver superior linear performance versus competing GaN transistors.

The release of the RFHA3942 and RFHA3944 follows the previous release of the RF393X series of UPTs targeting continuous wave (CW) and pulsed peak power applications.
This new series of linear GaN discrete amplifiers is optimised for broadband applications requiring linear back-off operation or reduced spurious performance.

RFMD plans to further its technology with future releases of 10W and 95W linear GaN devices over the next 12 months, significantly expanding the GaN UPT options available to RFMD's customers.

RFMD's highly linear GaN UPTs target new and existing communication architectures requiring improved broadband linear performance in support of high peak-to-average modulation waveforms.

The RFHA3942 and RFHA3944 are tuneable over a broad frequency range (DC to 4GHz) and provide CW peak power of 35W and 65W respectively. They also offer high gain of 15dB and high peak efficiency of over 55 percent.

Using an IS95 9.8dB PAR signal tuned to 2.1GHz, the RFHA3942 achieves -43dBc adjacent channel power (ACP) at 34dBm POUT and the RFHA3944 achieves -54dBc ACP at 37dBm POUT.

What's more, the RFHA3942 and RFHA3944 offer high terminal impedance at the input and output of the package, enabling wideband gain and power performance advantages in a single amplifier. Both devices are packaged in a flanged ceramic two-leaded package that leverages RFMD's advanced heat-sink and power-dissipation technologies to deliver excellent thermal stability and conductivity.

Jeff Shealy, vice president and general manager of RFMD's Power Broadband business unit, says, "RFMD is very pleased to expand its GaN-based product portfolio, offering industry-leading linear power performance in support of diverse end markets. RFMD's GaN product portfolio clearly demonstrates our continued commitment to technology and product leadership, and we look forward to introducing additional GaN devices that feature superior power density, high efficiency, rugged dependability, and 'green' power consumption advantages."

Samples and production quantities are available now through RFMD's online store or through local RFMD sales channels.

RFMD GaN HEMT PAs suited to high peak-to-average ratio apps

RFMD's RFHA104x series of high-power gallium nitride broadband power transistors (BPTs) are optimised for military communications, commercial wireless infrastructure, and general purpose applications

RFMD's latest advanced 65V high power density GaN semiconductor process is optimised for high peak-to-average ratio applications.

The firm's new high-performance amplifiers achieve high power with high efficiency and flat gain over a broad frequency range in a single amplifier design.

Each is an input-matched GaN transistor packaged in an air cavity ceramic package providing excellent thermal stability. Ease of integration is accomplished through the incorporation of simple, optimised, matching networks external to the package that provide wideband gain and high efficiency, all in a single amplifier ideal for linear correction circuits.

The RFHA1042 has a peak power of 125W and a

single circuit for frequency of 225MHz to 450MHz. The RFHA1043 can operate at 150W and single circuit for frequency of 1.2GHz to 1.85GHz.

48V CW broadband performance

At a POUT of 45.2dBm, the RFHA1042 has a gain of 18.5dB and the RFHA1043 a gain of 15.5dB. The drain efficiency of the RFHA1042 is 42 percent and is 30 percent for the RFHA1043.

48V CW broadband performance

The RFHA1042 has a POUT of 45.2dBm and the RFHA1043 a POUT of 52dBm. The RFHA1042 has a gain of 16dB and the RFHA1043 a gain of 13.5dB. The drain efficiency of the RFHA1042 is 60 percent and is 51 percent for the RFHA1043.

The devices are optimised for video bandwidth and exhibit minimal memory effects.

These products are currently available in production quantities. Large signal models are also available

Infinera unveils instant enabling software activation of 100G

The firm's new "Instant Bandwidth" software enables Infinera's indium phosphide on DTN-X platform

Infinera has announced the availability of Infinera Instant Bandwidth on the InP based DTN-X platform.
Instant Bandwidth allows network operators to rapidly deploy bandwidth in 100 Gigabits per second (100G) increments without the typical long wait times associated with provisioning equipment, as well as engineering and activating services.
With Infinera's Instant Bandwidth, network operators can instantly provision an additional 100G of network capacity with one-click to achieve a success based business model. Instant Bandwidth enables service providers to differentiate their services by shortening provisioning times and accelerating service delivery while simultaneously reducing time to revenue.
TeliaSonera International Carrier (TSIC) is the first to announce the selection and deployment of the Infinera DTN-X platform with Instant Bandwidth for their nationwide 100G U.S. network. TSIC can now turn up 100G of transport capacity via one-click software control enabling the rapid deployment of new services to their customers.Transport network operators, like TSIC, are experiencing increased and variable demand for bandwidth from customers. Activating bandwidth services as soon as their customer demands it now becomes a competitive weapon.

Infinera maintains its Instant Bandwidth is the industry's first software-activated 100G bandwidth delivery solution that enables a success-based business model for service providers and lowers operational costs.

Through this model, operators can immediately deploy 100G of incremental network capacity at the same time they activate the customer service. This capability enables an architecture where bandwidth can be provisioned on demand and potentially moved throughout the network in the future, as an example to respond to a natural disaster or scheduled events like popular sporting competitions.

In contrast, conventional solutions result in higher operational expenses and longer lead times because they require multiple costly and time consuming activities for every 100G of network capacity. These activities include ordering, shipping, engineering, installation and provisioning taking many weeks or even months to fulfil. Instant Bandwidth™ reduces the time to revenue by closing the gap between network infrastructure investment and customer service activation and enables the deployment of bandwidth with a single click.

"2012 has been the 'year of 100G': interest in 100G is broad-based and deployments are outpacing our market projections," says Dana Cooperson, VP Network Infrastructure at Ovum. "Operators need a way to keep pace with uncertain network traffic growth without under or over provisioning infrastructure capacity. Network operators want to deploy capacity at 100G incrementally while minimizing and balancing capex and opex. This success-based business approach allows operators to rapidly deploy capacity as customer demand arises and differentiate their offering in a highly competitive market. Infinera's Instant Bandwidth™

is a very interesting approach to an important 100G business requirement."

The Instant Bandwidth solution is a combination of new hardware, software and operational innovation from Infinera. The hardware includes new line cards supporting 500G long-haul super-channels with 100G activated initially. This solution features Infinera's 500G Photonic Integrated Circuits (PICs) and FlexCoherent processor that delivers record-breaking Polarisation Mode Dispersion (PMD) performance overcoming some of the worst fibre impairments over critical parts of operators' networks.

All of these features are enabled for the initial 100G of capacity on the line card that can progressively increase to 500G with simple one-click software activation delivered using the enhanced Infinera DNA network management system. The DTN-X integrates 5 Terabits of OTN switching per bay in the same platform and is automated by an intelligent standards based control plane. These technologies provide a foundation for the Instant Bandwidth™ solution and result in flexible infrastructure bandwidth with better wavelength utilization, fewer fibre connections, less space and less power and overall lower operational costs when compared to conventional optical transport architectures.

"Instant Bandwidth on the DTN-X creates more opportunities for our customers to win by using time as a weapon to compete and respond to increasingly variable demands to flexibly grow and manage network capacity," says Dave Welch, Infinera Co-founder, Executive Vice President and Chief Strategy Officer. "Software activated bandwidth changes the business model and the economics of transport networking, accelerating time to revenue for operators while boosting their competitiveness."

Infinera started shipping the DTN-X platform earlier this year and the Instant Bandwidth solution for it is now available.

Advanced Photonix receives $5.9 million for 100G telecoms

The commitment for 2013, is for indium phosphide based high-speed optical receivers

Advanced Photonix subsidiary, Picometrix has secured an annual commitment estimated at more than $5.2 million from a major telecommunications network equipment customer.

The cash is for the company's 100G family of coherent receivers for DP-QPSK modulation and $760K for its 40G receivers for DPSK modulation. Both of these are used in long-haul dense wavelength division multiplexing (DWDM) systems.

Shipments are expected to begin in the company's 4th quarter of FY2013.

The CR-100A 100G optical receiver utilises the company's patented photodiode arrays, an optical photonic integrated circuit (PIC), and high-speed linear amplifiers. The product comes in the industry standard CCRx Multisource Agreement (MSA) form factor, is consistent with OIF, and supports data rates up to 128 Gb/s.

The CR-100A high-speed optical receivers (HSOR) are suited to telecom applications. Picometrix offers a broad range of 100G and 40G HSOR solutions for both client-side and line-side equipment.

"We are pleased to have received a substantial increase in commitment for 2013 from our lead customer, further solidifying our industry leading position in 100G coherent receivers. This further validates our success in developing optical receivers that support our network equipment customers' deployment of next generation optical networks to global telecom service providers," says Robin Risser, COO of API.

"This agreement demonstrates that 100G coherent network deployment is in the early growth stage as service providers continue to selectively spend on capacity expansion, despite a weak macro-economic environment, to accommodate traffic growth driven by video, mobile video, the proliferation of network-attached devices, and

social networking applications that are enabling consumers to access bandwidth-intensive content anytime and anywhere over fixed and wireless networks. We believe that 100G networks are in the very early stage of deployment and we are committed to developing and supplying state of the art and products to support this fast growing market."

Cyprus Telecom deploys Infinera InP PIC DTN-X Platform

Infinera's indium phosphide PICs will be used for the island's 100G mediterranean subsea network

Cyprus Telecommunications Authority (Cyta), is using Infinera's DTN-X platform.

It features 500 Gigabit per second (Gb/s) long-haul super-channels, across the TE-North Cable System, interconnecting Asia and Africa to Europe.

Cyta selected the DTN-X platform to deliver commercial services to its customers for the scalability, efficiency, simplicity and reliability the solution delivers to its network.

Cyta is one of the leading telecommunications providers in Cyprus, providing fixed and mobile telephony to internet service provision and broadband applications. Cyta operates and maintains the ALEXANDROS subsystem, part of Telecom Egypt's TE-North Cable System which stretches 3,600 kilometres connecting Abu Talat, Egypt, to Marseilles, France, with a branch to Pentaskhinos, Cyprus.

The deployment of Infinera's DTN-X platform will allow Cyta to add additional capacity to the ALEXANDROS subsystem, with the ability to upgrade TE North's terrestrial network in the future, in order to serve global operators who rely on Cyta to offer services in the Middle East, Asia and Africa region.

"We are delighted to work with Infinera to deploy the DTN-X platform on this critical international telecommunications route," says Yiannis Koulias, Cyta's Director of National & International Wholesale Market. "We are confident the Infinera DTN-X delivers the most advanced optical transport platform based on 500 Gb/s photonic integrated circuits. The FlexCoherent technology will allow us to optimise transmission performance across our existing subsea fibre plant and meet the demands of our customers quickly and efficiently."

"We are committed to delivering innovative optical transport network solutions to customers like Cyta," adds Chris Champion, VP EMEA Sales for Infinera. "We are excited that Cyta has chosen our DTN-X platform to deliver services quickly and reliably to global operators who rely on this important Mediterranean route."

IPtronics strikes back against Avago

IPtronics is suing Avago for violating standards and misuse of trade secrets regarding its 40G and 100G VCSEL multimode optical communications technology

IPtronics A/S, a designer of optical interconnect components for digital communications has filed claims against subsidiaries of Avago Techologies Ltd.

IPtronics says the Singapore-based company deliberately violated commitments made to standards setting organisations and failed to protect IPtronics' confidential information. The claims were filed as counterclaims in ongoing litigation in the U.S. District Court in San Jose.

In making these claims, IPtronics alleges that Avago ignored legally binding commitments to standards setting organisations to disclose patented technology and to make that technology available for licensing.

IPtronics is challenging Avago's improper conduct of concealing its patents from the standards organisations and then improperly using those patents to stifle competition.

The company also states that Avago induced IPtronics to disclose its confidential information through a series of misrepresentations and that Avago then failed to protect that information.

The standards abuses detailed in the filing impact short-range, 40G and 100G multimode VCSEL-based fibre optical modules used for communications in cloud, Web 2.0, and high-performance computing applications.

IPtronics alleges that Avago's conduct threatens not only IPtronics but also other manufacturers and distributors of optical interconnect equipment, all of whom were the intended beneficiaries of commitments Avago is now disregarding. IPtronics strongly believes that these illegal actions on behalf of Avago will stifle the innovation needed in this market and adversely affect the entire industry.

The company also points out that Avago recently expanded its claims against the optical interconnect industry by asking the U.S. International Trade Commission to initiate an investigation against IPtronics and two other companies.

IPtronics believes these claims are without merit and says it will defend itself aggressively in the ITC.

TriQuint's GaN transistors slash amplifier size by half

The firm's gallium nitride devices are suited to broadband systems used in commercial and military applications

TriQuint Semiconductor is introducing four new rugged GaN HEMT RF power transistors that offer superior gain and efficiency.

The company's GaN transistors can cut the size of amplifier line-ups in half while improving efficiency and gain.

TriQuint's new GaN transistors deliver RF output power from 30-37W (CW) over operating frequencies as broad as DC to 6 GHz. They are excellent choices for applications ranging from commercial and defence radar to communications, test equipment, electronic warfare and similar broadband systems.

TriQuint's new GaN power transistors include the 28V T1G6003028-FS that operates from DC to 6 GHz and delivers 30W output power with efficiency of 55% at 3.5 GHz and 44 percent at 6 GHz.

The T1G6003028-FL delivers the same performance and is offered in a flanged package to satisfy these assembly requirements.

TriQuint's new 32V T1G4003532-FS and the flanged-package T1G4003532-FL are ideal for S-band radar and similar applications. They deliver 37W (CW) output power from DC to 3.5 GHz. Both devices provide more than 16dB of gain at 3.5 GHz and 10dB of gain at 6 GHz; their power-added efficiency is 60% at 5 GHz and 49.6 percent at 6 GHz.

All four new GaN transistors can withstand output impedance (VSWR) mismatches up to 10:1 without functional damage and are optimized for operation at high drain bias conditions, reducing system cost and thermal management overhead. All devices are exportable to most countries.

TriQuint's GaAs amplifiers simplify assembly

The firm's four gallium arsenide amplifiers are suited for use in microwave radios, very small aperture terminals and military applications

TriQuint Semiconductor has released four new packaged GaAs pHEMT RF power amplifier modules that deliver high output power, gain and efficiency with coverage from 6-38 GHz.

Each new amplifier is packaged for easier assembly including designs that support multi-layer PCB layouts.

TriQuint's new amplifiers are suited for use in commercial applications such as point-to-point microwave radios, very small aperture terminals (VSATs) and defence systems such as communications, radar and electronic warfare (EW).

The four new amplifiers include: the TGA2502-GSG (3.6W [CW] from 13-16 GHz for VSAT systems); the TGA2575-TS (3W [CW] from 32-38 GHz for communications and defence radar systems); the TGA2704-SM (7W [CW] from 9-11 GHz for microwave radio and radar); and the TGA2710-SM (7W [CW] from 9.5-12 GHz also for microwave radio and radar).

The TGA2575-TS is the latest addition to TriQuint's Die-on-Tab product family, which makes it easier for manufacturers to handle die-level devices and assemble components by placing semiconductor FETs or MMIC amplifiers on thermal spreaders. A vacuum reflow process creates bonds between dies and bases. These bonds are virtually void-free and have high thermal stability. The TGA2575-TS and all die-on-tab products are inspected in the factory for thorough quality assurance and higher effective yields.

TriQuint's new GaAs pHEMT RF power amplifiers have been released at European Microwave Week (EuMW) in Amsterdam. TriQuint has also revealed four new GaN RF power transistors for a wide range of commercial and defence applications including communications, radar and EW.

In addition to introducing 12 new product solutions at EuMW, TriQuint is presenting information covering new radar and sensing technology during the European-focused "Defence, Security and Space Forum."

Mitsubishi uses SiC to improve factory productivity

The silicon carbide power module for CNC drive units offers higher speed and torque for driving machine tool spindles and servo motors

Mitsubishi Electric Corporation has launched a drive unit equipped with a SiC power module for computerised numerical controllers (CNCs).

The MDS-DM2-SPHV3-20080 is a multi-hybrid, multi-axis integrated-drive unit for drive control of spindle and servo motors. Sales will begin on December 3rd 2012.

MDS-DM2-SPHV3-20080 multi-hybrid drive unit

Power conversion modules are widely used in inverters and converters of household appliances and industrial equipment. SiC power modules are superior to conventional silicon modules in terms of their significantly reduced switching loss and high tolerance to temperature.

Until now, Mitsubishi Electric has commercialised SiC power modules for inverters in air conditioners and railcars. The new SiC power module for CNC drive units offers higher speed and torque for driving machine tool spindles and servo motors, which is expected to improve manufacturing productivity in

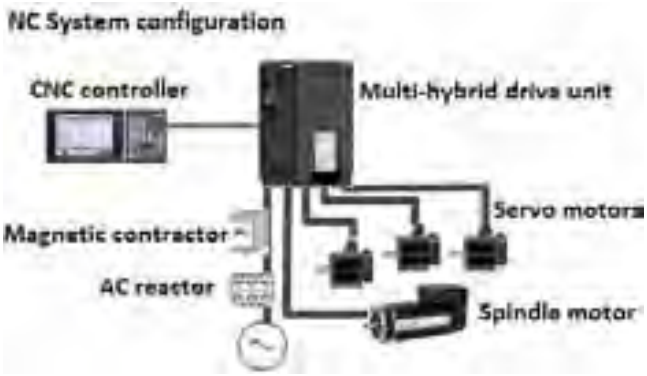
factories.

The SiC power module offer high-speed switching operation and increased spindle motor speed up to twice that of its previous model (MDS-DM Series) under specific conditions. The SiC diodes also have a reduced power loss in drive unit results in 15 percent higher torque for spindle motors than the MDS-DM S series under specific conditions.

Power shut-off and other functions enable downsizing and reduced wiring.

What's more, the "Safe Torque Off" function for shutting off the power supply to motors reduces the number of magnetic reactors required, is available as a standard feature.

Also, an interface for linear scale enables direct detection and feedback of machine positions, meaning it requires no external interface unit.



InAs quantum dots offer a new route to large-scale quantum computing

Indium arsenide QDs offer a better alternative to gallium arsenide and may allow quantum researchers to manipulate a large number of qubits, enough for a practical machine

In a step towards creating a working quantum computer, Princeton researchers have developed a method that may allow the quick and reliable transfer of quantum information throughout a computing device.

The finding, by a team led by Princeton physicist Jason Petta, could eventually allow engineers to build quantum computers consisting of millions of quantum bits, or qubits. So far, quantum researchers have only been able to manipulate small numbers of qubits, not enough for a practical machine.

Jason Petta

"The whole game at this point in quantum computing is trying to build a larger system," says Andrew Houck, an assistant professor of electrical engineering who is part of the research team.

Andrew Houck

To make the transfer, Petta's team used a stream of microwave photons to analyse a pair of electrons trapped in a tiny cage called a quantum dot (QD). The "spin state" of the electrons - information about how they are spinning - serves as the qubit, a basic unit of information. The microwave stream allows the scientists to read that information.

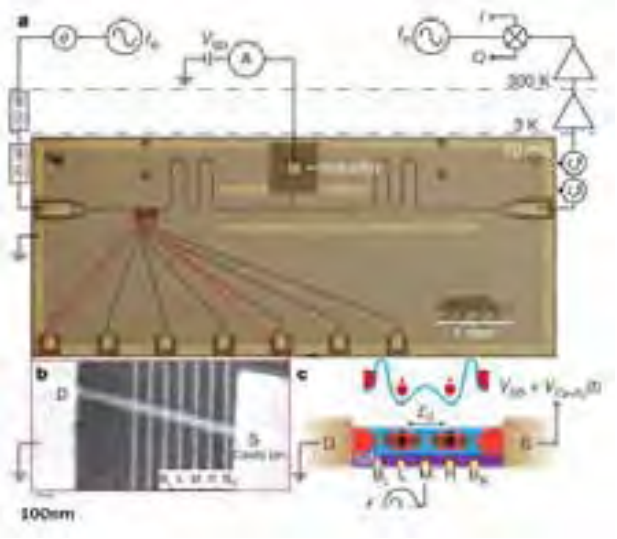
The researchers used InAs for their QDs and developed an architecture allowing them to achieve a charge-cavity coupling rate of about 30 megahertz. This, they say, is consistent with coupling rates obtained in GaAs quantum dots.

"We create a cavity with mirrors on both ends – but they don't reflect visible light, they reflect microwave radiation," Petta explains. "Then we send microwaves in one end, and we look at the microwaves as they come out the other end. The microwaves are affected by the spin states of

the electrons in the cavity, and we can read that change."

The distances involved are very small with the entire apparatus operating over a little more than a centimetre. But on the subatomic scale, they are vast. It is like coordinating the motion of a top spinning on the moon with another on the surface of the earth.

"It's the most amazing thing," says Jake Taylor, a physicist at the National Institute of Standards and Technology and the Joint Quantum Institute at the University of Maryland, who worked on the project with the Princeton team. "You have a single electron almost completely changing the properties of an inch-long electrical system."



Hybrid quantum dot-superconducting resonator device. (a) Circuit schematic and micrograph of the hybrid device design. Scanning electron micrograph (b) and cross-sectional schematic view (c) of the InAs nanowire double quantum dot (DQD). The left and right barrier gates (BL and BR), left and right plunger gates (L and R), and middle gate (M) are biased to create a double-well potential within the nanowire. The drain contact of the nanowire, D, is grounded, and the source contact, S, is connected to an antinode of the resonator, oscillating at a voltage VCavity. (Credit Petersson et. al.)

For years, teams of scientists have pursued the idea of using quantum mechanics to build a new machine that would revolutionise computing. The goal is not to build a faster or more powerful computer, but to create one that approaches problems in a completely different way.

Standard computers store information as classical "bits", which can take on a value of either 0 or 1. These bits allow programmers to create the complex instructions that are the basis for modern computing power. Since Alan Turing took the first steps toward creating a computer at Princeton in 1936, engineers have created vastly more powerful and complex machines, but this basic binary system has remained unchanged.

The power of a quantum computer comes from the complex rules of quantum mechanics, which describe the universe of subatomic particles. Quantum mechanics says that an electron can spin in one direction, representing a 1, or in another direction, a 0.

But it can also be in something called "superposition" representing all states between 1 and 0. If scientists and engineers can build a working machine that takes advantage of this, they would open up entirely new fields of computing.

"The point of a quantum computer is not that they can do what a normal computer can do but faster; that's not what they are," says Houck. "The quantum computer would allow us to approach problems differently. It would allow us to solve problems that cannot be solved with a normal computer."

Mathematicians are still working on possible uses for a quantum system, but the machines could allow them to accomplish tasks such as factoring currently unfactorable numbers, breaking codes or predicting the behaviour of molecules.

One challenge facing scientists is that the spins of electrons, or any other quantum particles, are incredibly delicate. Any outside influences, whether a wisp of magnetism or glimpse of light, destabilises the electrons' spins and introduces errors.

Over the years, scientists have developed techniques to observe spin states without disturbing them. (This year's Nobel Prize in physics honoured two scientists who first demonstrated the direct observation of quantum particles.) But analysing small numbers of spins is not enough; millions will be required to make a real quantum processor.

To approach the problem, Petta's team combined techniques from two branches of science: from

materials science, they used an InAs quantum dot to hold and analyse electrons' spins; and from optics, they adopted a microwave channel to transfer the spin information from the dot.

To make the quantum dots, the team isolated a pair of electrons on a small section of material called a "semiconductor nanowire." Basically, that means a wire that is so thin that it can hold electrons like soda bubbles in a straw. They then created small "cages" along the wire. The cages are set up so that electrons will settle into a particular cage depending on their energy level.

This is how the team reads the spin state; electrons of similar spin will repel, while those of different spins will attract. So the team manipulates the electrons to a certain energy level and then reads their position. If they are in the same cage, they are spinning differently; if they are in different cages, the spins are the same.

The second step is to place this quantum dot inside the microwave channel. This allows the team to transfer the information about the pair's spin state - the qubit.

Petta said the next step is to increase the reliability of the setup for a single electron pair. After that, the team plans to add more quantum dots to create more qubits. Team members are cautiously optimistic. There appear to be no overwhelming problems at this point but, as with any system, increasing complexity could lead to unforeseen difficulties.

"The methods we are using here are scalable, and we would like to use them in a larger system," Petta says. "But to make use of the scaling, it needs to work a little better. The first step is to make better mirrors for the microwave cavity."

The research was reported in the journal Nature on Oct. 18

This research was supported by the National Science Foundation, the Alfred P. Sloan Foundation, the Packard Foundation, the Army Research Office, and the Defence Advanced Research Projects Agency Quantum Entanglement Science and Technology Program.

TriQuint's GaAs PAs & GaN transistors speed up customer designs

The firm is introducing four gallium nitride based power transistors and four gallium arsenide based pHEMT power amplifiers. They are suited to applications such as emergency responder radios, electronic warfare, radar solutions and test equipment

TriQuint Semiconductor is rolling out new processes to more quickly expand its catalogue of products for commercial and defence customers.

TriQuint's new set of products include a family of RF GPS diplexers that reduces PCB space by nearly three times compared to ceramic filter products.

The firm will also showcase new packaged transistors and amplifiers including four based on GaN and four based on gallium arsenide GaAs technology. The products support a wide variety of commercial and defence applications such as emergency responder radios, electronic warfare, radar solutions and test equipment.

"TriQuint's new integration approach and focus on broad-market products is allowing us to be more responsive to customer requests," says Infrastructure and Defence Products Vice President and General Manager, James L. Klein. "TriQuint's focus to expand our product lines and deliver more products to customers more quickly has resulted in a new approach to filter technology. This new design and manufacturing flexibility will enable our global customers to bring their products to market faster than ever."

TriQuint's new diplexer family grew out of customer needs for performance and faster delivery, along with the option to change filters throughout production lifetimes. The firm's new diplexer modules allow designers to incorporate any two filters from its extensive surface acoustic wave (SAW) CSP5 portfolio.

This new flexibility gives infrastructure and defence customers a customised solution using commercial off-the-shelf (COTS) products while avoiding the cost and time of a custom design. The solution

also protects against performance compromises when trying to use a single device across multiple applications.

In addition to quicker product delivery, the new approach allows customers to reduce the space needed for filter designs. The new plug-and-play, 5 x 5 x 2mm integrated products are orders of magnitude smaller than lumped element diplexers and nearly three times smaller than similar high performance RF ceramic filter modules.

The presentation is a special program of European Microwave Week and will focus on new GaN products and integrated assemblies for the changing needs of global security and defence systems. Admission is free.

Technical Specifications for TriQuint EuMW Product Solutions: Sampling Now

Apart from four SAW diplexer modules designed for GPS, TriQuint will exhibit the following:

T1G6003028-FS
DC-6 GHz GaN RF power transistor. Specifications are as follows: 30W; 14dB gain at 3.5GHz; 10dB gain at 6 GHz; drain efficiency: 55% at 3.5 GHz / 44% at 6 GHz; 28V at 200 mA, withstands 10:1 VSWR, EAR99 flangeless package.

T1G6003028-FL
DC-6 GHz GaN RF power transistor. Specifications are as follows: 30W; 14dB gain at 3.5GHz; 10dB gain at 6 GHz; drain efficiency: 55% at 3.5 GHz / 44% at 6 GHz; 28V at 200 mA, withstands 10:1 VSWR, EAR99 flanged package.

T1G4003532-FS
DC-3.5 GHz GaN RF power transistor. Specifications are as follows: 37W CW; more than 16dB gain at 3.5 GHz; 10dB gain at 6 GHz; power-added efficiency: 60% at 5 GHz / 49.6% at 6 GHz; 32V at 2.4A; withstands 10:1 VSWR; EAR99 flangeless package.

T1G4003532-FL
DC-3.5 GHz GaN RF power transistor. Specifications are as follows: 37W CW, more than 16dB gain at 3.5 GHz; 10dB gain at 6GHz; power-added efficiency: 60% at 5 GHz / 49.6% at 6 GHz; 32V at 2.4A; withstands 10:1 VSWR; EAR99; flange mount package.

TGA2502-GSG
13-16 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 2.8W; 20dB large-signal gain; 25dB small-signal gain; 25% efficiency; 7V at 1.3A; 14-lead flange mount package.

TGA2704-SM
9-11 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 7W; 19dB large-signal gain; 22dB small-signal gain; 40% power-added efficiency; 9V at 1.05A; 7x7x1.27mm leadless SMT package.

TGA2710-SM
9.5-12 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 7W; 19dB large-signal gain; 20dB small-signal gain; 36% power-added efficiency; 9V at 1.05A; 7x7x1.27mm leadless SMT package.

TGA2575-TS
32-38 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 3W; 19dB small-signal gain; 22% power-added efficiency; 6V at 2.1A. TGA2575 die is mounted to an 8.92x5.31mm thermal spreader.

Samples and evaluation boards are available.

Asahi Kasei to develop III-V devices with Aixtron system

Apart from arsenide and phosphide optoelectronic device development, the Japanese firm will improve its antimonide-based magnetic sensors

Asahi Kasei has ordered an Aixtron 6 x 2-inch MOCVD system to develop its next generation arsenide-phosphide-based optoelectronic devices and antimonide-based sensor devices.

The order for the Close Coupled Showerhead (CCS), was placed in the first quarter and delivery is due in the fourth quarter of 2012.

The Aixtron system will be initially used for R&D purposes and can be used to grow on small and large wafers. CCS-based processes can also be easily scaled-up later for volume production.

What's more, the CCS concept also allows high

yields with larger area devices. Asahi Kasei has also ordered special features for its system including an EpiTT, an ARGUS multi-channel pyrometer, and Gap Adjustment.

Through its subsidiary, Asahi Kasei Microdevices Corporation, Asahi Kasei has been developing antimonide-based magnetic sensors for some time, based on the Hall Effect. Antimonide-based sensors benefit from some unique material properties which result in the highest sensitivity compared with sensors made from other materials.

Asahi Kasei Microdevices Corporation,a fully owned subsidiary of Asahi Kasei, is a manufacturer of Hall elements and Hall Effect ICs. Aixtron says it has more than 75 percent share in this market.

The main applications of Hall elements are brushless motors used in Blu-ray/DVD drives, cooling fans for electrical equipment, current sensors for home appliances and position detection sensors used in image stabiliser systems of digital still and video cameras.

Hall Effect ICs are also widely used in position and rotation detection for mobile phones, motors, industrial and automotive equipment.

Advanced Photonix takes on Donald C. Pastor as non-executive chairman

The supplier of III-V based optoelectronic products has separated the roles of Chairman of the Board and Chief Executive Officer, consistent with current best governance practices

Advanced Photonix Inc. (API) has appointed Donald C. Pastor as Non-Executive Chairman of the Company.

Pastor became an independent director of the Company in July 2005 and is currently serving as the Chairman of the Compensation Committee and serves on the Audit Committee.

He has over 30 years of Senior Executive level experience in high technology and defense related industries, and has successfully served as a CEO, CFO and division level President in both start-up and turnaround situations.

In his new role Donald C. Pastor will take a more prominent role in monitoring the implementation of the Board's business strategies, in the development of enhanced reporting mechanisms, and in the communications between the Board and API's principal executive officers.

Richard Kurtz, who has been the Company's Chief Executive Officer since February 2003 and President since June 2006, will continue to oversee the day-to-day operations of the company.

"The independent directors believe the Company is entering a critical phase as our investment in technology is beginning to propel the Company forward. This change will allow the management team to devote their full attention to meeting the day-to-day needs of our customers in our growing markets. As Chairman, I will work closely with Rick in support of the Company's overall strategic direction and brand positioning," states Pastor.

"I believe the time is right to separate the Chairman and Chief Executive Officer roles and I look forward to working more closely with Don as we grow and expand our business on a national and global level," adds Kurtz.

Lance Brewer, Chairman of the Governance and Nominating Committee stated, "the directors of API are excited to have an executive with Don's experience and record of success across a number of industries take a more active role in the oversight of the Company. We believe that at this time, separating the roles of Chairman of the Board and Chief Executive Officer will help API realize the full potential of its world class technology."

Jenoptik unveils a wide-ranging photodiode portfolio

The photodiodes are made from a range of III-phosphides, arsenides, nitrides and silicon carbide

Jenoptik has developed a new product range of photodiodes with an angle-independent response spectrum.

Compared with conventional silicon photodiodes, the new photodiodes detect a predefined wavelength range without the need for the insertion of an additional filter.

The photodiodes are made from materials such as GaP, AlGaN, AlGaAs, InGaAs, or SiC and are designed for a spectral range of 150 to 1750nm.

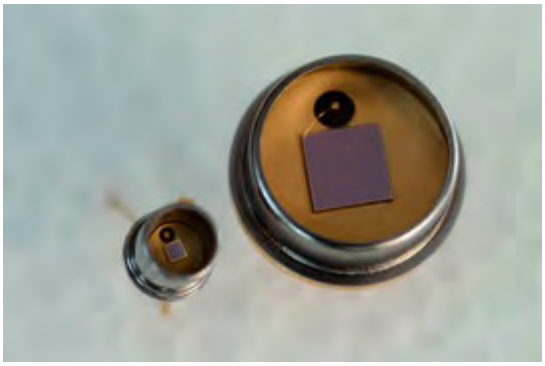
Unlike dielectric filters, they also provide spectral receiving characteristics that are independent of the angle of incidence of the radiation.

The new photodiodes are ideally suited for all photometric applications where an extended measurement range is required.

These new diodes can save space and follow the trend towards miniaturisation while simplifying assembly.

Jenoptik provides customer specific solutions and a wide range of photodiode products as preassembled standard products in SMD and TO housings.

Their detection is wavelength-selective. Jenoptik says they have very good signal and noise performance. In hermetically sealed special housings, they are thermally stable up to 125°C.



UV-Photodiodes

Photodiodes provide safety.

They are widely-used in the automotive, security and health care industries in a wide range of applications. These include daylight/tunnel sensors or lane departure warning systems in vehicles.

They can be applied in monitoring safety levels in gas detectors, in water disinfection of UV radiation, as flame sensors for burner monitoring, as detectors in photoelectric sensors, and for analysis of body fluids concentration in medical technology.

Jenoptik has extended its assembly and packaging process chain by recent investments in wafer sawing and multi-chip bonding, and can processe wafers of up to 300mm.

This enables customers to realise economical solutions with high-precision production processes that are at the forefront of technology.

The new systems are particularly suitable for the processing of complex customised micro-electronic components such as image processing sensors.

Using the more powerful double-spindle wafer saw, the new fully automatic system cuts, cleans and exposes the wafers contained in a magazine.

Jenoptik says the two-spindle saw also reduces the cycle time by more than half when compared to semi-automatic processes.

Its intelligent water supply system makes the saw especially suitable for the processing of silicon-based image sensors and optical glass.

Jenoptik is now working with a multi-chip bonder to further process the 300mm wafers.

Depending on the quality of the source material, this chip bonder achieves a placement accuracy of up to ±10 µm and can process chips with an edge length of between 0.2 and 80mm.

The main advantage of 300mm wafer source material is that there is less waste.

Depending on the chip size required, there is a correspondingly higher yield per wafer. This substantially reduces manufacturing costs for semiconductor chips in comparison with smaller wafer diameters.

Jenoptik will be exhibiting examples of its products at its booth at the electronica trade fair. These exhibitions range from the basic wafer material to the complete micro-electronic component, including software.

The company will demonstrate its digital image processing, from application-specific CMOS imaging modules to microscope cameras from the ProgRes range and options for integrated, customised image-processing systems.

Guven promoted at Hittite Microwave

Gorkem Guven will manage engineering, marketing and business developments organisations at the company

Hittite Microwave Corporation has promoted Gorkem Guven to Vice President.

In this executive role, Guven will manage various engineering, marketing and business developments organisations.

Gorkem Guven joined Hittite in April 2000, and has served in various roles including integrated circuit design, business development, and general management.

He has led a number of numerous strategic technology initiatives and market penetration projects for the company. Guven has 14 years of semiconductor and industry experience and has a bachelor's degree in Electrical Engineering and a Masters of Business Administration.

"I am pleased to promote Gorkem to this executive position. He is a passionate, business savvy technologist that is expert in creating, planning and managing complex technology developments. He has a proven track record of identifying customer requirements and managing our teams to develop world class products to satisfy those needs," says Stephen G. Daly, Chairman, President and CEO. "This new position expands our executive team to support our continued growth."

Hittite Microwave Corporation is a designer and manufacturer of ICs, subsystems and instrumentation for technically demanding digital, RF, microwave and millimetre-wave applications covering DC to 110 GHz.

Anadigics markets GaN line amplifier

The company's high output gallium nitride power doubler amplifier delivers high linearity, low distortion, and low bit error rate for CATV applications

Anadigics has introduced the ACA2428 GaN line amplifier MMIC.

The new GaN power doubler line amplifier uses Anadigics' proprietary architectures to ensure distortion-free video and audio in 1 GHz CATV systems.

ACA2428 GaN amplifier

With high output power and low current consumption, the company's GaN line amplifier helps to save energy to enable green CATV infrastructure solutions.

"CATV networks are increasingly operating in a fully loaded spectrum to support high-definition television, video on demand, and high data rate internet," says Tim Laverick, vice president of infrastructure products at Anadigics.

"Anadigics' new GaN line amplifier provides a best-in-class combination of output power, linearity, bit error rate, and noise figure to ensure the highest quality of video delivery in these network conditions. This level of performance is coupled with exceptional efficiency and world-class reliability and ruggedness, enabling advanced green solutions that minimise power consumption and costly truck rolls."

Anadigics' ACA2428 GaN line amplifier MMIC is optimised for 50 to 1,000 MHz frequency band applications by delivering +58 dBmV output power and 21 dB gain at 1 GHz. Available in a 16 lead SOIC, the line amplifier is powered through the centre tap of the output impedance transformer with a single +24 V supply. The ACA2428 is optimised

for several CATV infrastructure applications, including output power doublers for system amplifiers and deep fibre nodes.

Samples of the ACA2428 are available now for qualified programs.

Advancing spintronics with ferromagnetic GaAs

By doping gallium arsenide with manganese, researchers have unlocked some ferromagnetic secrets of promising materials for computing

Spintronic technology promises to revolutionise the computing industry with smaller, faster and more energy efficient data storage and processing.

In spintronics, data is processed on the basis of electron "spin" rather than charge.
Materials drawing much attention for spintronic applications are dilute magnetic semiconductors. These are normal semiconductors incorporating a small amount of magnetic atoms to make them ferromagnetic.

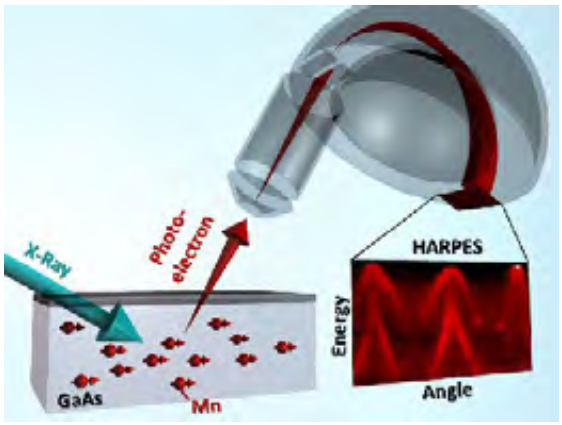
Understanding the source of ferromagnetism in dilute magnetic semiconductors has been a major road-block impeding their further development and use in spintronics.

Until now.

Now researchers at Berkeley Lab say they have made a significant step forward in removing this road-block.

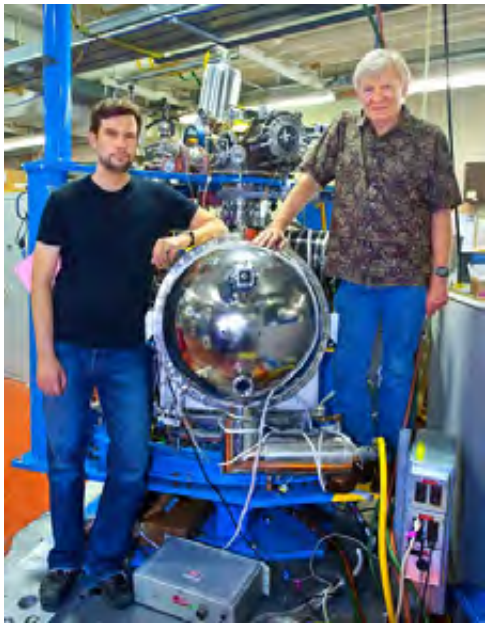
The multi-institutional collaboration of researchers led by scientists at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), have used a new technique called HARPES. This stands for Hard x-ray Angle-Resolved PhotoEmission Spectroscopy.

The scientists used the technique to investigate the bulk electronic structure of the prototypical dilute magnetic semiconductor gallium manganese arsenide (GaMnAs). Their findings show that the material's ferromagnetism arises from both of the two different mechanisms that have been proposed to explain it.



With the HARPES technique, a beam of x-rays flashed on a sample causes photoelectrons from within the bulk to be emitted. Measuring the kinetic energy of these photoelectrons and the angles at which they are ejected reveals much about the sample's electronic structure. Here the manganese (Mn) atoms in GasMnAs are shown to be aligned ferromagnetically, with all their atomic magnets pointing the same way. (Image from Alex Gray)

"This study represents the first application of HARPES to a forefront problem in materials science, uncovering the origin of the ferromagnetism in the so-called dilute magnetic semiconductors," says Charles Fadley, the physicist who led the development of HARPES. "Our results also suggest that the HARPES technique should be broadly applicable to many new classes of materials in the future."



Alexander Gray (left) and Charles Fadley at Beamline 9.3.1 of Berkeley Lab's Advanced Light Source where they are now carrying out HARPES

experiments. (Photo by Roy Kaltschmidt, Berkeley Lab)

Fadley, who holds joint appointments with Berkeley Lab's Materials Sciences Division and the University of California (UC) Davis is the senior author of a paper describing this work in the journal *Nature Materials*.

For the semiconductors used in today's computers, tablets and smart phones, once a device is fabricated it is the electronic structures below the surface, in the bulk of the material or in buried layers, that determine its effectiveness.

HARPES, which is based on the photoelectric effect described in 1905 by Albert Einstein, enables scientists to study bulk electronic effects with minimum interference from surface reactions or contamination.

It also allows them to probe buried layers and interfaces that are ubiquitous in nanoscale devices, and are key to smaller logic elements in electronics, novel memory architectures in spintronics, and more efficient energy conversion in photovoltaic cells.

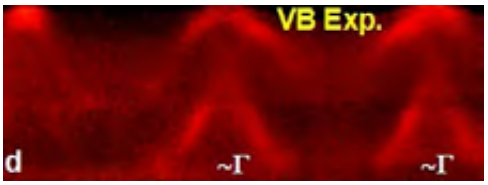
"The key to probing the bulk electronic structure is using hard x-rays, which are x-rays with sufficiently high photon energies to eject photoelectrons from deep beneath the surface of a solid material," says Gray, who worked with Fadley to develop the HARPES technique.

"High-energy photons impart high kinetic energies to the ejected photoelectrons, enabling them to travel longer distances within the solid. The result is that more of the signal originating from the bulk will be detected by the analyser."

In this new study, Gray and Fadley and their collaborators, used HARPES to shed important new light on the electronic bulk structure of gallium manganese arsenide.

As a semiconductor, GaAs is second only to silicon in widespread use and importance. If a few percent of the gallium atoms in this semiconductor are replaced with atoms of manganese the result is a dilute magnetic semiconductor. Such materials would be especially well-suited for further development into spintronic devices if the mechanisms behind their ferromagnetism were better understood.

"Right now the temperature at which gallium manganese arsenide operates as a dilute magnetic semiconductor is 1700 Kelvin," Fadley says. "Understanding the actual mechanism by which the magnetic moments of individual manganese atoms are coupled so as to become ferromagnetic is critical to being able to design future materials that would operate at room temperature."



HARPES data on GaMnAs indicate that the ferromagnetism of dilute magnetic semiconductors from two distinct mechanisms

The two prevailing theories behind the origin of ferromagnetism in GaMnAs and other dilute magnetic semiconductors are the "p-d exchange model" and the "double exchange model."

According to this model, ferromagnetism is mediated by electrons residing in the valence bands of GaAs whose influence extends through the material to other manganese atoms. The double exchange model holds that the magnetism-mediating electrons reside in a separate impurity band created by doping the GaAs with manganese. These electrons in effect jump back and forth between two manganese atoms so as to lower their energy when their ferromagnetic magnets are parallel.

"Our bulk-sensitive HARPES measurements revealed that the manganese-induced impurity band is located mostly between the GaAs valence-band maximum and the Fermi level, but the manganese states are also merged with the GaAs valence bands," Gray says. "This is evidence that the two mechanisms co-exist and both act to give rise to ferromagnetism."

Fadley adds, "We now have a better fundamental understanding of electronic interactions in dilute magnetic semiconductors that can suggest future materials with different parent semiconductors and different magnetic dopants. HARPES should provide an important tool for characterising these

future materials."

Gray and Fadley conducted this study using a high intensity undulator beamline at the SPring8 synchrotron radiation facility in Hyogo, Japan. The plant is operated by the Japanese National Institute for Materials Sciences.

New HARPES studies are now underway at Berkeley Lab's Advanced Light Source (ALS) using the Multi-Technique Spectrometer/Diffractometer endstation at the hard x-ray photoemission beamline (9.3.1).

More details of this work have been published in the paper, "Bulk electronic structure of the dilute magnetic semiconductor GaMnAs through hard X-ray angle-resolved photoemission," by Alexander Gray *et al* in *Nature Materials*. DOI :10.1038/nmat3450

This research was primarily supported by the DOE Office of Science.

Multiple GaN-based amplifiers revealed by RFMD

The firm's new gallium nitride amplifiers are designed for cable applications

RF Micro Devices has unveiled a series of multiple GaN-based CATV amplifiers.

The new CATV amplifiers include the RFPD2940, which the firm claims is the best-in-class, high-power GaN-based CATV power-doubler amplifier. RFMD has also launched a new family of GaN-based push-pull CATV amplifiers, led by the RFPP2870 and RFCM3080.

RFPP2870

RFMD's RFPD2940 GaN-based CATV power-doubler amplifier delivers an output power of +63dBmV without compromising the critical linearity performance requirements of CATV applications.

The superior output power of the RFPD2940 enables CATV network operators to upgrade existing systems to wider bandwidths. This enables higher data throughput while also reducing operating expenses.

The RFPD2940 CATV power-doubler amplifier operates from 45MHz to 1000MHz, has a 23dB gain at 1000MHz and features an input and output return loss of -20dB. The device delivers better than -73dB CTB and CSO performance. It is housed in an industry-standard SOT-115J package and is available today for immediate sampling.

RFMD's RFPP2870 and RFCM3080 GaN-based push-pull amplifiers are ideally suited to drive GaN-based final stage CATV power-doubler amplifiers. The RFPP2870 and RFCM3080 feature 28dB gain at 1003MHz, have a typical input and output return loss of -20dB, and deliver distortion levels of -68dBc CTB and -75dBc CSO.

The RFPP2870 is housed in an industry-standard SOT-115 package, and the RFCM3080 is housed in a compact 11mm x 8.5mm multi-chip-module surface mount package.

Using GaN to shrink communication devices

Laser cooling achieved with gallium nitride could enable scientists to observe novel quantum effects and make the HEMTS used in satellites more resistant to damaging ultraviolet rays

Light might one day be used to cool the materials through which it passes, instead of heating them.

This could be due to a breakthrough by engineers at Lehigh and Johns Hopkins Universities.

The discovery could lead to smaller, lighter and cheaper communication devices and enable faster switching times, higher operating voltages and

increased output.

Yujie Ding from Lehigh and Jacob B. Khurgin at Johns Hopkins, have achieved what they say is the most favourable ratio to date between opposing types of light-scattering phenomena that occur in semiconducting materials.

Photons, units of light energy, typically maintain the same kinetic energy and wavelength when they exit a material as they do when they strike it.

Raman scattering, named after the 1930 Nobel Prize winner in Physics, refers to the small fraction of scattered photons whose kinetic energy and wavelength, or frequency, differ from those of incident photons. When this frequency is lower, it is called Stokes scattering. When it is higher, it is called anti-Stokes scattering.

The ratio of the occurrence of Stokes to anti-Stokes scattering, says Ding, is typically 35:1. Scientists would like to reduce this to 1:1, at which point a material neither heats nor cools when struck by light.

Ideally, they would like to reduce it even further, and initiate more anti-Stokes than Stokes scattering. In this case, the material imparts its energy, and thus its heat, to the light passing through it.

Ding and Khurgin, working with GaN, have succeeded in reducing the ratio of Stokes to anti-Stokes to 2:1.

GaN, considered one of the most important semiconducting material since silicon, is used in LEDs and laser diodes. Other applications include high-frequency, high-power transistors that can operate at high temperatures and solar cell arrays for satellites. And due to its relative biocompatibility, GaN can also be used in electronic implants in humans.

Laser cooling achieved with GaN could also enable scientists to observe novel quantum effects and could make the high-electron mobility transistors used in satellites more resistant to damaging ultraviolet rays.

“We are the only group to minimise the Stokes-anti-Stokes ratio from 35:1 to 2:1 at room temperature,” says Ding. “We have accomplished this by exploiting the different resonance behaviours of Stokes and anti-Stokes scattering.”

Researchers now achieve laser cooling, says Ding, by adding a dopant to the lattices of certain crystalline materials. But the portion of the lattice that actually cools represents only a tiny fraction of the entire lattice. If the right Stokes-anti-Stokes ratio can be achieved, every atom in the GaN lattice would cool and contribute to the cooling effect.

Ding and Khurgin plan next to build an optical resonator.

“We are still puzzled by the fundamental limit to the Stokes-anti-Stokes ratio and by the feasibility of reaching a ratio of 1 or less,” says Ding. “We want to see, experimentally, how an optical resonator affects this ratio. We have already done the theoretical work for this. We want to conduct experiments inside a nanowire or other nanostructure to show how this ratio is affected by the structure.

The research, led by Ding and Khurgin, has been supported by the National Science Foundation and the Defence Advanced Research Projects Agency (DARPA).

Further details of this work have been published in an invited article titled, “From anti-Stokes photoluminescence to resonant Raman scattering in GaN single crystals and GaN-based heterostructures,” in *Laser and Photonics Review,* Rev. 6, No. 5, 660–677 (2012). DOI 10.1002/lpor.201000028

Latest wired GaN broadband components to be showcased by RFMD

The firm will describe its gallium nitride based products which are claimed to deliver increased bandwidth and power efficiency for network upgrades at the SCTE conference

RF Micro Devices will showcase its portfolio of wired broadband components at the SCTE Cable-Tec Expo 2012 in Orlando, Florida.

RFMD's wired broadband components leverage the company's multi-chip-module (MCM) integration capabilities and broad access to all key process technologies. These include CATV, optical access, fibre-optic, and other applications.

During the Expo, RFMD will present a broad array of products, including its silicon-on-insulator (SOI) CATV control components and its GaN-based CATV amplifiers, which deliver increased bandwidth, improved power efficiency, and enhanced reliability for network upgrades.

First wavelength-tuneable XFP-RF optical transmitter from Finisar

The device designed for cable access networks, should bring new-found operational flexibility to cable operators

Finisar has revealed what it says is the industry's first 1 GHz RF-modulated, widely-tuneable optical transmitter in a small-form factor module for cable operators' access networks.

The XFP-RF transmitter can be designed into existing broadband optical platforms to double the density and halve the power consumption of transmitters in Hybrid Fibre Coaxial (HFC) networks. It can also be plugged directly into next-generation Cable Modem Termination Systems and QAM modulators with optical ports, saving space and power.

Consumer demands for video and bandwidth services continue to rise. As a result, cable operators are deploying Dense Wavelength Division Multiplexing (DWDM) in their access networks to dramatically increase the bandwidth available over their existing fibre infrastructure.

Finisar's XFP-RF optical transmitter module introduces wide-band wavelength tuning to HFC networks, allowing the cable operator to tune it to 80 different DWDM wavelengths across the entire C-band in less than 500 milliseconds.

Tuneability eliminates the need for an inventory of transmitters at fixed wavelengths and eases the provisioning of complex DWDM networks. Wavelength-tuneability also enables future, innovative architectures that can route services by managing the wavelengths of the HFC transmitters.

The XFP-RF transmitter utilises Finisar's high-volume XFP manufacturing process being used for today's wavelength-tuneable 10 Gb/s digital transceivers. It can be fully-loaded from 50 MHz to 1 GHz with a reach up to 40 km, and has operational bandwidth up to 1.2 GHz to accommodate frequency expansions in the cable access network. The performance is distance-agnostic so a single transmitter can be deployed for redundant paths to a node or to multiple nodes in a tapped architecture where the distance can vary greatly.

"Finisar has combined its high-volume Small-Form Factor module capabilities, wavelength-tuneable laser technology, and its extensive experience in CATV transmitters to advance optics for the next evolution of cable access networks," says Shawn Esser, Director of Product Marketing for CATV products at Finisar.

"As cable operators continue to deploy more optics to segment their networks, our wavelength-tuneable XFP-RF transmitter saves valuable space, reduces energy requirements and improves their operational flexibility. The XFP-RF transmitter deployed in existing optical platforms today is designed to be able to be re-deployed in next-generation infrastructure equipment designed with optical ports to future-proof cable operators' investment," he concludes.

RF Electronics

Strategy Analytics: Tuneable antennas enhance smartphones

Skyworks, RFMD, Avago, TriQuint and Murata, to compete in this segment using GaAs, CMOS, RF MEMS and voltage-dependent dielectric variable capacitor technologies

Compact, integrated antenna tuners were used in several popular smartphones in 2011, the first of a wave of such tuners from Peregrine Semi, RFMD and others.

The Strategy Analytics report, "Outlook for Active Antennas & Tunable Components in Cellular Phones" reviews the prospects for tuneable RF components, comparing the different approaches and suppliers, and provides an upbeat forecast of the market through 2017.

Christopher Taylor, Director of the Strategy Analytics RF & Wireless Components market research service says, "Mobile devices that support 4G, 3G and 2G in multiple bands have complex RF front-ends, with compromises in antenna performance that can degrade calls, as Apple learned last year. Tuneable components can reduce dropped calls and improve battery life, while simplifying the cellphone."

Eric Higham, Director of the Strategy Analytics GaAs and Compound Semiconductor market research service adds, "Antennas with tuneable impedance match will emerge as an important piece of the cell phone RF front-end, and we expect antenna specialists including Ethertronics and Skycross, in combination with front-end component suppliers including Skyworks, RFMD, Avago Tech, TriQuint and Murata, to compete aggressively in this segment using GaAs, CMOS, RF MEMS and voltage-dependent dielectric variable capacitor technologies."

Stephen Entwistle, VP of the Strategy Analytics Strategic Technologies group concludes, "The new 'antenna tuner' product category will bring success to some new entrants such as WiSpry and inevitably shake up the existing order among cellphone RF front-end component vendors."

Skyworks board restructures to push product portfolio

The RF device manufacturer has made leadership changes to enhance focus and drive its products forward

Skyworks Solutions is restructuring its executive management team to increase collaboration between its front-end solutions and high performance analogue teams.

The firm aims to drive development of next generation solutions and set the stage for further market outperformance.

Liam Griffin, who previously served as executive vice president and general manager of Skyworks' high performance analogue business, has been promoted to executive vice president and corporate general manager.

This newly created role encompasses responsibility for all of Skyworks' business units and is designed to enhance product line performance, leverage organisational synergies and best capitalise on market opportunities.

Prior to his leadership role in high performance analogue, Griffin served as the Company's senior vice president of sales and marketing where he gained in depth knowledge of Skyworks' broad product portfolio.

"Skyworks is enabling mobile connectivity across some of the world's most exciting communications platforms including smartphones, tablets and e-readers," says David J. Aldrich, president and chief executive officer of Skyworks.

"We are capturing more content per platform than ever before and rapidly expanding our footprint in complementary new vertical markets such as automotive, medical and home automation. With our customers demanding higher levels of analogue and RF integration and placing greater value on total solutions, we are proactively driving alignment across all Skyworks teams to create a more integrated and rapid development cycle for our next

generation products. Liam's track record of success makes him the ideal person for this key leadership role."

As part of the realignment, Gregory Waters will be leaving Skyworks following a transition period.

"We thank Greg for his instrumental role in building Skyworks' front-end solutions franchise and are grateful for his many contributions over the years. We wish him well in his future endeavours," Aldrich concludes.

TriQuint rases the bar in GaN reliability

The firm says its new process enables more robust, high-efficiency gallium nitride (GaN) RF devices

TriQuint believes it has achieved record-setting circuit reliability that exceeds previous industry standards.

The company's new GaN benchmark supports highly-reliable integrated RF solutions . TriQuint says its new devices use less power, are compact, and serve wide frequency ranges.

Any RF system can benefit from reduced maintenance and longer operational lifetimes arising from increased reliability. These include commercial and defence RF infrastructure, broadband communications, first-responder radios and space-based applications.

"We're pleased to announce this new GaN reliability milestone," says James L. Klein, Vice President and GM for Infrastructure and Defence Products. "The achievement supports our foundry services and helps us accelerate product development. We are delivering more products and services than ever before."

TriQuint's TQGaN25 process, qualified to operate up to 40 Volts, has achieved a mean time to failure of greater than 10 million hours at 200°C and greater than 1 million hours at 225°C.

This reliability milestone was achieved with TriQuint's newly-released Generation II 0.25µm GaN on SiC process utilised for GaN product solutions and Foundry Services.

TriQuint achieved its new GaN performance through in-house development programs. This new reliability also supports objectives of TriQuint's Defence Production Act (DPA) Title III contract that is funded by the Department of Defence Tri-Services laboratories including the U.S. Air Force, Army and Navy. TriQuint is also reducing manufacturing cycle times and increasing yields while making other GaN enhancements that work hand-in-hand with DPA Title III goals.

All manufacturing enhancements are designed to support greater affordability of next-generation AESA (active electronically scanned array) radars, new EW systems and commercial applications. Defence systems currently in technology development phases have production planned for 2016-2020.

RFMD adds to its family of linear GaN power transistors

The gallium nitride transistors are optimised for broadband applications requiring linear back-off operation or reduced spurious performance

RF Micro Devices has production released two highly linear GaN RF unmatched power transistors (UPTs).
RFMD says the RFHA3942 (35W) and RFHA3944 (65W) deliver superior linear performance versus competing GaN transistors.

The release of the RFHA3942 and RFHA3944 follows the previous release of the RF393X series of UPTs targeting continuous wave (CW) and pulsed peak power applications.

This new series of linear GaN discrete amplifiers is optimised for broadband applications requiring linear back-off operation or reduced spurious performance. RFMD plans to further its technology with future releases of 10W and 95W linear GaN devices over the next 12 months, significantly expanding the GaN UPT options available to RFMD's customers.

RFMD's highly linear GaN UPTs target new and existing communication architectures requiring

improved broadband linear performance in support of high peak-to-average modulation waveforms.

The RFHA3942 and RFHA3944 are tuneable over a broad frequency range (DC to 4GHz) and provide CW peak power of 35W and 65W respectively. They also offer high gain of 15dB and high peak efficiency of over 55 percent.
Using an IS95 9.8dB PAR signal tuned to 2.1GHz, the RFHA3942 achieves -43dBc adjacent channel power (ACP) at 34dBm POUT and the RFHA3944 achieves -54dBc ACP at 37dBm POUT.

What's more, the RFHA3942 and RFHA3944 offer high terminal impedance at the input and output of the package, enabling wideband gain and power performance advantages in a single amplifier. Both devices are packaged in a flanged ceramic two-leaded package that leverages RFMD's advanced heat-sink and power-dissipation technologies to deliver excellent thermal stability and conductivity.

Jeff Shealy, vice president and general manager of RFMD's Power Broadband business unit, says, "RFMD is very pleased to expand its GaN-based product portfolio, offering industry-leading linear power performance in support of diverse end markets."

" RFMD's GaN product portfolio clearly demonstrates our continued commitment to technology and product leadership, and we look forward to introducing additional GaN devices that feature superior power density, high efficiency, rugged dependability, and 'green' power consumption advantages," continues Shealy.

Samples and production quantities are available now through RFMD's online store or through local RFMD sale

Integra unveils GaN on SiC devices for S-Band radar

The two gallium nitride on silicon carbide modules are suited to weather radar and surface ship radar. S-band radar is also used in some communications satellites, especially those used to communicate with the space shuttle and the international space station

Integra is launching two internally pre-matched, GaN high electron mobility transistors (HEMTs) for S-band radar.

The IGN2729M500 operates over the 2.7 - 2.9 GHz instantaneous frequency band. Under 300µs/10% pulse conditions it supplies a minimum of 500 W of peak output power with typical performance of 560 W, typically 12 dB gain and over 60 % efficiency. The device is rated for peak output power of 500 W with 10% duty factor and average power of 50W.

The IGN3135M130 operates over the 3.1–3.5 GHz instantaneous frequency band. Under 300µs / 20 % pulse conditions it supplies a minimum of 130 W of peak output power with typical performance of 150 W with 12dB gain. The device is rated for peak output power of 130W with 20% duty factor and average power of 26W.

When appropriately rated, both HEMTS are operable under a wide range of pulse widths and duty factors. Specified operation for both devices is with Class AB bias. All devices are 100% screened for large signal RF parameters in a fixed tuned broadband matching circuit / test fixture.

RFMD adds to its family of linear GaN power transistors

The gallium nitride transistors are optimised for broadband applications requiring linear back-off operation or reduced spurious performance

RF Micro Devices has production released two

highly linear GaN RF unmatched power transistors (UPTs).

RFMD says the RFHA3942 (35W) and RFHA3944 (65W) deliver superior linear performance versus competing GaN transistors.

The release of the RFHA3942 and RFHA3944 follows the previous release of the RF393X series of UPTs targeting continuous wave (CW) and pulsed peak power applications.
This new series of linear GaN discrete amplifiers is optimised for broadband applications requiring linear back-off operation or reduced spurious performance.

RFMD plans to further its technology with future releases of 10W and 95W linear GaN devices over the next 12 months, significantly expanding the GaN UPT options available to RFMD's customers.

RFMD's highly linear GaN UPTs target new and existing communication architectures requiring improved broadband linear performance in support of high peak-to-average modulation waveforms.

The RFHA3942 and RFHA3944 are tuneable over a broad frequency range (DC to 4GHz) and provide CW peak power of 35W and 65W respectively. They also offer high gain of 15dB and high peak efficiency of over 55 percent.

Using an IS95 9.8dB PAR signal tuned to 2.1GHz, the RFHA3942 achieves -43dBc adjacent channel power (ACP) at 34dBm POUT and the RFHA3944 achieves -54dBc ACP at 37dBm POUT.

What's more, the RFHA3942 and RFHA3944 offer high terminal impedance at the input and output of the package, enabling wideband gain and power performance advantages in a single amplifier. Both devices are packaged in a flanged ceramic two-leaded package that leverages RFMD's advanced heat-sink and power-dissipation technologies to deliver excellent thermal stability and conductivity.

Jeff Shealy, vice president and general manager of RFMD's Power Broadband business unit, says, "RFMD is very pleased to expand its GaN-based product portfolio, offering industry-leading linear power performance in support of diverse end markets. RFMD's GaN product portfolio clearly demonstrates our continued commitment to technology and product leadership, and we look forward to introducing additional GaN devices that feature superior power density, high efficiency, rugged dependability, and 'green' power consumption advantages."

Samples and production quantities are available now through RFMD's online store or through local RFMD sales channels.

RFMD GaN HEMT PAs suited to high peak-to-average ratio apps

RFMD's RFHA104x series of high-power gallium nitride broadband power transistors (BPTs) are optimised for military communications, commercial wireless infrastructure, and general purpose applications

RFMD's latest advanced 65V high power density GaN semiconductor process is optimised for high peak-to-average ratio applications.

The firm's new high-performance amplifiers achieve high power with high efficiency and flat gain over a broad frequency range in a single amplifier design.

Each is an input-matched GaN transistor packaged in an air cavity ceramic package providing excellent thermal stability. Ease of integration is accomplished through the incorporation of simple, optimised, matching networks external to the package that provide wideband gain and high efficiency, all in a single amplifier ideal for linear correction circuits.

The RFHA1042 has a peak power of 125W and a single circuit for frequency of 225MHz to 450MHz. The RFHA1043 can operate at 150W and single circuit for frequency of 1.2GHz to 1.85GHz.

48V CW broadband performance

At a POUT of 45.2dBm, the RFHA1042 has a gain of 18.5dB and the RFHA1043 a gain of 15.5dB. The drain efficiency of the RFHA1042 is 42 percent and is 30 percent for the RFHA1043.

48V CW broadband performance

The RFHA1042 has a POUT of 45.2dBm and the RFHA1043 a POUT of 52dBm. The RFHA1042 has a gain of 16dB and the RFHA1043 a gain of 13.5dB. The drain efficiency of the RFHA1042 is 60 percent and is 51 percent for the RFHA1043.

The devices are optimised for video bandwidth and exhibit minimal memory effects.

These products are currently available in production quantities. Large signal models are also available.

Skyworks Exceeds Updated Q4 FY12 Revenue and EPS Guidance

Skyworks Solutions reported fourth fiscal quarter and year end 2012 results for the period ending September 28, 2012. Revenue for the quarter was $421.1 million, up 8.2 % sequentially and exceeded the Company's updated guidance of $420 million provided during its analyst day on September 20, 2012.

Delivers $421 Million in Revenue, Up 8 % Sequentially

Posts $0.53 in Non-GAAP EPS ($0.32 GAAP), $0.01 Better than Updated Guidance
Expands Operating Margin 100 Basis Points Sequentially to 24.6 Percent on a Non-GAAP Basis (17.8 Percent GAAP)
Guides to 14 Percent Year-Over-Year Revenue Growth in Q1 FY13

On a non-GAAP basis, operating income for the fourth fiscal quarter of 2012 was $103.6 million, up from $91.7 million in the third fiscal quarter of 2012, reflecting a 13 percent increase.

Non-GAAP diluted earnings per share for the fourth fiscal quarter was $0.53 compared to $0.45 for the prior fiscal quarter, representing an 18 % sequential improvement. On a GAAP basis, operating income for the fourth fiscal quarter of 2012 was $74.8 million and diluted earnings per share was $0.32.

For fiscal year 2012, revenue was $1.569 billion, up 11 % versus $1.419 billion in fiscal 2011. For fiscal 2012, non-GAAP diluted earnings per share was $1.90 and GAAP diluted earnings per share was $1.05.

"Skyworks is capitalising on global mobile connectivity ubiquity and demand for high performance analogue solutions across a diverse set of vertical markets," said David J. Aldrich, president and chief executive officer of Skyworks.

"Interrelated macro trends such as social networking, cloud-based content and the explosion of audio and video streaming are driving increased semiconductor content and complexity in smartphones, tablets, ultrabooks and e-readers as well as within the supporting network infrastructure."

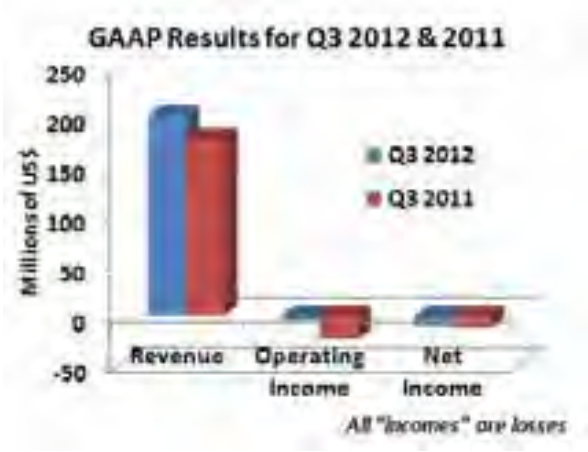
"At the same time, wireless and power management functionality is rapidly proliferating across adjacent applications spanning machine-to-machine, automotive, broadband, home automation, smart grid and medical markets. Given our differentiated product portfolio, engagements with all key OEMs and scale, Skyworks is well positioned to continue to gain market share, capture additional content per platform and, as a result, significantly outperform our addressed markets throughout fiscal 2013," he concluded.

TriQuint "incomes" still making a loss

Revenues for Q3 2012 were $200.8 million, down 7 percent from the Q3 2011

TriQuint Semiconductor has announced financial results for the quarter ended September 29th, 2012.

Revenues for the third quarter of 2012 were $200.8 million, down 7% from the third quarter of 2011. GAAP net loss for the quarter was $11.2 million, or $(0.07) per share.



The Mobile Devices market revenue grew 13%, Networks grew 11% and Defence was up 16%, in each case sequentially. Revenue for the nine months ended September 29th, 2012 was $595.6 million, down 11% from the nine months ended October 1st, 2011.

Commenting on the results for the quarter ended September 29th, 2012, Ralph Quinsey, President and Chief Executive Officer, said, "TriQuint's third quarter results improved sequentially with 13% revenue growth driven by increased demand from our major smartphone customers and order strength for infrastructure and defence products. We are expecting ten to twelve percent revenue growth in the fourth quarter with continued strength in each of our major markets but with pressure on gross margins due to planned inventory reductions."

Gross margin for the third quarter of 2012 was 30.7%, up sequentially from 25.2%. Gross margin for the nine months ended September 29th, 2012 was 28.4%, down from 38.1% for the same period in 2011 due to lower factory utilisation.

Operating expenses for the third quarter of 2012 were $67.1 million, or 33% of revenue, down from $69.4 million in the previous quarter due to reduced litigation costs. Operating expenses for the nine months ended September 29th, 2012 were $202.6 million compared to $201.3 million for the same period in 2011.

Net loss for the third quarter of 2012 was $11.2 million or $(0.07) per share, compared with a net loss of $13.1 million, or $(0.08) per share, in the previous quarter. Net loss for the nine months ended September 29th, 2012 was $22.4 million or $(0.14) per share compared to a net income of $43.8 million or $0.25 per diluted share for the nine months ended October 1st, 2011.

Cash and investments decreased by $17.8 million to $144.6 million in the quarter due primarily to higher sales volume later in the quarter resulting in a higher accounts receivable ending balance.

The company believes fourth quarter 2012 revenues will be between $220 million and $225 million.

AMCAD's testing system ideal for GaN & SiC HV transistors

The 1kV/ 30A IV pulse tool provides high voltage signals and short pulse / fast switching capabilities in gallium nitride and silicon carbide devices simultaneously

French firm, AMCAD Engineering has upgraded its PIV semiconductor device analyser family for the next generation of High Voltage Fast Switching (HVFS) Transistors.

HVFS transistors open the way to new targets and new designs for high efficiency DC-DC converters, switches, hubs and servers, telecom base stations, and automotive applications. Other applications include LED drive circuits and Class D audio amplifiers.

The latest HVFS transistor technologies include Enhanced Mode GaN FET and SiC MOSFET. They offer very fast switching frequencies that are up to 10 times higher than previous solutions and permit designers to use lower duty cycles than they currently do.

AMCAD says that until now, there were no efficient testing solutions which highlighted the capabilities of these new technologies. Previous solutions could not provide simultaneously high voltage signals and short pulse / fast switching capabilities.

“AMCAD complements its existing Pulse IV system portfolio by offering a new solution with pulse width down to 400ns@1KV to help customer testing High voltage Fast Switching transistors”, says Tony Gasseling, General Manager. He continues, “Once again, we are very pleased to lead the innovation in the field of semiconductor pulsed characterisation”.

The PIV High Voltage Fast Switching measurement system will be demonstrated for the first time during the European Microwave Week Exhibition, at AMCAD Booth #413.
AMCAD Engineering provides solutions to today’s electronic design challenges. The company is dedicated to providing the most advanced solutions and tools in test and modelling to the RF, microwave IC and power electronic markets.

Cree GaN transistors PAs enable crystal clear HD

Along with Array Wireless, Cree is implementing its gallium nitride devices to enhance HD video

Cree and Array Wireless are helping to bring the clarity of high-definition (HD) video transmission to Sunday Night Football (SNF) on NBC.

The HD NFL games are broadcast using wireless video systems from Array Wireless that employ Cree’s GaN RF components.

Array Wireless counts on Cree’s RF GaN technology to create high efficiency, low distortion, robust power amplifiers that are essential for high-definition video transmission.

Cree GaN RF technology is deployed in Array Wireless’ S-Band linear power amplifier product series, enabling smaller, lighter and more efficient power amplifiers than those based on GaAs.

Winged Vision, a leader in aerial sports broadcasting, uses high linearity amplifiers from Array Wireless to transmit SNF video transmissions and maintain unparalleled fidelity from pre-game to post-game.

According to Bob Mikkelson, president, at Winged Vision, the light weight Coded Orthogonal Frequency-Division Multiplexing (COFDM) amplifiers from Array Wireless are a key component in developing compact HD broadcast systems, with “performance and efficiency that are head and shoulders above the rest.”

“Cree’s GaN RF devices are ideal for meeting the stringent linearity requirements for wide bandwidth HD digital transmission at high efficiency operation,” says Ed Takacs, president and founder, Array Wireless.

“The lighter weight systems they enable are extremely beneficial in lowering fuel consumption and operating costs for our customers. We migrated from GaAs devices to Cree GaN devices several years ago to offer increased transmission range while reducing our power amplifier size, weight and power consumption.”

Array Wireless’ TruPower Series Linear RF Amplifiers bring a new level of performance and reliability to microwave transmission of digitally modulated signals from UHF to 10GHz. TruPower amplifiers use patent-pending linearisation technology to minimise distortion and provide superior signal quality for complex multi-carrier modulations like OFDM while minimising DC power consumption, heat and weight.

Cree RF GaN HEMT and MMIC devices are available for linear and pulsed amplifier applications in frequency bands from DC to Ku-Band at 18GHz. The devices are available in a variety of output power ratings from 1W to 40W.

Multiple GaN-based amplifiers revealed by RFMD

The firm's new gallium nitride amplifiers are designed for cable applications

RF Micro Devices has unveiled a series of multiple GaN-based CATV amplifiers.

The new CATV amplifiers include the RFPD2940, which the firm claims is the best-in-class, high-power GaN-based CATV power-doubler amplifier. RFMD has also launched a new family of GaN-based push-pull CATV amplifiers, led by the RFPP2870 and RFCM3080.

RFPP2870

RFMD's RFPD2940 GaN-based CATV power-doubler amplifier delivers an output power of +63dBmV without compromising the critical linearity performance requirements of CATV applications.

The superior output power of the RFPD2940 enables CATV network operators to upgrade existing systems to wider bandwidths. This enables higher data throughput while also reducing operating expenses.

The RFPD2940 CATV power-doubler amplifier operates from 45MHz to 1000MHz, has a 23dB gain at 1000MHz and features an input and output return loss of -20dB. The device delivers better than -73dB CTB and CSO performance. It is housed in an industry-standard SOT-115J package and is available today for immediate sampling.

RFMD's RFPP2870 and RFCM3080 GaN-based push-pull amplifiers are ideally suited to drive GaN-based final stage CATV power-doubler amplifiers. The RFPP2870 and RFCM3080 feature 28dB gain at 1003MHz, have a typical input and output return loss of -20dB, and deliver distortion levels of -68dBc CTB and -75dBc CSO.

The RFPP2870 is housed in an industry-standard SOT-115 package, and the RFCM3080 is housed in a compact 11mm x 8.5mm multi-chip-module surface mount package.

TechAmerica says all is well at TriQuint

The RF solutions supplier has been awarded for promoting a healthy lifestyle to its employees

TriQuint has been honoured with the 2012 Corporate Wellness Award from TechAmerica, a technology trade association.

The award recognises a company and its HR staff for promoting internal employee wellness in the organisation. TriQuint's wellness initiative, called "Live Well", gives employees and their families not only the tools and resources, but also the motivation to make good choices about their overall physical, mental and financial health.

"The technology community has long been known to support the health and well-being of our employees and TriQuint exemplified that commitment this year. We are thrilled to honour their efforts," says Shawn Osborne, President and CEO of TechAmerica.

In addition to offering employees and their spouses biometric screenings, educational courses and a host of other programs, TriQuint partnered with TechAmerica to offer a wellness walking challenge.

TriQuint stood out in the TechAmerica challenge

by having 428 active participants, the most of any company participating. Employees from TriQuint sites around the globe formed 124 teams for the friendly eight week competition, and walked or ran more than 230 million steps collectively.

"One of the most rewarding things about implementing a Wellness Initiative like 'Live Well' at TriQuint has been seeing how passionately our employees all over the world have embraced it. Employees have told us that our programs have literally saved their lives. There is nothing more rewarding than that," says Debbie Burke, TriQuint Vice President of Human Resources.

"We continue to listen to our employees' suggestions on how to make the programs more relevant to them, and the changes are really making a difference. We are honoured to be recognised for the Corporate Wellness Award by TechAmerica."

Burke accepted the award for TriQuint at TechAmerica's 54th annual David Packard Medal of Achievement and Innovators Award Dinner on October 9th, 2012.

RFMD ITC lawsuit withdrawn by Peregrine

RFMD believes the decision to terminate the ITC proceedings is because no infringement of Peregrine's patents occurred

Peregrine Semiconductor has filed a motion to voluntarily withdraw the lawsuit against RF Micro Devices with the International Trade Commission (ITC) in February 2012.

RFMD believes the decision by Peregrine to terminate the ITC proceeding is in response to developments in the case that have consistently validated RFMD's position that no infringement of Peregrine's patents occurred.

The firm also says that the validity of the asserted Peregrine patents is clearly in doubt. RFMD maintains that it respects the intellectual property rights of others and takes care to avoid infringements.

RFMD says it will continue to vigorously defend its position in the companion case filed by Peregrine in April 2012 in the U.S. District Court for the Southern District of California.

Latest wired GaN broadband components to be showcased by RFMD

The firm will describe its gallium nitride based products which are claimed to deliver increased bandwidth and power efficiency for network upgrades at the SCTE conference

RF Micro Devices will showcase its portfolio of wired broadband components at the SCTE Cable-Tec Expo 2012 in Orlando, Florida.

RFMD's wired broadband components leverage the company's multi-chip-module (MCM) integration capabilities and broad access to all key process technologies. These include CATV, optical access, fibre-optic, and other applications.

During the Expo, RFMD will present a broad array of products, including its silicon-on-insulator (SOI) CATV control components and its GaN-based CATV amplifiers, which deliver increased bandwidth, improved power efficiency, and enhanced reliability for network upgrades.

Lasers
Oclaro to sell off assets to II-VI subsidiary

The agreement is to generate cash and strengthen the firm's existing relationship with II-VI and Photop Technologies

Oclaro, Inc., a provider and innovator of optical communications and laser products, has signed a definitive agreement to sell the assets of its Santa Rosa thin film filter business to Photop Technologies, Inc., a wholly-owned subsidiary of II-VI Incorporated.

Oclaro says it will sell its interleaver product line to Photop Koncent, Inc. (FuZhou).

Both transactions are expected to close on December 3rd, 2012.

Total consideration to Oclaro for these transactions will be in the form of cash proceeds of $27 million, with $23 million to be paid upon closing, $3 million payable on or before December 28th, 2012 and $1 million to be held in escrow until December 31st, 2013.

"Divesting our thin film filter business and the interleaver product line is consistent with our strategy to focus our resources on our core competencies," says Alain Couder, chairman and CEO of Oclaro.

"The proceeds from these deals improve our balance sheet and give us additional operating flexibility to serve our global customer base. The agreements also strengthen our existing relationships with II-VI and Photop, and will ensure customers in the telecom, life sciences and industrial markets continued access to these products as part of an even broader portfolio from a market leader."

Francis J. Kramer, president and CEO of II-VI Incorporated comments, "This acquisition will enhance Photop's core business while expanding their global footprint and diversification into the growing life sciences market. We look forward to the world class team at Santa Rosa becoming a part of II-VI."

Divesting these product lines is expected to reduce revenues for the fiscal quarter ended December 29th, 2012 by approximately $2 million compared to the guidance range issued by Oclaro in connection with its earnings announcement on November 5th, 2012.

Revenues for these product lines in the full fiscal quarter ended September 29th, 2012 were $3.6 million.

Dilas fibre-coupled laser diode system delivers up to 1kW

The III-arsenide based laser is suited to soldering, heat treatment and thin metal welding as well as, scientific research applications like fibre laser pumping

German firm Dilas, a diode laser manufacturer, has launched the next generation fibre-coupled system which was developed to suit the needs for volume production in industrial applications.

Dilas SF1000/400

The Dilas SF1000/400 is capable of delivering up to 1 kilowatt (kW) output from a 400µm fibre at 976nm, at a single wavelength.

Dilas' fibre-coupled system is based on macro-

channel cooled diode laser bars featuring a compact footprint and convenient aiming beam. With a beam parameter product of 44mm mrad this system delivers 1kW through a cladding-mode free QBH high-power 400µm core diameter fibre, NA0.22 or an optional 800µm core diameter, NA0.12 fibre.

The laser is also available with a Q5 (LLK-B) industrial fibre connector.

The turnkey system comes with a water-air-chiller, diode laser power supply, and control unit providing external interfaces, chassis and metal-armoured fibre. The 1kW system is designed with a user friendly interface for ease of integration of material processing workstations.

The Dilas SD1000/400 system is ideal for material processing applications such as, soldering, heat treatment and thin metal welding as well as, scientific research applications like fibre laser pumping.

Eblana unveils 1877nm single-wavelength laser diode

The strained quantum well indium phosphide design is ideally suited for moisture detection

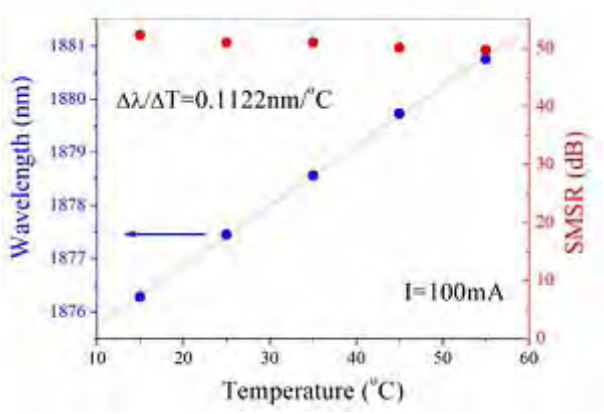
Eblana Photonics has released a single wavelength 1877nm Laser Diode (LD) module for laser spectroscopy applications.

The optically isolated 14-pin butterfly EP1877-DM series laser module is ideally suited for moisture detection in Tuneable Diode Laser Absorption Spectroscopy (TDLAS) applications.

This new laser product expands on Eblana's existing gas detection product portfolio which already includes lasers for detecting methane (λ = 1654nm), CO2 (λ = 2004nm) and moisture (λ = 1392nm).

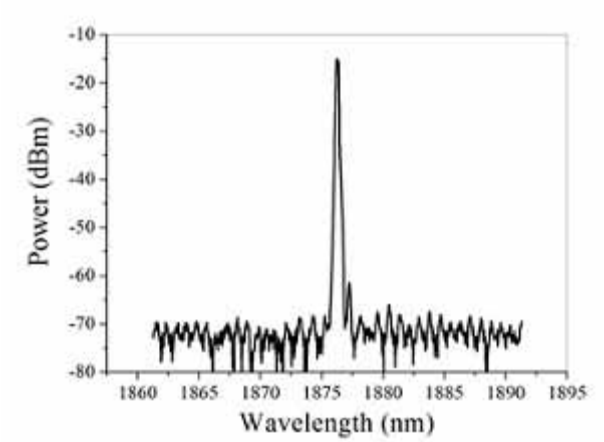
The laser is fabricated using Eblana's discrete mode laser technology platform, which delivers DFB-like performance at a price point geared to high volume applications.

Eblana's strained quantum well InP design provides stable, high performance, single wavelength operation and a wide degree of current tuning for wavelength control.



EP1877-DM temperature tuning plot

The product is ideally suited for H2O detection using the 1877nm absorption line and has a high spectral purity with a typical side-mode suppression ratio of 45dB. The LD has a narrow spectral line width frequency of about 1MHz.



EP1877-DM PL spectrum

Eblana maintains that the device exhibits exceptional device to device wavelength and performance uniformity. The module is packaged in a standard 14 Pin Butterfly with integrated TEC and optical isolator.

"We are delighted to announce this latest addition to our gas detection product line for TDLAS applications" says Jim Somers, Eblana's CEO. "We are seeing an increasing trend towards laser-based gas detection systems for high volume deployments. Our customers are successfully displacing older, chemical based gas detection

installations with TDLAS on the basis that the laser based system provides higher accuracy, is more reliable and has a lower overall total cost of ownership".

Richard Phelan, director of new product development at Eblana, adds, "Our Discrete Mode laser products are perfectly suited to TDLAS systems where precise wavelength control and stable performance are critical considerations. In response to market demand, we are planning further product releases in this application area in the near future".

Eblana says other centre wavelengths are available on request.

Based in Ireland, Eblana Photonics designs and manufactures laser diodes emitting in the range 680 nm to 2050 nm for communications, sensing and measurement applications.

Brolis opens new MBE and laser diode facility

Brolis' new building features a class 1000/10000 cleanroom environment with dedicated facilities for MBE and optoelectronic device testing and packaging. The entire facility was raised in less than 9 months, accelerated by the investments from the Venture Capital fund LitCapital and European Union structural grants.

"Our goal was to launch the facility as fast as possible, so that we do not lose the momentum, both technological and competitive. Today, I believe we are pretty much on schedule with the opening. Our second milestone is to deliver first R&D laser diode products by February, 2013," says Dominykas Vizbaras, CEO of Brolis Semiconductors.

According to Augustinas Vizbaras, company's COO, first laser products will be 2090 nm, 2330 nm, 2730 nm, 3300 nm, and 3400 nm. Some of these wavelengths will also be high power products.

Brolis Semiconductors specialises in mid-infrared type-I GaSb laser diodes and MBE epitaxy. The company serves the community with MBE epitaxial wafers for antimonide and arsenide materials for thermal imaging focal plane arrays, CPV and custom devices for industrial, defense, and scientific markets.

The company also manufactures GaSb laser diodes in the 1800 – 4000 nm wavelength range. Major markets for the laser diodes are gas sensing for industrial process monitoring, medical and defense. High power laser diodes and laser diode bars can be used for direct IR countermeasures, dermatology and plastic welding.

Raman spectroscopy comes in blue, green and red

CRAIC is offering a tool which measures Raman spectra of micron-scale samples with multiple lasers ranging from 405 to 830nm

CRAIC Technologies has added more laser wavelengths to its Apollo Raman microspectrometer.

Designed to be added to many different types of light microscopes, the CRAIC Apollo enables scientists and engineers to measure the Raman spectra from microscopic samples or microscope sampling areas of large samples.

The CRAIC Apollo can also be added to a CRAIC Technologies microspectrophotometer, adding Raman microspectroscopy to UV-visible-NIR absorbance, reflectance and fluorescence microspectroscopy and imaging.

And because the CRAIC Apollo is now offered with lasers with peak wavelengths ranging from 405 nm through the 830 nm, a whole host of capabilities

are now available to researchers and engineers including resonance Raman spectroscopy and more.

What's more, multiple lasers can be combined on a single microscope for maximum experimental flexibility. By offering these new lasers for the CRAIC Apollo Raman spectrometer, CRAIC Technologies is able to supply a more powerful tool for sample micro-analysis.

"CRAIC Technologies has been an innovator in the field of UV-visi ble-NIR microanalysis since its founding. We have helped to advance the field of microscale analysis with innovative instrumentation, software, research and teaching.

We have seen the need for Raman microspectroscopy in addition to our current capabilities of UV-visible-NIR and luminescence microspectroscopy. Therefore, we created the CRAIC Apollo Raman microspectrometer based around a large number of different lasers," says Paul Martin, President of CRAIC Technologies.

"And by combining the power of Raman spectroscopy with our UV-visible microspectrophotometers, the customer no longer has purchase a separate instrument, nor move the sample between instruments and acquire the data separately. You can analyse the same microscopic area of the sample under the same conditions without additional sample preparation or instrument alignment. Improved results and sample analysis throughput can be dramatically increased."

The CRAIC Apollo Raman microspectrometer is a self contained unit that features Raman grade lasers as the light source, an advanced optical interface to the microscope, a Raman spectrometer and sophisticated software for instrument control and data analysis.

Lasers are now offered throughout the visible and near infrared region and include 405, 473, 488, 546, 638, 660, 785 and 830 nm. Each module can be used either individually or the modules may be combined so that multiple laser wavelengths can be used to probe a single sample.

The idea is to provide a highly flexible Raman microspectrometer with the optimum laser wavelengths to enhance your spectroscopic results. These rugged, self-contained units are also designed to be used either with an optical microscope or with a CRAIC Technologies microspectrophotometer.

With high sensitivity, durable design, ease-of-use, multiple imaging and spectroscopic techniques and the support of CRAIC Technologies, the CRAIC A

Princeton reveals 650nm red laser array

With an efficiency of over 20 percent, and a spectral width of ~ 1nm the array is suited to medical and illumination applications

Princeton Optronics, an innovator in high efficiency, high power VCSELs and VCSEL arrays, is marketing high power (15W) red laser devices and arrays at 650nm for medical and illumination applications.

These arrays have an efficiency of over 20 percent, a spectral width of approximately 1nm and a circular beam with divergence of 18 degrees (full angle). The array measures 3 x 3mm and is mounted on submounts.

The firm says it can deliver such arrays in high volume through its high volume manufacturing operation.

Princeton also delivers single devices and lower power as well as addressable arrays at red and other wavelengths. The company can make custom devices and arrays of other configurations and other wavelengths in red.

Guven promoted at Hittite Microwave

Gorkem Guven will manage engineering, marketing and business developments organisations at the company

Hittite Microwave Corporation has promoted Gorkem Guven to Vice President.

In this executive role, Guven will manage various engineering, marketing and business developments organisations.

Gorkem Guven joined Hittite in April 2000, and has served in various roles including integrated circuit design, business development, and general management.

He has led a number of numerous strategic technology initiatives and market penetration projects for the company. Guven has 14 years of semiconductor and industry experience and has a bachelor's degree in Electrical Engineering and a Masters of Business Administration.

"I am pleased to promote Gorkem to this executive position. He is a passionate, business savvy technologist that is expert in creating, planning and managing complex technology developments. He has a proven track record of identifying customer requirements and managing our teams to develop world class products to satisfy those needs," says Stephen G. Daly, Chairman, President and CEO. "This new position expands our executive team to support our continued growth."

Hittite Microwave Corporation is a designer and manufacturer of ICs, subsystems and instrumentation for technically demanding digital, RF, microwave and millimetre-wave applications covering DC to 110 GHz.

Using GaN to shrink communication devices

Laser cooling achieved with gallium nitride could enable scientists to observe novel quantum effects and make the HEMTS used in satellites more resistant to damaging ultraviolet rays

Light might one day be used to cool the materials through which it passes, instead of heating them.

This could be due to a breakthrough by engineers at Lehigh and Johns Hopkins Universities.

The discovery could lead to smaller, lighter and cheaper communication devices and enable faster switching times, higher operating voltages and increased output.

Yujie Ding from Lehigh and Jacob B. Khurgin at Johns Hopkins, have achieved what they say is the most favourable ratio to date between opposing types of light-scattering phenomena that occur in semiconducting materials.

Photons, units of light energy, typically maintain the same kinetic energy and wavelength when they exit a material as they do when they strike it.

Raman scattering, named after the 1930 Nobel Prize winner in Physics, refers to the small fraction of scattered photons whose kinetic energy and wavelength, or frequency, differ from those of incident photons. When this frequency is lower, it is called Stokes scattering. When it is higher, it is called anti-Stokes scattering.

The ratio of the occurrence of Stokes to anti-Stokes scattering, says Ding, is typically 35:1. Scientists would like to reduce this to 1:1, at which point a material neither heats nor cools when struck by light.

Ideally, they would like to reduce it even further, and initiate more anti-Stokes than Stokes scattering. In this case, the material imparts its energy, and thus its heat, to the light passing through it.

Ding and Khurgin, working with GaN, have succeeded in reducing the ratio of Stokes to anti-Stokes to 2:1.

GaN, considered one of the most important semiconducting material since silicon, is used in LEDs and laser diodes. Other applications include high-frequency, high-power transistors that can operate at high temperatures and solar cell arrays for satellites. And due to its relative biocompatibility, GaN can also be used in electronic implants in humans.

Laser cooling achieved with GaN could also enable scientists to observe novel quantum effects and could make the high-electron mobility transistors used in satellites more resistant to damaging ultraviolet rays.

"We are the only group to minimise the Stokes-anti-Stokes ratio from 35:1 to 2:1 at room temperature," says Ding. "We have accomplished this by exploiting the different resonance behaviours of Stokes and anti-Stokes scattering."

Researchers now achieve laser cooling, says Ding, by adding a dopant to the lattices of certain crystalline materials. But the portion of the lattice that actually cools represents only a tiny fraction of the entire lattice. If the right Stokes-anti-Stokes ratio can be achieved, every atom in the GaN lattice would cool and contribute to the cooling effect.

Ding and Khurgin plan next to build an optical resonator.

"We are still puzzled by the fundamental limit to the Stokes-anti-Stokes ratio and by the feasibility of reaching a ratio of 1 or less," says Ding. "We want to see, experimentally, how an optical resonator affects this ratio. We have already done the theoretical work for this. We want to conduct experiments inside a nanowire or other nanostructure to show how this ratio is affected by the structure.

The research, led by Ding and Khurgin, has been supported by the National Science Foundation and the Defence Advanced Research Projects Agency (DARPA).

Further details of this work have been published in an invited article titled, "From anti-Stokes photoluminescence to resonant Raman scattering in GaN single crystals and GaN-based heterostructures," in *Laser and Photonics Review,* Rev. 6, No. 5, 660–677 (2012). DOI 10.1002/lpor.201000028

First wavelength-tuneable XFP-RF optical transmitter from Finisar

The device designed for cable access networks, should bring new-found operational flexibility to cable operators

Finisar has revealed what it says is the industry's first 1 GHz RF-modulated, widely-tuneable optical transmitter in a small-form factor module for cable operators' access networks.

The XFP-RF transmitter can be designed into existing broadband optical platforms to double the density and halve the power consumption of transmitters in Hybrid Fibre Coaxial (HFC) networks. It can also be plugged directly into next-generation Cable Modem Termination Systems and QAM modulators with optical ports, saving space and power.

Consumer demands for video and bandwidth services continue to rise. As a result, cable operators are deploying Dense Wavelength Division Multiplexing (DWDM) in their access networks to dramatically increase the bandwidth available over their existing fibre infrastructure.

Finisar's XFP-RF optical transmitter module introduces wide-band wavelength tuning to HFC networks, allowing the cable operator to tune it to 80 different DWDM wavelengths across the entire C-band in less than 500 milliseconds.

Tuneability eliminates the need for an inventory of transmitters at fixed wavelengths and eases the provisioning of complex DWDM networks. Wavelength-tuneability also enables future, innovative architectures that can route services by managing the wavelengths of the HFC transmitters.

The XFP-RF transmitter utilises Finisar's high-volume XFP manufacturing process being used for today's wavelength-tuneable 10 Gb/s digital transceivers. It can be fully-loaded from 50 MHz to 1 GHz with a reach up to 40 km, and has operational bandwidth up to 1.2 GHz to accommodate frequency expansions in the cable access network. The performance is distance-agnostic so a single transmitter can be deployed for redundant paths to a node or to multiple nodes in a tapped architecture where the distance can vary greatly.

"Finisar has combined its high-volume Small-Form Factor module capabilities, wavelength-tuneable laser technology, and its extensive experience in CATV transmitters to advance optics for the next evolution of cable access networks," says Shawn Esser, Director of Product Marketing for CATV products at Finisar.

"As cable operators continue to deploy more optics to segment their networks, our wavelength-tuneable XFP-RF transmitter saves valuable space, reduces energy requirements and improves their operational flexibility. The XFP-RF transmitter deployed in existing optical platforms today is designed to be able to be re-deployed in next-generation

infrastructure equipment designed with optical ports to future-proof cable operators' investment," he concludes.

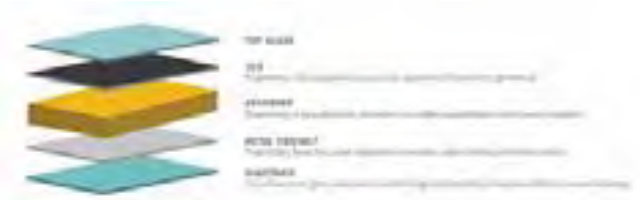
Solar

Stion awarded $2 million by DOE SunShot initiative

The firm aims to expand its CIGSSe thin film module manufacturing in California and Mississippi

Stion, a manufacturer of high-efficiency CIGS thin-film solar modules, has been granted an award of $2 million from the US Department of Energy's SunShot Initiative.

The company aims to continue pilot production and scale-up of its ultra high-efficiency thin film modules based on proprietary tandem junction technology in California and Mississippi.



Stion CIGS solar cell structure

The award is a Tier 2 grant under the Sunshot's Incubator 7 Program and is designed to accelerate the transition to commercial production.

It is a follow-on to the Tier 1 award given to Stion in February 2011. As part of Tier 1, Stion successfully advanced its technology into commercial prototype stage and produced tandem junction prototype modules at 18.8 percent aperture efficiency, the highest for any module prototype based on thin-film technology.

"We are extremely excited to continue working with DOE to help address America's critical need for clean, secure sources of energy", says Chet Farris, Stion's President & CEO. "Our progress on the tandem technology demonstrates that thin films can achieve industry-leading efficiencies on a scalable, low-cost production platform."

Stion's unique approach to thin film PV leverages proprietary materials and device expertise along with a robust, high-volume manufacturing process based on readily available, standardised equipment. Stion began shipments of products in March based on its single junction CIGSSe technology, and has produced commercial modules with as high as 15.6 percent aperture efficiency.

The tandem junction module would increase efficiency by enabling broader and more effective harvesting of available light using an additional thin film device. It utilises mechanically stacked top and bottom devices to eliminate the design and manufacturing challenges associated with traditional junction integration, and maintains the same glass / glass packaging design as Stion's current commercial modules.

Semprius to provide III-V solar modules for U.S. DoD

The III-V solar cells will be used in the 200 kilowatt system at Edwards Air Force Base in 2013

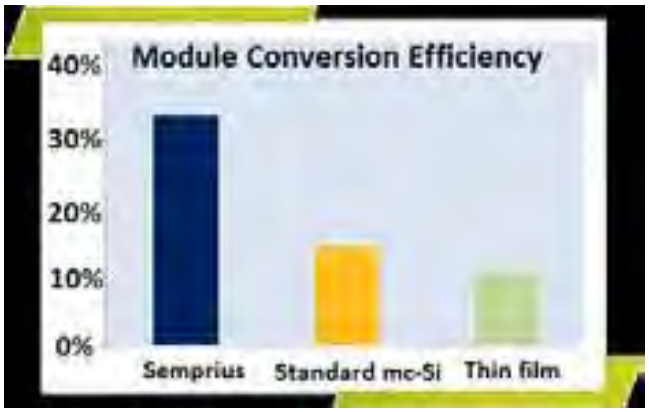
Semprius will be providing its technology to Pratt & Whitney Rocketdyne's (PWR's) $2.3 million award from the Environmental Security Technology Certification Program (ESTCP) office of the U.S. Department of Defence (DoD).

Semprius modules use III-V multi-junction solar cells and the design means they dissipate heat better and run cooler. This enables the modules to outperform traditional silicon and thin-film modules in hotter climates.

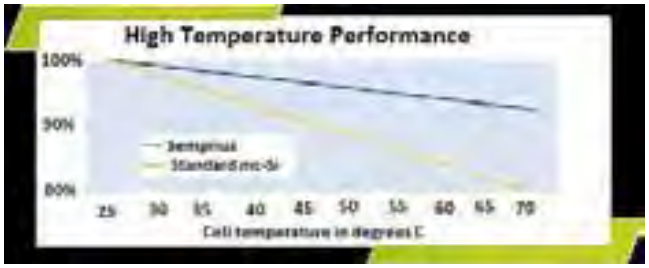
The project is designed to demonstrate the high-performance and cost-effectiveness of HCPV technology for use at DoD installations as well as in other commercial and utility scale applications.

As part of the project, PWR will install a 200 kilowatt (kW) solar system at Edwards Air Force Base in California. The system will comprise 2,400 Semprius modules mounted on dual-axis trackers and will produce over 400,000 kWh of electricity annually, enough to power approximately 40 homes.

Semprius' manufacturing facility, located in Henderson, North Carolina, uses a proprietary process to deliver the world's highest efficiency solar modules. At 33.9 percent, Semprius says its modules are the first to convert over one-third of the sun's energy into electricity.



What's more, Semprius modules perform better than conventional modules under high temperature conditions, and in locations like the U.S. Southwest, Semprius says its systems can deliver up to 30 percent more energy than equivalent PV systems, as illustrated in the graph below.



"We are honoured to be working with PWR to deliver our HCPV modules to the DoD," says Joe Carr, CEO of Semprius. "We believe that our technology will play an increasingly important role in delivering cost-competitive, sustainable energy."

Semprius and PWR, part of United Technologiies began working together in 2011 to demonstrate Semprius' technology at the University of Alabama-Huntsville. Over the past 18 months, the companies have collaborated to scale-up the technology into a cost-effective, commercial-grade system.

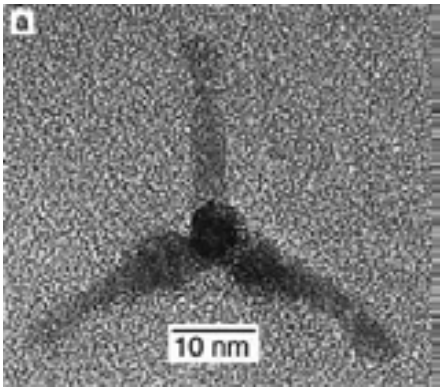
"Having spent several years evaluating emerging PV technologies, we've selected Semprius because of the potential of their technology to drive down the cost of solar electricity significantly," says Randy Parsley, Renewable Energy Program Manager at PWR. "We look forward to executing this project with Semprius to help the DoD begin to achieve its energy independence and energy security goals."

U.S. grants QMC tetrapod quantum dot synthesis patent

The patent, regarding a green method of manufacturing II-VI quantum dots, will provide precise control of both QD shape and dimension during synthesis

Quantum Materials Corporation, Inc. (QMC) has been granted the USPTO patent of a fundamental disruptive technology for synthesis of Group II-VI inorganic tetrapod quantum dots.

The patent, "Synthesis of Uniform Nanoparticle Shapes with High Selectivity," invented by Michael S. Wong's group at William Marsh Rice University, Houston, Texas, gives precise control of both QD shape and dimension during synthesis and is adaptable to quantum dots production of industrial scale quantities.



QMC II-VI tetrapod quantum dot

The new synthesis is a greener method using surfactants as would be found in laundry detergent instead of highly toxic chemicals used during industry standard small batch synthesis.

QMC has acquired the exclusive worldwide license for this patent and its wholly owned renewable energy subsidiary, Solterra Renewable Technologies, has the same rights specific to QD Solar Applications.

QMC recently announced a high quantum yield of 80 percent for a new class of tetrapod QD synthesised with this patented process.

According to a new market research report, "Quantum Dots (QD) Market – Global Forecast & Analysis (2012 – 2022)" published by MarketsandMarkets, the total market for Quantum dots is expected to reach $7.48 billion by 2022, at a CAGR of 55.2 percent from 2012 to 2022.

The Rice University QD synthesis produces the same-sized tetrapods, in which more than 92+ percent are full tetrapods, with a similar high degree of process control over QD shape, size, uniformity, and selectivity. The synthesis is applicable to a wide range of mono and hybrid Group II-VI tetrapod QD with/without shell and can optimise specific characteristics by modifying process parameters.

Across the broader QD industry however, other companies have been striving to increase production, but none have predicted scaling quantum dot production remotely close to multiple kilograms per day.
QMC's development of breakthrough software-controlled continuous flow chemistry process allows scaling of tetrapod quantum dot production to 100kg/day. Increasing production will transform tetrapod quantum dots from a novelty to a commodity, available across industries and applications where prior limited availability and high prices restricted product development.

For example, 100kg daily QD production can support a QD Solar Cell Plant producing one Gigawatt/year of R2R flexible QD solar cells at an industry competitive .75 cents/Watt at the start.

Tetrapod QDs are claimed to offer inherent advantages over spherical QDs including higher brightness, and more colours, the use of less active material (QDs) for any application, higher photostability and therefore longer lifetime; which together more than justify their product development.

OLEDs, for example, share design architecture similarities and would not require entirely new research to adapt to TQD-LEDs. Spherical quantum dots, at the low price of $2000/gm. are 30 times more expensive than gold today.

Until now, it has not been economically feasible to commercialise QD applications due to their high cost, which stems from the difficulty of small batch manufacture, the inability to produce uniform, same size QD from batch to batch, and to promise a reliable, timely supply.

Over the last half dozen years university and corporate quantum dot research has increased dramatically and there are ready QD applications that may now be "business planned" for joint ventures or possible licensing with QMC and Solterra Renewable Technologies.

Stephen B. Squires, CEO and President of Quantum Materials Corporation, Inc. and Solterra Renewable Technologies, Inc., says, "With the granting of the US Patent, tetrapod quantum dots are well positioned to revolutionise several industries in offering dramatic performance at cost effective levels."

"While the technology has been under review, we have continued to execute our vision to establish global manufacturing centres and strategic partnerships for creating dramatic value in our companies."

Squires continues, "We are excited to continue our business plan with the IP protection offered by the granted allowances. Adoption of quantum dots will result in new classes of products with advanced features, improved performance, energy efficiency, and lower cost."

Art Lamstein, Director of Marketing for QMC and SRT adds, "The timeline is moved forward to present day and market forecasts will need be rewritten for quantum dot based renewable energy, photovoltaics, biotech diagnostic assays, drug delivery platforms, theranostic cancer and other biomedicine treatments, QD-LED and

opto-electronic devices, photonics, low power SSL lighting, batteries, fuel cells, thermo-QD applications, quantum computing, memory, and conductive inks (to name a few)."

Ascent Solar reveals latest portable EnerPlex charger

The CIGS based EnerPlex Kickr IV allows consumers to transform the way they charge and use electronics in their everyday lives

Ascent Solar Technologies, a manufacturer of state-of-the-art, flexible thin-film photovoltaic modules, has launched its newest consumer product, the EnerPlex Kickr IV.

Ascent Solar Kickr IV charger

The EnerPlex Kickr IV is a rugged, lightweight and compact solar charging solution, ideal for a day at the beach, a week in the backcountry, a picnic in the park or even placed on the dashboard driving to work. The durable and lightweight attributes of the product set it apart from competitors using traditional rigid, heavy and fragile crystalline-based solar panels.

Victor Lee, Ascent's President & CEO, says, "The EnerPlex Kickr IV brings to consumers the ability to transform the way they charge and use electronics in their everyday lives. EnerPlex Kickr IV users no longer need to be on lookout for the nearest outlet, or plan their day around a phone's battery life."

In support of the ongoing relief efforts being conducted along the East Coast in the wake of Superstorm Sandy, Ascent Solar has pledged 10 percent of revenues, through the end of the year from its EnerPlex product line to support the American Red Cross as they help families recover from this devastating tragedy.

Lee continues, "We are saddened by the devastating effects of Superstorm Sandy, but are encouraged by the support and efforts of friends, neighbours and families as all help to recover from this tragedy. We at Ascent feel thankful that we have the opportunity to help the American Red Cross in their support and recovery efforts."

Novel process can improve quantum dots for solar cells

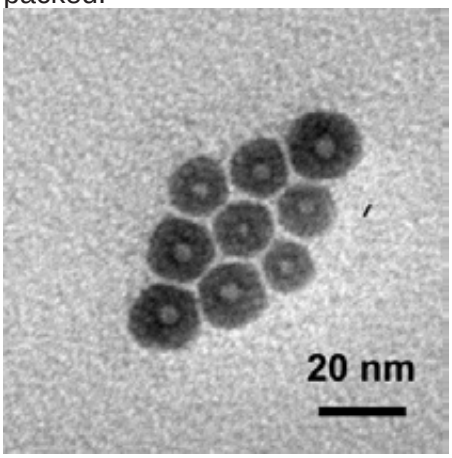
Using a novel molten droplet method to make lava dots out of zinc sulphide, cadmium sulphide and zinc selenide, hollow particles can exceed some performance metrics of quantum dots in a solar-cell test device

Serendipity proved to be a key ingredient for the latest nanoparticles discovered at Rice University.

The new "lava dot" particles were discovered accidentally when researchers stumbled upon a way of using molten droplets of metal salt to make hollow, coated versions of a nanotech staple known as quantum dots.

The results appear online this week in the journal Nanotechnology.

The researchers also found that lava dots arrange themselves in evenly spaced patterns on flat surfaces, thanks in part to a soft outer coating that can alter its shape when the particles are tightly packed.



A nine-pack of lava dots created at Rice (Photo by

Sravani Gullapalli)

"We're exploring potential of using these particles as catalysts for hydrogen production, as chemical sensors and as components in solar cells, but the main point of this paper is how we make these materials," says co-author Michael Wong, professor of chemical and biomolecular engineering at Rice.

"We came up with this 'molten-droplet synthesis' technique and found we can use the same process to make hollow nano-size particles out of several kinds of elements. The upshot is that this discovery is about a whole family of particles rather than one specific composition."

Like their quantum dot cousins, Rice's lava dots can be made of semiconductors like cadmium selenide and zinc sulphide.

Wong's lab has been working steadily to improve the synthesis of quantum dots for more than five years.

In 2007, Wong's team discovered a cleaner and cheaper way to synthesise four-legged quantum dots - particles smaller than a living cell that look like tiny versions of children's jacks. These "nanojacks," which are also called quantum tetrapods, can be used to harvest sunlight in a revolutionary new kind of solar panel.

The key step in the 2007 discovery was the use of a surfactant called CTAB.

In 2010 Rice graduate student Sravani Gullapalli was attempting to refine the "nanojack" synthesis even further when she discovered lava dots.

"This new chemistry to make the tetrapods was fairly cheap, but we were looking for an even cheaper way," Wong said. "Sravani said, 'Let's get rid of this expensive phosphorus surfactant and just see what happens.' So she did, and these little things just popped out on the electron microscope screen."

When sitting by themselves, lava dots appear round, but their soft outer shells flatten when they are packed near one another. (Graphic by Sravani Gullapalli)

Wong recalled the team's initial surprise. "We said, 'What is going on here? How do you go from four-legged nanojacks to these little balls?'"

He said it took the team more than a year to decipher the unusual formation mechanism that yielded the hollow, soft-shelled particles.

To make the particles, Gullapalli added three kinds of solid powder - cadmium nitrate, selenium and a tiny amount of CTAB - to an oil solvent. She then slowly heated the mixture while stirring. The cadmium nitrate melted first and formed tiny nanodroplets that cannot be seen with the naked eye.

"Nothing happens until the temperature continues to rise and the selenium melts," Gullapalli said. "The molten selenium then wraps around the cadmium nitrate droplet, and the cadmium nitrate diffuses out and leaves a hole where the droplet once was."

She said the cadmium selenide shell surrounding the hole is nanocrystalline and is enveloped in a soft outer shell of pure selenium.

When Gullapalli examined the lava dots with a transmission electron microscope, she found them to be bigger than standard quantum dots, about 15-20 nanometres (nm) in diameter. The holes were about 4-5 nm in diameter.

She also noticed something peculiar. When sitting by themselves they appeared round, and when tightly packed, the shell appeared to become compressed, even though neighbouring dots never came into actual contact with one another.

"That's one of the twists to this weird chemistry," Wong said. "The solvent forms its own surfactant during this process. The surfactant coats the particles and keeps them from touching each other, even when they are tightly packed together."

Wong's team later found it could use the molten droplet method to make lava dots out of zinc sulphide, cadmium sulphide and zinc selenide.

"We found that the hollow particles met and even exceeded some performance metrics of quantum dots in a solar-cell test device, and we're continuing to examine how these might be useful," Gullapalli concluded.

The research was supported by the Shell Centre of Sustainability at Rice University and SABIC Americas.

Georgia Tech-CNRS to grow nitride alloys with Aixtron reactor

The 3 x 2-inch CCS tool will be used to grow nitride R&D materials for light emitting sources, solar cells and sensors

Aixtron's existing customer, UMI Georgia Tech-CNRS in Metz, France, has ordered a new MOCVD system from the firm.

The 3 x 2-inch Close Coupled Showerhead (CCS) system will be dedicated to the growth of nitride alloy R&D materials for light emitting sources, solar cells, sensors and other applications.

Aixtron Europe's service support team has installed and commissioned the new reactor in a dedicated cleanroom at the Georgia Tech-Lorraine campus in Metz.

3 x 2-inch Aixtron CCS reactor

According to Professor Abdallah Ougazzaden, Director of UMI Georgia Tech-CNRS, "We are very familiar with Aixtron MOCVD systems, so this was a straightforward decision to make. The CCS system perfectly matches our R&D plans in respect of GaN, InN, BN and related alloys for light emitting sources, solar cells, sensors and other applications, depending on how the semiconductor market evolves."

"We formed a strong relationship with Professor Ougazzaden in France and Professor Russell Dupuis from Georgia Tech in the US, both of whom have excellent teams covering all aspects of MOCVD nitride R&D," Aixtron's COO Bernd Schulte adds. "The Georgia Tech-CNRS International Joint Unit (UMI*) produces excellent scientific output and is actively involved in national and international research programs focusing on secure networks and innovative materials for optics and electronics."

The Georgia Tech-CNRS International Joint Unit, or "UMI", is an international research unit established between the Georgia Institute of Technology and CNRS (Centre National de la Recherche Scientifique) to further collaborative research in the fields of telecommunications and innovative materials.

Programs include optoelectronic techniques for signal encryption and secure transmission for optical and wireless systems, nonlinear optics, new materials and nanostructures for photonics and electronics, multifunctional materials, the ultrasonic characterisation of materials, and the development of new ultrasonic sensors.

XsunX gets set to demonstrate CIGSolar system

Having completed assembly of its CIGSolar TFPV solar cell system, the company is beginning to ready the system for customer demonstrations

XsunX, the developer of CIGSolar, a patent-pending solar cell manufacturing process, has recently completed the assembly of its baseline CIGSolar TFPV solar cell evaporation system.

The company is now fast tracking start-up, testing, and calibration of its new CIGSolar technology for customer demonstrations.

“With the successful completion of the system assembly, interested customers have been contacting us to schedule system demonstrations of the CIGSolar system,” says Tom Djokovich, CEO of XsunX, Inc. “We are as excited and eager as they are, so we are working with these customers to address their questions and schedule on-site meetings while preparing our CIGSolar evaporator for deposition demonstrations. Many of the potential customers are interested in the smaller footprint and cost-competiveness of our scalable system to service regional demand and employment goals.”

Worldwide demand for solar products continues to grow with new installations on track to reach about 30 GW in 2012 - that’s the equivalent of adding about twenty seven 1.1GW nuclear reactors. So while it is easy to see that solar power production continues to grow in impact and importance, the solar industry itself has been experiencing limitations to furthering cost reductions.

What’s more, the rapid pricing erosions over the last two years have left manufacturers with either negative operating margins or they have been forced out of business. The industry’s need, and the focus of CIGSolar TFPV cell evaporation technology, is to provide manufacturers a path to further cost reductions and an opportunity to restore operating margins.

The company’s technology, of which samples were certified delivering 15.91 percent average efficiency in testing conducted by NREL, utilises multi-small area thermal co-evaporation for rapid deposition of final-sized cells to better control the complex management of the CIGS layer deposition process.

The company’s method, unlike other CIGS manufacturing technology, begins and ends using individual thin stainless steel substrates matched in size to silicon cells for use as an alternative to silicon cells for existing module assembly lines.

In addition to providing for a smaller and more precise deposition environment, the CIGSolar process also helps to avoid performance losses experienced when cells are either cut from rolls of manufactured CIGS material or mismatched electrically in monolithic assemblies.

5N Plus opens recycling facility in Malaysia

The producer of specialty metals such as indium, gallium and germanium used in MOCVD growth, has also acquired 100 percent of MCP Metals (Shenzhen) Co., Ltd gallium refining facility

5N Plus’s new recycling Malaysian facility is now operational.

The facility which is located within the Kulim High Technology Park, one of Malaysia’s highest profile industrial areas for technological firms, was completed under budget.

Providing recycling services for solar cell manufacturers, the facility is expected to gradually increase its range of products and services to address broader requirements and capture opportunities in the South-Asian market.

The company has also acquired the remaining 50 percent ownership interest in the joint venture company MCP Metals (Shenzhen) Co., Ltd, a gallium refining facility located in Shenzhen, China.

“Expansion of our activities in Asia is part of our growth strategy as we expect to see increasing demand for our products in this part of the world. Our Shenzhen and new Malaysian facilities will be instrumental in allowing us to leverage this demand and the corresponding business opportunities,” explains Jacques L’Ecuyer, President and Chief

Executive Officer of 5N Plus.

Novel multi-junction solar cell to rival III-Vs

Using multiple tiers of indirect bandgap semiconductors, such as silicon and germanium, it is claimed that efficiencies of 40 percent can be reached

Researchers at Ben-Gurion University of the Negev (BGU) in Israel have developed a radically new design for a concentrator solar cell.

When irradiated from the side, the module generates solar conversion efficiencies that rival, and may eventually surpass, the most ultra-efficient photovoltaics.

Practical implementation of the researcher's technique is limited to indirect bandgap semiconductors (including silicon and germanium), with a dramatic reduction in series resistance. This suggests that ultra-efficient operation at irradiance levels of thousands of suns is tenable. The result, in principle, rivals today's best multi-junction III-V cells.

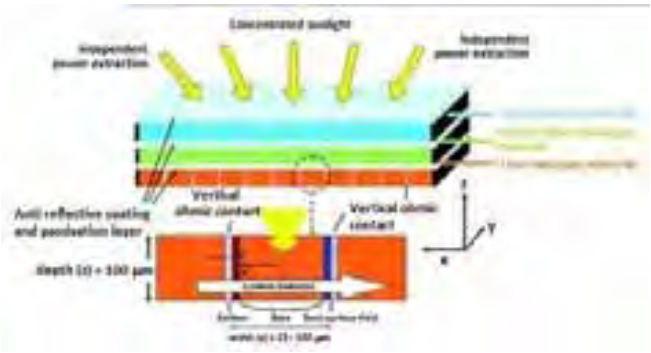
The new cell architecture developed at the David Ben-Gurion National Solar Research Centre at BGU, can exceed an ultra-efficient 40 percent conversion efficiency with intensities equal to 10,000 suns.

"Typically a concentrator solar cell comprises interdependent stacked materials connected in series, with significant associated fabrication difficulties and efficiency limitations," explains Jeffrey Gordon, a member of the Department of Solar Energy and Environmental Physics at BGU's Jacob Blaustein Institutes for Desert Research.

"Our new designs for concentrator photovoltaic cells comprise multiple tiers of semiconductor materials that are totally independent, and overcome numerous challenges in compiling the elements of even the most efficient solar cells," he says.

The BGU invention also demonstrates the distinctly new possibility of exploiting common materials, such as silicon, previously deemed unsuitable under highly concentrated solar radiation.

Tailoring the cells to edge (side) illumination reduces the cell internal resistance to negligible levels.



Structure of BGU solar cell

This increases the solar concentration levels at which cell efficiency peaks to up to 10,000 times ambient solar beam radiation, which is significantly higher than ever before.

"Our future depends on the development of alternative energies, and BGU is leading the way in this field," explains Doron Krakow, executive vice president of American Associates, Ben-Gurion University of the Negev (AABGU). "Prof. Gordon and his colleagues in BGU's Energy Initiative continue to bring new innovations that will impact our world for the better."

The new technology was recently detailed in the paper, "Multiple-bandgap vertical-junction architectures for ultra-efficient concentrator solar cells" by Avi Braun *et al* in *Energy & Environmental Science,* 2012,5, 8523-8527. DOI: 10.1039/C2EE22167E

Soitec takes another step forward in South Africa

The company has signed a power purchase agreement covering its soon to be built 44 MWp Touwsrivier power plant

Soitec has announced the signature of a power purchase agreement covering the electricity generated at the Touwsrivier power plant it is to build in South Africa.

This signature represents a decisive step for the project submitted by Soitec in connection with

the first call for projects from independent power producers (IPPs) launched by the South African Ministry of Energy for which Touwsrivier was pre-selected in December 2011.

Following the signature of the power purchase agreement, Soitec will now seek to refinance the project and launch the construction of the power plant.

Based in the Western Cape, close to the Aquila Private Game Reserve (in which Soitec has already built a pilot facility), the Touwsrivier power plant will ultimately have 44 MWp in capacity.

Construction is scheduled to be completed during 2014, but commercial operation of the first installed systems will begin in mid-2013.

Commenting on the agreement, Gaetan Borgers, Executive Vice President of Soitec's Solar energy division, says, "Approval of the power purchase agreement by the South African Ministry of Energy and its signature by national electricity supplier Eskom represent a major step forward in the expansion of our business in South Africa and generally worldwide. It reflects the suitability of our concentrating photovoltaic technology for very sunny regions. Thanks to our first-class ability to innovate and our industrial expertise, our modules boast a yield of close to 30 percent and a very long service life."

According to the Integrated Resource Plan (IRP2010) launched by the South African Department of Energy, about 42 percent of the electricity generated in the country will come from renewable resources in 2030. The IPP program calls for 3,725 MW in renewable energy capacity to be built, including 1,450 MW in photovoltaic power. 18 solar photovoltaic projects (out of 28 renewable projects) were selected after the IPP first bid submission.

Summing up, André-Jacques Auberton-Hervé, Chairman and Chief Executive Officer of Soitec, adds, "We are very pleased and honoured that our Touwsrivier project is one of the first to have been selected by the South African Department of Energy. Our concentrating photovoltaic technology can be used to harness an immediately available, renewable and carbon-free energy source. The fact we are able to take aspects of local content into account is another key point of our approach. The South African government is pursuing an ambitious energy policy and should be commended for doing so. I am delighted that we can help it to achieve its targets."

Soitec's products include substrates for microelectronics (most notably SOI: Silicon-on-Insulator) and concentrator photovoltaic systems (CPV). The company's core technologies are Smart Cut, Smart Stacking and Concentrix, as well as expertise in epitaxy.

Ascent Solar climbs higher with U.S. Air Force funding

The firm's new copper-indium-gallium-diselenide technology should benefit products that operate at higher temperatures

Ascent Solar Technologies has been selected for an Air Force Small Business Innovative Research (SBIR) Phase 2 award.

The reason for the award is to demonstrate a next-generation photovoltaic product that builds upon Ascent's flexible monolithically integrated CIGS technology.

Subject to contract finalisation, the Air Force SBIR Phase 2 program is expected to run 24 months with a program value of up to $750,000.

"Solar cells perform best at lower temperatures, but they can get hot during normal operation," states Victor Lee, President and CEO at Ascent Solar Technologies, Inc.

"Modifying our existing technology can improve its performance at higher temperatures. This Air Force program builds upon significant work already conducted by our team in this area. After program completion, we envision a new product that will perform over 30 percent better under some operating conditions that utilise process modifications that can be used in our existing manufacturing line," concludes Lee.

IHS: Thailand & Indonesia to drive SEA PV market

Total cumulative photovoltaic installations in Southeast Asia are forecast to reach almost 5GW by 2016

IMS Research has analysed the PV markets in Thailand, Malaysia, Indonesia, Vietnam, Singapore and the Philippines.

The firm's new report reveals that the region will grow at 50 percent per year on average over the next five years. This provides an attractive market for the ailing suppliers in Europe.

Installations have previously been dominated by Thailand. However, other regions are also forecast to quickly account for a significant share of the market.

IMS' new report, "The PV Market in South East Asia" indicates that although the region accounted for less than one percent of global installations in 2011, its share will increase by more than four times by 2016. Annual Installations are forecast to grow by 50 percent a year on average for the next five years and exceed 1GW by 2015.

PV relates to a number of material systems. Apart from silicon based materials, photovoltaics include CdTe, CiGS and III-V multi-junction solar cells.

In recent years, Thailand has accounted for the majority of installations in the region and will be the fifth largest market in Asia in 2012 (after China, Japan, India and Australia). Rapid growth in Thailand has been driven by the attractive 'adder' incentive scheme which has resulted in several large ground-mount systems being completed.

However, a new incentive scheme to promote smaller roof-top systems is expected in 2013. As a result, the market share of utility-scale systems in Thailand is forecast to fall by 25 percent by 2016.

The PV market in Southeast Asia is forecast to diversify significantly in the future. "Although the market is currently dominated by Thailand, a number of countries within the South East Asia region have huge potential for PV and offer significant opportunities to suppliers, and these will account for a growing share of the market in the future," says Jessica Jin, PV market analyst at IMS Research.

"Given its substantial and quickly growing need for electricity, the small amount of the population that currently have access to electricity, and its reliance on diesel generators on its thousands of islands, PV is an highly attractive solution for providing distributed electricity sources in Indonesia."

The report predicts that Indonesia will be the fastest growing market in the region installing close to 1GW of PV over the next four years, with off-grid systems set to account for a significant share of this.

The report also indicates the region is home to some large manufacturing facilities for Western PV cell and module manufacturers. These manufacturers do not hold a significant market share, and five of the largest PV module suppliers to the region were found to be Chinese or Japanese manufacturers. In contrast, the majority of the largest system integrators were headquartered locally.

Researched by IMS Research's analyst team located in Asia, the "PV Market in South East Asia" report was published on 29th October. It contains detailed analysis and forecast for installations and the PV module and inverter supply chain in the region.

Opel enlists consultant to advance its POET technology

The firm aims to use the veteran's expertise to market its III-V compound semiconductor solar technology

Opel Technologies has appointed Lee Shepherd as Vice President of Technology.

This became effective on October 26th, 2012.

Shepherd joins Opel as a consultant through his wholly owned firm of IT Millwrights Corporation of Kanata, Ontario.

Lee Shepherd brings his expertise to assist the special committee of the Board which was

established to drive the monetisation efforts of the POET platform technology of Opel's ODIS Division.

"Opel has revitalised the Company's direction so that the core component of the strategy is to continue developing the POET platform," says Peter Copetti, Executive Director of the Board. "We welcome Lee Shepherd; he joins our team to provide his guidance on POET's roadmap and assisting in ultimately marketing the technology as expeditiously as possible," Copetti adds.

Shepherd has over 25 years of experience in business, technical, and military leadership roles. He has spent the last 18 years in the Telecommunications/Information Technology industry serving in technical, management, product architecture, engineering program management, technical sales, merger and acquisition leadership, and entrepreneurial roles of ever-increasing scope and responsibility.

A company owned by Shepherd entered into a consulting agreement with Opel ; his company will provide the consulting services for a term of one year and be paid a consulting fee not exceeding $10,000 per month.

He was also granted a stock option to purchase 500,000 shares at an exercise price of $0.43 per share, expiring on October 26th, 2017. The price was determined as yesterday closing trading price on the TSX Venture Exchange. The options vest 25 percent immediately and 25 percent every six months thereafter.

Opel, through ODIS, designs III-V semiconductor devices for military, industrial and commercial applications, including infrared sensor arrays and ultra-low-power random access memory.

The company has 37 patents issued and 13 patents pending, primarily for its semiconductor POET process, which enables the monolithic fabrication of integrated circuits containing both electronic and optical elements, with potential high-speed and power-efficient applications in devices such as servers, tablet computers and smartphones.

Upgrading equipment should help solar panel makers to survive

Companies need innovative tools to differentiate from their cheaper Chinese rivals. Cadmium telluride, CIGS and silicon cell manufacturers currently have an overcapacity of 82 percent

Reeling from a glut of production capacity, makers of solar panels need to acquire innovative production equipment.

According to Lux Research, solar firms need to do this in order to cut costs, increase margins, and offer differentiated products.

This year, global capacity utilisation is at 55 percent for crystalline silicon (x-Si) module production, 70 percent for CdTe and 80 percent for CIGS. Consequently, cell and module manufacturers are turning to core product differentiation to revamp margins and fend off low-cost Chinese competition.

"Across the industry there is recognition that innovation is needed to survive a shakeout," says Fatima Toor, Lux Research Analyst and the lead author of the report titled, "Turning Lemons into Lemonade: Opportunities in the Turbulent Photovoltaic Equipment Market." "Equipment suppliers have a vital role to play in enabling that innovation."

Lux Research analysts examined the PV production equipment landscape to identify opportunities for innovation.

In CIGS, standardisation is key. CIGS thin-film PV relies on custom equipment today. However, off-the-shelf tools and improved throughput will drive higher efficiencies, performance and yield - lowering capex and helping manufacturers attain scale and competitive production costs.

New cell designs lead to equipment upgrades. Emerging cell designs, such as selective emitter and heterojunction with intrinsic thin layer present potential for high efficiencies. However, they require new tools, and as a result, 60 percent to 70 percent of new equipment sales are for cell production equipment.

There's also an opportunity to reduce silicon costs. Using direct solidification and epitaxial silicon eliminate the need for wafer sawing. What's more, emerging quasi-monocrystalline silicon ingot growth enables 40 percent cheaper c-Si wafers.

First Solar cadmium telluride panels to power up Dubai

The 13 MW project is phase one in UAE's planned 1GW Mohammad Bin Rashid Al Maktoum Solar Park

First Solar has been selected by the Dubai Electricity & Water Authority (DEWA) to construct a 13 megawatt (MWDC) solar photovoltaic (PV) power plant in Seih Al Dahal.

The location is approximately 50 kilometres south of Dubai.

Under the terms of the agreement, First Solar will provide engineering, procurement and construction services, as well as its CdTe thin-film PV modules.

The 13MW solar PV power plant is the first phase of the landmark Mohammad Bin Rashid Al Maktoum Solar Park. Named after the leader of the Emirate of Dubai, the AED 12 billion (US$3.27 billion) project is expected to eventually cover 48 square kilometres and produce 1,000MW of clean energy for the nation's capital using both PV and solar thermal technology.

"The PV plant installation is a key step in the implementation of the energy diversification strategy adopted by the Supreme Council of Energy, in which solar energy is set to become part of Dubai's energy portfolio. The strategy is based on Dubai's growing energy requirements and aims to maintain security of supply in the Emirate of Dubai," says HE Saeed Mohammed Al Tayer, MD & CEO of DEWA.

"We are delighted that DEWA has chosen First Solar to build the first phase of this flagship project, which illustrates our strategy to provide comprehensive solar power plant solutions in sustainable markets," says Jim Hughes, CEO of First Solar. "We commend His Highness for his vision in promoting a path toward a sustainable future for Dubai that preserves natural resources, reduces pollution and serves the Emirate's rapidly growing power needs."

The 13MW power plant is expected to generate more than 22 million kilowatt hours of electricity per year, on average, enough to meet the average annual electricity needs of more than 500 local households.

Electricity generated by the power plant on average will displace more than 14,000 metric tons of CO2 annually, equivalent to removing 1,600 cars from the road every year.

The solar park is to be implemented by Dubai's Supreme Council of Energy (SCE) and managed and operated by DEWA, the state-owned power company, as part of the Dubai Integrated Energy Strategy 2030.

First Solar recently opened an office in Dubai and is in an advanced stage of establishing an office in Saudi Arabia too.

First Solar to launch Operations Centre

The advanced O&M capabilities should optimise output, revenue and grid integration for customers of the cadmium telluride panel manufacturer

First Solar is launching a global Operations Centre.

The facility is a centralised monitoring and control centre where power plants, operations and maintenance (O&M) programs can be monitored, operated and connected to utility and customer networks.

The Operations Centre combines First Solar's power prediction and analytical capabilities with its diagnostics and plant controls. The main aims of the centre are to maximise power output and minimise maintenance costs for the firm's customers.

It also aims to enable the world's largest solar photovoltaic power plants to integrate seamlessly with the electrical grid and contribute to grid stability.

First Solar's global Operations Centre is a centralised monitoring and control centre where power plants can be remotely monitored, operated and connected to utility and customer networks

The new, second-generation Operations Centre, located in Mesa, Arizona is fully compliant with North American Electric Reliability Corporation (NERC) standards.

It is designed to be scalable to accommodate the growing global fleet of PV power plants in First Solar's O&M program.

First Solar currently operates 14 plants with 460 megawatts (MW) of peak generating capacity. The company says this will increase to 23 plants with 850 MW of capacity by the end of this year and 27 plants with 2,200 MW of capacity in 2013.

The Operations Centre and its staff maximise power plant availability and reduce costs for customers by preventing potential problems from occurring and quickly and efficiently fixing those that do.

The Operations Centre collects and processes a wide range of real-time power plant data. These include electrical performance, equipment status and weather data. These are monitored and analysed against key performance and operational parameters.

Automated data analysis detects issues in the plants and automatically dispatches maintenance crews to resolve them, and proprietary algorithms, developed using years of O&M data enable the system to predict potential issues and schedule preventive maintenance before a problem occurs.

A key feature of First Solar's power plant design is its advanced plant controls, which are critical for managing grid reliability and stability and can be controlled remotely from the Operations Centre.

Features include ramp-rate control, which limits how fast a power plant's output increases or decreases in order to minimise grid disruption; ride-through capability, which enables a power plant to operate through faults and other grid disturbances.

Other advantages include active power control, which ca

n be used to modulate power output and frequency droop control, which enables a power plant to provide critical grid support when grid frequency is changing.

These tools have become increasingly important as more solar generating capacity is connected to the grid.

"Our years of experience and investment have enabled us to build a proprietary system that allows us to optimise our customers' power plants to produce the maximum amount of energy and revenue under their power purchase agreements while minimising costs and risk," says Bob Callery, Vice President of O&M. "The vast quantity of data we gather also gives us invaluable insight into the real-word performance of our products and supports the continuous improvement of our power plants."

"Predictability and reliability have become increasingly critical to utilities and grid operators as large-scale renewable power plants are connected to the grid," continues Mahesh Morjaria, Vice President of Global Grid Integration.

"First Solar has invested considerable time and resources to ensure our power plants integrate seamlessly into the grid and provide features that not only avoid disruptions, but also can help to actively mitigate disruptions elsewhere on the grid."

Advancing spintronics with ferromagnetic GaAs

By doping gallium arsenide with manganese, researchers have unlocked some ferromagnetic secrets of promising materials for computing

Spintronic technology promises to revolutionise the computing industry with smaller, faster and more energy efficient data storage and processing.

In spintronics, data is processed on the basis of electron "spin" rather than charge.
Materials drawing much attention for spintronic applications are dilute magnetic semiconductors. These are normal semiconductors incorporating a small amount of magnetic atoms to make them ferromagnetic.

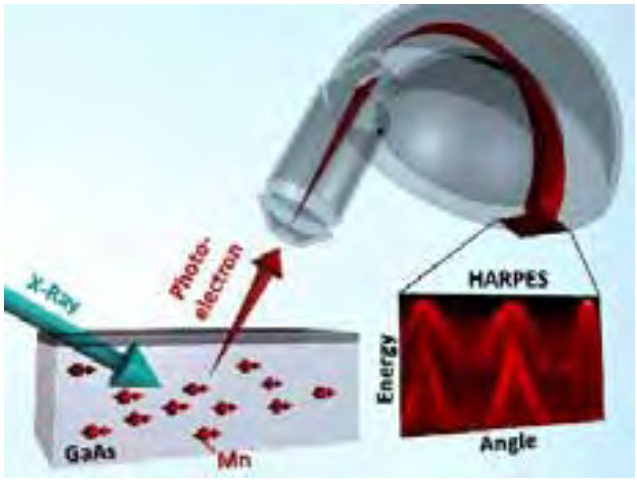
Understanding the source of ferromagnetism in dilute magnetic semiconductors has been a major road-block impeding their further development and use in spintronics.

Until now.

Now researchers at Berkeley Lab say they have made a significant step forward in removing this road-block.

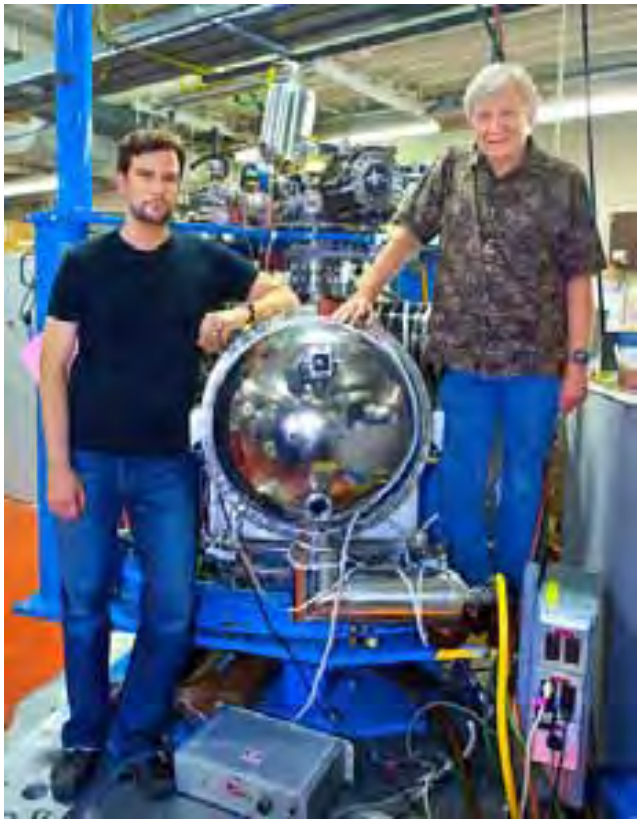
The multi-institutional collaboration of researchers led by scientists at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), have used a new technique called HARPES. This stands for Hard x-ray Angle-Resolved PhotoEmission Spectroscopy.

The scientists used the technique to investigate the bulk electronic structure of the prototypical dilute magnetic semiconductor gallium manganese arsenide (GaMnAs). Their findings show that the material's ferromagnetism arises from both of the two different mechanisms that have been proposed to explain it.



With the HARPES technique, a beam of x-rays flashed on a sample causes photoelectrons from within the bulk to be emitted. Measuring the kinetic energy of these photoelectrons and the angles at which they are ejected reveals much about the sample's electronic structure. Here the manganese (Mn) atoms in GasMnAs are shown to be aligned ferromagnetically, with all their atomic magnets pointing the same way. (Image from Alex Gray)

"This study represents the first application of HARPES to a forefront problem in materials science, uncovering the origin of the ferromagnetism in the so-called dilute magnetic semiconductors," says Charles Fadley, the physicist who led the development of HARPES. "Our results also suggest that the HARPES technique should be broadly applicable to many new classes of materials in the future."



Alexander Gray (left) and Charles Fadley at Beamline 9.3.1 of Berkeley Lab's Advanced Light Source where they are now carrying out HARPES experiments. (Photo by Roy Kaltschmidt, Berkeley Lab)

Fadley, who holds joint appointments with Berkeley Lab's Materials Sciences Division and the University of California (UC) Davis is the senior author of a paper describing this work in the journal *Nature Materials*.

For the semiconductors used in today's computers, tablets and smart phones, once a device is fabricated it is the electronic structures below the

surface, in the bulk of the material or in buried layers, that determine its effectiveness.

HARPES, which is based on the photoelectric effect described in 1905 by Albert Einstein, enables scientists to study bulk electronic effects with minimum interference from surface reactions or contamination.

It also allows them to probe buried layers and interfaces that are ubiquitous in nanoscale devices, and are key to smaller logic elements in electronics, novel memory architectures in spintronics, and more efficient energy conversion in photovoltaic cells.

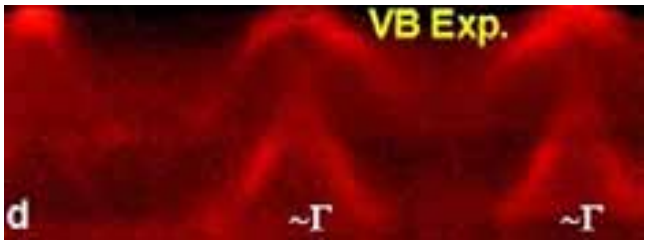
"The key to probing the bulk electronic structure is using hard x-rays, which are x-rays with sufficiently high photon energies to eject photoelectrons from deep beneath the surface of a solid material," says Gray, who worked with Fadley to develop the HARPES technique.

"High-energy photons impart high kinetic energies to the ejected photoelectrons, enabling them to travel longer distances within the solid. The result is that more of the signal originating from the bulk will be detected by the analyser."

In this new study, Gray and Fadley and their collaborators, used HARPES to shed important new light on the electronic bulk structure of gallium manganese arsenide.

As a semiconductor, GaAs is second only to silicon in widespread use and importance. If a few percent of the gallium atoms in this semiconductor are replaced with atoms of manganese the result is a dilute magnetic semiconductor. Such materials would be especially well-suited for further development into spintronic devices if the mechanisms behind their ferromagnetism were better understood.

"Right now the temperature at which gallium manganese arsenide operates as a dilute magnetic semiconductor is 1700 Kelvin," Fadley says. "Understanding the actual mechanism by which the magnetic moments of individual manganese atoms are coupled so as to become ferromagnetic is critical to being able to design future materials that would operate at room temperature."



HARPES data on GaMnAs indicate that the ferromagnetism of dilute magnetic semiconductors from two distinct mechanisms

The two prevailing theories behind the origin of ferromagnetism in GaMnAs and other dilute magnetic semiconductors are the "p-d exchange model" and the "double exchange model."

According to this model, ferromagnetism is mediated by electrons residing in the valence bands of GaAs whose influence extends through the material to other manganese atoms. The double exchange model holds that the magnetism-mediating electrons reside in a separate impurity band created by doping the GaAs with manganese. These electrons in effect jump back and forth between two manganese atoms so as to lower their energy when their ferromagnetic magnets are parallel.

"Our bulk-sensitive HARPES measurements revealed that the manganese-induced impurity band is located mostly between the GaAs valence-band maximum and the Fermi level, but the manganese states are also merged with the GaAs valence bands," Gray says. "This is evidence that the two mechanisms co-exist and both act to give rise to ferromagnetism."

Fadley adds, "We now have a better fundamental understanding of electronic interactions in dilute magnetic semiconductors that can suggest future materials with different parent semiconductors and different magnetic dopants. HARPES should provide an important tool for characterising these future materials."

Gray and Fadley conducted this study using a high intensity undulator beamline at the SPring8 synchrotron radiation facility in Hyogo, Japan. The plant is operated by the Japanese National Institute for Materials Sciences.

New HARPES studies are now underway at Berkeley Lab's Advanced Light Source (ALS) using

the Multi-Technique Spectrometer/Diffractometer endstation at the hard x-ray photoemission beamline (9.3.1).

More details of this work have been published in the paper, "Bulk electronic structure of the dilute magnetic semiconductor GaMnAs through hard X-ray angle-resolved photoemission," by Alexander Gray *et al* in *Nature Materials*. DOI :10.1038/nmat3450

This research was primarily supported by the DOE Office of Science.

Ascent Solar & CarTech drive battery charging forward

The two companies have collaborated to use Ascent's thin-film CIGS solar modules for automotive battery charging

Ascent Solar has announced the initial sale of SOLab Basic and SOLab Premium products, as branded by Ascent's joint development partner, CTC CarTech Company.

SOLab is an autonomous solar charger meant for automotive battery cycling & trickle charging.

Integrating Ascent's thin-film CIGS solar modules into SOLab Basic and SoLab Premium products is claimed to be the first of its kind of application for automotive battery charging solutions.

Sebastian Hotz, CarTech's Head of Sales Product Division, says, "With Ascent we found the best partner for delivering innovative products into the field of autonomous solar chargers for automotive professionals."

Hotz continues, "The production of thin film solar is highly innovative for our product and ideal to manufacture. Not only the functionality but also the product design from Ascent makes the product very unique."

Victor Lee, Ascent Solar's President & CEO, adds, "We are extremely pleased with these innovative products and are proud to be able to work closely with CarTech to bring them to market. These products are a good illustration of the multitude of applications that Ascent's unique technology can be utilised in."

Saint-Gobain CIGS to power up Saudi Arabia

The firm's copper indium gallium selenide modules are grown on a glass substrate, reducing costs as compared to polycrystalline silicon cells

Saint-Gobain has signed an M.O.U. with HRH Prince Faisal Bin Salman Bin Abdulaziz Al Saud, to set up a high-tech company in the solar energy sector in Saudi Arabia.

The signing ceremony was held in Torgau, Germany, where Saint-Gobain's Avancis affiliate operates one of the world's most modern thin film Photovoltaic (PV) module plants.

Under the terms of the memorandum, Saint-Gobain will provide technical assistance and engineering expertise to build and operate a CIGS thin film PV module manufacturing facility in KSA. This project is part of a larger program which includes the construction of solar power plants in the kingdom.

This strategic alliance will lay the foundation for other businesses in the field of solar. What's more, it will accelerate the development of solar power plants equipped with modules manufactured in Saudi Arabia using Avancis CIGS technology.

The solar electricity generated using sunlight could lead to a reduction in the consumption of crude oil.

Fully aligned with K.A.CARE's (King Abdullah City for Atomic and Renewable Energy) strategic priorities, this program will enable the development of a competitive manufacturing base in the kingdom.

K.A.CARE was established in April 2010 by Royal Decree and is in charge of developing nuclear and renewable energy in the Kingdom. It has set itself the target to install 41 GWp of solar power by 2032 - of which 16 GWp should be contributed by PV power generation.

"We are very honoured to work together with HRH Prince Faisal, leveraging our technology and

manufacturing expertise to make solar energy a competitive source of electricity for the Kingdom. The cost of the electricity produced in this way will have a very strong local content," comments Jean-Pierre Floris.

HRH Prince Faisal emphasises the Kingdom will benefit in two different ways as a result of this partnership. "On the one hand, it is going to result in an alternative and efficient way of producing electricity and on other hand, the introduction of very innovative technology to the Kingdom of Saudi-Arabia will be the outcome."

Based on depositing CIGS thin films on a glass substrate, the technology developed by Avancis avoids using traditional crystalline silicon, enabling low production costs, like other thin-film based techniques.

With its electrical efficiency of over 12 percent industrially and up to 20 percent in the laboratory, the technology is comparable to the higher yields produced by polycrystalline silicon modules. Easy-to-mount, attractive and reliable, CIGS thin-film based modules are suited to both solar fields and rooftop installations.

Emcore wins $5 million contract to power AMOS-6 satellite

The firm's III-V ZTJ solar cells will provide steerable Ku-band with Pan-European and Middle East coverage and broadband services in Africa and Europe

Emcore wins $5 million contract to power AMOS-6 satellite

Emcore Corporation has been awarded a solar panel manufacturing contract by ATK for the AMOS-6 commercial telecommunications satellite planned for launch in early 2015.

Solar panels populated with Emcore's most advanced ZTJ triple-junction solar cells will power the AMOS-6 spacecraft manufactured by Israel Aerospace Industries (IAI).

ZTJ solar cell structure

AMOS-6, operated by Spacecom, is to be co-located at the 4˚W orbital position with AMOS-2 and AMOS-3.

It will provide steerable Ku-band with Pan-European and Middle East coverage, and a Ka-band beam for broadband services in Africa and Europe.

The AMOS satellite fleet, beginning with the AMOS-1 in 1996, provides broadcasting and communications services to Direct-To-Home television operators, TV broadcasters and programmers, government and corporate organisations, and VSAT (Very Small Aperture Terminal) network operators.

ZTJ space solar panel

"We are excited about this opportunity to adapt our space-proven modular PUMA array, from GPS IIF and Orbital's Star2 GEO line, to provide power to IAI's AMOS-6 satellite for Spacecom," says Dave Messner, Vice President and General Manager of ATK Deployables business in Goleta, California.

"We look forward to delivering over 10kW of end-of-life power using Emcore's solar cell technology to enable another successful satellite mission."

"This is an important award for Emcore. The manufacture of the AMOS-6 solar panels will reinforce our heritage in the telecom satellite business and allow us to pursue future opportunities in that market," continues Brad Clevenger, General Manager of Emcore's Photovoltaics Division.

"Emcore greatly values our long-standing business

relationship with ATK, and we are extremely honoured to receive this award. We look forward to working with ATK on the AMOS-6 mission."

With a Beginning-Of-Life (BOL) conversion efficiency nearing 30 percent and the option for a patented, onboard monolithic bypass diode, Emcore's multi-junction solar cells provide very high power to interplanetary spacecraft and earth orbiting satellites.

Centrotherm submits reorganisation concept to court

If accepted, the CIGS innovator could then operate once again on the market as a reorganised company on a fully independent basis

centrotherm photovoltaics AG submitted its reorganisation and future concept as planned to the District Court of Ulm.

The concept is decisive for the future of the Group.

After being examined by the court, the insolvency plan will be presented to creditors in the next step, who will then decide on whether to accept it in a separate discussion and voting meeting.

"Our aim is maintain centrotherm as an independent company based on this plan and to guide it towards a successful future. Ultimately this would benefit everyone involved in the process," says the company's own administrator Tobias Hoefer.

The plan aims for the highest possible satisfaction of creditors. If it accepted by the creditors and confirmed by the court, the proceedings can be terminated in line with the regulations of the German Act Relating to the Further Simplification of the Reorganisation of Companies (ESUG), and the German Insolvency Directive (InsO).

centrotherm photovoltaics AG could then operate again on a solid basis on the market as a reorganised company and on a fully independent basis.

The same applies for the subsidiaries centrotherm thermal solutions GmbH & Co. KG and centrotherm SiTec GmbH, which are currently engaged in their own proceedings and for whom insolvency plans have also been submitted to the court on time.

Insolvency creditors of the named companies are able to register their receivables to the court-appointed administrator by November 5th in order that they participate in the continued process and are able to decide on the approval of the insolvency plans.

The court has appointed the lawyer Martin Hörmann from the anchor Rechtsanwälte legal firm, Ulm, as centrotherm photovoltaics AG's administrator. The lawyer Alexander Reus, also from anchor Rechtsanwälte, has been appointed administrator for the subsidiaries centrotherm thermal solutions GmbH & Co. KG and centrotherm SiTec GmbH.

First Solar branches out into Indonesia

The company will electrify Indonesia with its cadmium telluride solar panels

First Solar and PT. Pembangkitan Jawa Bali Services (PJB Services) of Indonesia have signed a memorandum of understanding (MOU).

The two firms will collaborate to deliver 100 MW of utility-scale solar power plants in Indonesia in order to address the growing energy demand in the country.

First Solar thin-film solar photovoltaic modules in a ground-mounted solar power plant

"Indonesia has an increasingly urgent need for reliable, cost-effective energy resources. The agreement with PJB Services facilitates an ideal collaboration to provide Indonesia with the needed solution," says Won Park, First Solar's Senior Manager of Business Development and Sales in Southeast Asia. "This MOU underscores First Solar's belief that the Indonesian market has great potential as a sustainable market where solar power can be a meaningful part of the energy mix."

The MOU is the first for First Solar in Indonesia and one of several related to the company's strategy of forging strategic alliances in fast-growing, sustainable energy markets worldwide. The MOU also represents the first foray into the development of utility-scale solar photovoltaic power plants for PJB Services, a leading provider of services for the operation and maintenance of conventional power plants in Indonesia, whose parent company is PJB, a subsidiary of Perusahaan Listrik Negara (PLN).

The MOU represents an initial step in the collaboration between the two companies toward the development, engineering, procurement, construction, operation and maintenance of an approximately 100 MW pipeline for solar PV power plants, including PV hybrid solutions, using First Solar's advanced thin-film CdTe PV modules and related system services and components.

"We are excited by the opportunity to collaborate with a world leader in solar energy for the development of utility-scale PV power plants in Indonesia," concludes Bernadus Sudarmanta, President of PJB Services. "Solar PV electricity can help Indonesia meet its fast-growing power needs while reducing its dependence on fossil fuels."

Solar Frontier CIS panels contribute to largest Mexico Installation

The firm's copper indium selenide panels will provide South America with 1.5 MWp of power

Solar Frontier has delivered 1.5 megawatt peak (MWp) of its CIS thin-film modules to a 5MW Iberdrola plant in Cerro Prieto, Mexico.

The Cerro Prieto project is owned by CFE, the state-owned electric utility company of Mexico.

It will be the largest PV installation in the country when it goes into production by the end of 2012. This project is the first for Solar Frontier in the rapidly growing North American market.

Iberdrola is combining Solar Frontier CIS technology with competing technology in this project. The hot climate and mounting on mono-axial trackers will highlight the advantages of Solar Frontier's lower temperature coefficient, which are valued for better performance in hotter conditions compared to crystalline silicon.

Iberdrola Ingenieria & Construcción Mexico S.A. de C.V. belongs to the Spanish group Iberdrola, one of the largest global energy suppliers, with extensive experience in renewable energy. Its goal by 2020 is to produce 20 percent less CO2 per kWh than the overall European electricity sector.

"This is a significant opportunity for Solar Frontier to strengthen its position in the regions served by Iberdrola to Iberdrola's high standards," says Wolfgang Lange, Managing Director, Solar Frontier Europe. "We are demonstrating to our most discriminating customers that CIS technology delivers more kWh over the lifetime of a project for a lower cost."

Solar Frontier suspends production at CIS MP2 facility

The firm is putting more resources into its copper, indium, selenium plant in Kunitomi

Solar Frontier will suspend production at its 60MW "MP2" solar module manufacturing plant as its 900 MW flagship Kunitomi plant continues to demonstrate improved performance.

The company is evaluating the role MP2 will play in opportunities to produce CIS solar products that are currently in development. The Kunitomi plant commenced commercial production in February 2011 and all lines at the plant were operational by July 2011.

The advanced plant now produces CIS solar

modules with efficiencies in the 13 to 14 percent range, delivering more kilowatt-hours per Watt than competing technologies.

The MP2 plant, which provided much of the knowledge base for the design efficiencies of Solar Frontier's Kunitomi plant, has operated since 2009. The MP2 facility is currently being evaluated for future opportunities to produce specialised solar modules being developed at Solar Frontier's Atsugi Research Centre for new and unique applications. Employees will transfer their skills from MP2 to the Kunitomi plant and to sales engineering roles.

"Solar Frontier's staff at the MP2 plant have done a tremendous job for the company," says Shigeaki Kameda, President of Solar Frontier. "They are a great resource of knowledge and expertise that will continue to help Solar Frontier grow. The Kunitomi plant is the largest solar module manufacturing facility in Japan, and Solar Frontier is the only solar panel manufacturer in the world with production exclusively in Japan. And with the heightened demand for solar in Japan, Solar Frontier is extremely well positioned with its combination of local manufacturing and skilled staff. Solar Frontier offers unique and significant advantages with made-in-Japan quality the world has come to trust."

"The knowledge base we have in our MP2 staff will contribute to Solar Frontier's progress beyond R&D and manufacturing," adds Atsuhiko Hirano, Solar Frontier Senior Vice President. "Solar Frontier is expanding on its leadership in the downstream market as part of its mission to deliver the most economical, ecological solar energy solutions on Earth."

XsunX's CIGS plant completion on target

The firm's recent expansion into a new CIGSolar marketing and technology demonstration facility is on the fast track completion schedule

XsunX is on target to complete the assembly of its CIGSolar TFPV cell evaporation system in October.

"CIGSolar" is the company's patent-pending solar cell manufacturing process offering a capital-efficient, low-cost alternative to the use of silicon solar cells.

The company has implemented a fast track completion schedule to expedite its technology demonstration and marketing efforts.

In July, XsunX announced receiving equity financing through Ironridge Energy, an institutional investor financing small cap public companies in the energy sector. The cash will enable the company to focus on assembling and configuring a demonstration of the CIGSolar TFPV cell evaporation system while also establishing technology marketing operations in its new facility in Irvine, California.

John C. Kirkland, Managing Director of Ironridge Global comments, "We are pleased to have had the opportunity to help facilitate the development of XsunX's unique TFPV cell evaporation system. The CIGSolar system offers the potential to improve operating efficiencies for the TFPV industry, and thereby assist in reducing our dependence on fossil fuels."

"The last few months have been a busy and exciting time for XsunX. We have been anxious to launch the start-up, testing, and calibration of our patent pending CIGSolar technology so that we can begin customer demonstrations as quickly as possible," adds Tom Djokovich, CEO of XsunX, Inc.

"The industry's obvious need and the focus of our CIGSolar TFPV cell evaporation technology, is to provide cost reductions and an opportunity to restore operating margins for manufacturers. How to achieve these goals has been an elusive challenge for the industry, but we believe that CIGSolar's new approach is the right solution to this challenge."

The company's method, unlike other CIGS manufacturing technology, uses individual thin stainless steel substrates sized to match silicon cells to be used as an alternative to silicon cells in existing or new solar module assembly lines.

Another significant improvement the company made is the use of a multi-small area thermal co-evaporation technology. This improves control of the complex management of the CIGS layer deposition process.

XsunX says this feature provides a more

precise deposition environment. Together, these improvements help to avoid performance losses experienced when cells are either cut from rolls of CIGS material or mismatched electrically in monolithic large area deposition assemblies.

"Some of our loyal customers have been working with us each step of the project, including monitoring our progress and assessing each of our milestones. They are very excited about the system's potential as we approach our start-up and preparation for demonstrations," says Joseph Grimes, COO of XsunX, Inc.

Western Australia switches on the power from First Solar

The firm's cadmium telluride modules will electrify the country's first large-scale solar project

Australia's first large-scale photovoltaic solar project has been officially switched on.

First Solar, Verve Energy and GE unit GE Energy Financial Services opened the 10-megawatt (MW) Greenough River Solar Farm near Geraldton, Western Australia.

Joined by WA Energy Minister Peter Collier, landholders, community members and contractors, the successful kick-off follows more than one year of planning, design, construction and testing.

"Today, the community is celebrating Australia's renewable energy future, and this is only the beginning. The Western Australia community has developed a genuine appetite for renewable energy, and today we are 10 megawatts closer to a cleaner energy future," said WA Minister of Energy Peter Collier.

"As the largest photovoltaic solar plant in operation in Australia, the Greenough River Solar Farm demonstrates that renewable technologies can contribute to meeting Australia's future energy needs on a sustainable, cost-competitive basis. This is a positive first step in validating the bright future that large-scale solar represents in Australia," added Jason Waters, CEO, Verve Energy.

"With this landmark project now complete, partners Verve Energy and GE Energy Financial Services are now evaluating the possibility of expanding the plant to up to 40 megawatts to satisfy growing demand for renewable energy."

The 10MW project is expected to generate enough solar energy to power 3,000 homes and displace 20,000 tonnes of greenhouse gases each year. The plant's output will be purchased by the WA Water Corporation to help offset the energy requirements of its Southern Seawater Desalination Plant.

This project marks GE Energy Financial Services' first renewable energy investment in Australia, adding to the company's global portfolio of more than US$8 billion committed worldwide for projects generating power from wind, solar, hydro, biomass, geothermal and other renewable sources.

"GE is one of the world's largest renewable energy investors and the Greenough River Solar Farm is just one example of the significant projects we can help turn into reality," noted Matt O'Connor, Managing Director at GE Energy Financial Services. "We see incredible investment opportunities in Australia and look forward to expanding on this successful project and applying our expertise to help the country's renewable energy market grow."

In addition to supplying over 150,000 of its advanced thin film PV modules and engineering, procurement and construction services for the plant, First Solar will provide operations and maintenance services for the next 15 years.

"First Solar is helping make large-scale solar power a reality in Australia," said Mark Widmar, First Solar Chief Financial Officer. "This landmark project provides a strong foundation for the long-term adoption of large-scale solar projects in the Australian power market. We are delighted to have partnered with local suppliers and contractors to deliver this project and to lead the development of a large-scale solar industry in Australia."

Western Australian state-owned power utility, Verve Energy, and GE Energy Financial Services each own 50 percent of the Greenough River Solar Farm, with the WA Government having provided A$20 (~ US $20.55) million in funding, including A$10 million from the WA Royalties for Regions program. No debt was raised to fund the project.

5N Plus subsidiary awarded $1.32 million for Ge substrates

The company will upgrade a portion of the NDS germanium metal inventory to unfinished germanium substrates to be used for multijunction solar cell production

5N Plus has announced that its 66.67% owned subsidiary Sylarus Technologies, LLC, has been awarded a US$1.32 million contract by the Defence Logistics Agency (DLA).

Sylarus will use the cash to upgrade a portion of the National Defence Stockpile (NDS) high purity germanium metal inventory to unfinished germanium substrates. These will be used in the manufacture of multijunction photovoltaic solar cells employed in National Security Space (NSS) applications.

Sylarus is the sole U.S. domestic space□qualified germanium substrate supplier to NSS customers, and says it is one of only two NSS□qualified germanium substrate suppliers worldwide.

The latest award brings the total Sylarus U.S. Government contract award value to over US$10 million.

The DLA award is strategic in nature as Sylarus now becomes part of the U.S. NDS for strategic materials. The company now believes it has the potential for a follow□on business, both as a strategic metal supplier and NDS inventory manager.

5N Plus manufactures purified metals such as gallium, germanium, indium, selenium and tellurium, used in the MOCVD growth of compound semiconductor wafers.

Power Electronics

TriQuint rases the bar in GaN reliability

The firm says its new process enables more robust, high-efficiency gallium nitride (GaN) RF devices

TriQuint believes it has achieved record-setting circuit reliability that exceeds previous industry standards.

The company's new GaN benchmark supports highly-reliable integrated RF solutions . TriQuint says its new devices use less power, are compact, and serve wide frequency ranges.

Any RF system can benefit from reduced maintenance and longer operational lifetimes arising from increased reliability. These include commercial and defence RF infrastructure, broadband communications, first-responder radios and space-based applications.

"We're pleased to announce this new GaN reliability milestone," says James L. Klein, Vice President and GM for Infrastructure and Defence Products. "The achievement supports our foundry services and helps us accelerate product development. We are delivering more products and services than ever before."

TriQuint's TQGaN25 process, qualified to operate up to 40 Volts, has achieved a mean time to failure of greater than 10 million hours at 2000C and greater than 1 million hours at 2250C.

This reliability milestone was achieved with TriQuint's newly-released Generation II 0.25µm GaN on SiC process utilised for GaN product solutions and Foundry Services.

TriQuint achieved its new GaN performance through in-house development programs. This new reliability also supports objectives of TriQuint's Defence Production Act (DPA) Title III contract that is funded by the Department of Defence Tri-Services laboratories including the U.S. Air Force, Army and Navy. TriQuint is also reducing manufacturing cycle

times and increasing yields while making other GaN enhancements that work hand-in-hand with DPA Title III goals.

All manufacturing enhancements are designed to support greater affordability of next-generation AESA (active electronically scanned array) radars, new EW systems and commercial applications. Defence systems currently in technology development phases have production planned for 2016-2020.

RFMD adds to its family of linear GaN power transistors

The gallium nitride transistors are optimised for broadband applications requiring linear back-off operation or reduced spurious performance

RF Micro Devices has production released two highly linear GaN RF unmatched power transistors (UPTs).
RFMD says the RFHA3942 (35W) and RFHA3944 (65W) deliver superior linear performance versus competing GaN transistors.

The release of the RFHA3942 and RFHA3944 follows the previous release of the RF393X series of UPTs targeting continuous wave (CW) and pulsed peak power applications.

This new series of linear GaN discrete amplifiers is optimised for broadband applications requiring linear back-off operation or reduced spurious performance. RFMD plans to further its technology with future releases of 10W and 95W linear GaN devices over the next 12 months, significantly expanding the GaN UPT options available to RFMD's customers.

RFMD's highly linear GaN UPTs target new and existing communication architectures requiring improved broadband linear performance in support of high peak-to-average modulation waveforms.

The RFHA3942 and RFHA3944 are tuneable over a broad frequency range (DC to 4GHz) and provide CW peak power of 35W and 65W respectively. They also offer high gain of 15dB and high peak efficiency of over 55 percent.
Using an IS95 9.8dB PAR signal tuned to 2.1GHz, the RFHA3942 achieves -43dBc adjacent channel power (ACP) at 34dBm POUT and the RFHA3944 achieves -54dBc ACP at 37dBm POUT.

What's more, the RFHA3942 and RFHA3944 offer high terminal impedance at the input and output of the package, enabling wideband gain and power performance advantages in a single amplifier. Both devices are packaged in a flanged ceramic two-leaded package that leverages RFMD's advanced heat-sink and power-dissipation technologies to deliver excellent thermal stability and conductivity.

Jeff Shealy, vice president and general manager of RFMD's Power Broadband business unit, says, "RFMD is very pleased to expand its GaN-based product portfolio, offering industry-leading linear power performance in support of diverse end markets."

" RFMD's GaN product portfolio clearly demonstrates our continued commitment to technology and product leadership, and we look forward to introducing additional GaN devices that feature superior power density, high efficiency, rugged dependability, and 'green' power consumption advantages," continues Shealy.

Samples and production quantities are available now through RFMD's online store or through local RFMD sale

Lake Shore electromagnet power supply for Hall Effect analysis

The rugged fault-tolerant design is optimised for large research-quality magnets

Lake Shore Cryotronics has launched the Model 648 electromagnet power supply, a robust, fault-tolerant 10 kW supply optimised for powering large 7-inch or 10-inch research electromagnets.

The Model 648 is suited to electromagnet characterisation systems used for a number of applications. These include Hall Effect studies and spin magnetic resonance demonstrations, used in the semiconductor industry.

The Model 648 electromagnet power supply is designed to be used with large electromagnets in high precision laboratory settings that require low electrical noise. Its linear design removes the undesirable higher frequency noise typical of many other switch mode power supplies.

The power supply's low output noise means researchers can obtain greater resolution and finer detail in results drawn from data taken during high sensitivity experiments. Eliminating the need for external switching or operator intervention to reverse current polarity, the Model 648 uses convenient bipolar, 4-quadrant operation, which provides clean transitions through zero without discontinuities.

Made to last, and to minimise down time, Lake Shore's built-in fault protection enables the system to survive direct shorts across the output without damage. Worry-free water cooling with zero internal connections eliminates the possibility of leaks and provides quiet, efficient operation compared to air-cooled supplies.

A unique safety interlock ensures that the cooling water is flowing to the supply while operating. Internal controls ensure efficient water management.

The Model 648 was designed for application convenience. Its high resolution programmed output current incorporates a proprietary digital-to-analogue converter that is monotonic over the entire output range and provides resolution of 1 mA.

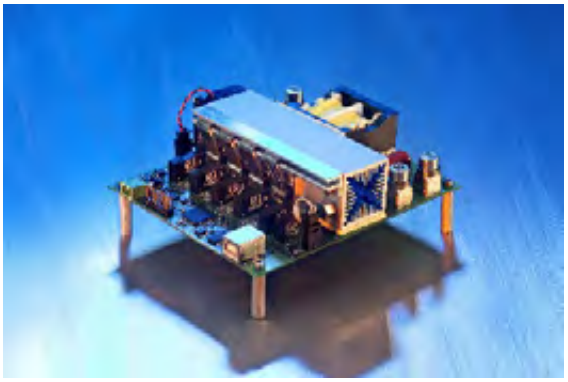
It is equipped with both parallel IEEE-488 and universal serial bus (USB) computer interfaces that provide access to operating data, stored parameters, and computer control of operating functions. The power supply's easy-to-use and intuitive interface provides full diagnostic and status information.

Increasing efficiency and shrinking GaN devices

Fraunhofer ISE has explored the limits of a new technology with gallium nitride power transistors

Scientists at the Fraunhofer Institute for Solar Energy Systems ISE have successfully tested new types of power transistors made of gallium nitride in power electronic systems.

With these transistors, the size of charging inverters for electric vehicles and the weight of power converters for aircrafts can be reduced and power supplies for server farms could gain efficiency.



Fraunhofer ISE 1MHz LLC resonant converter

Gallium nitride (GaN) has been in the centre of interest of many semiconductor researchers for a long time.

"With power transistors made of GaN, significantly higher switching frequencies are achievable than with ordinary silicon power transistors. In contrast to SiC, GaN is particularly suited for the lower voltage range. Especially resonant topologies can fully utilise the advantages of GaN power transistors," says Bruno Burger, head of the department "Power Electronics" at Fraunhofer ISE.

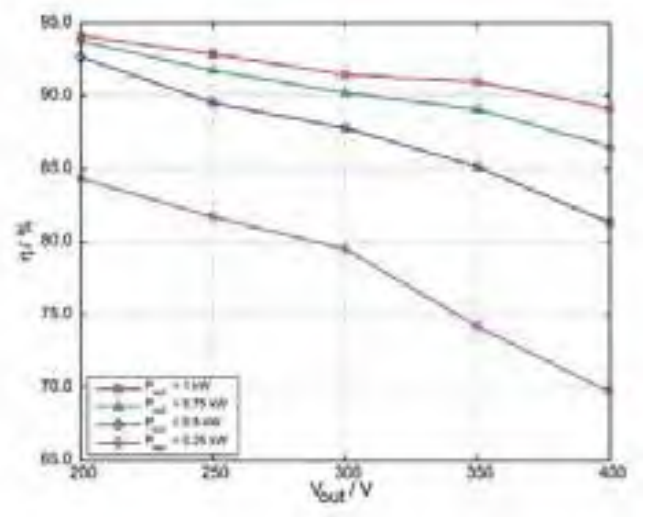
Despite the substantial need for research, impressing results have been obtained in an internal study. A DC/DC converter with rated output

power of one kilowatt was operated at a switching frequency of one megahertz providing 94 percent peak efficiency. “With regard to the 600V GaN transistor the switching frequency and also the efficiency of the DC/DC converter could have been raised to an even higher level. The limiting factor was the high-frequency transformer,” points out Arne Hendrik Wienhausen who performed the experiments.

Until today, only transistors made of silicon have been used in power electronic systems with voltages up to 600V. Switching and conduction losses of these transistors are significantly higher than those of transistors made of GaN. Therefore high losses are generated in the transistors which need to be dissipated in a complex way.

In addition to the higher efficiency, GaN provides the opportunity of increasing the switching frequency to exceed the state-of-the-art multiple fold. As a result, the passive components like inductors, transformers and capacitors can be much smaller leading to more compact and light-weight designs and expensive materials can be saved.

The scientists at Fraunhofer ISE predict that GaN will permanently change the world of power electronics. In all applications where system weight and volume are crucial, power transistors made of GaN and operated at high frequency offer great advantages over other technologies. It can be assumed that the switching frequency of one megahertz demonstrated in the DC/DC converter is only a first step towards much higher switching frequencies while maintaining high efficiency.



Converter efficiency of the 1MHz LLC resonant converter

The GaN power transistors used in the converter were produced by Panasonic.

Integra unveils GaN on SiC devices for S-Band radar

The two gallium nitride on silicon carbide modules are suited to weather radar and surface ship radar. S-band radar is also used in some communications satellites, especially those used to communicate with the space shuttle and the international space station

Integra is launching two internally pre-matched, GaN high electron mobility transistors (HEMTs) for S-band radar.

The IGN2729M500 operates over the 2.7 - 2.9 GHz instantaneous frequency band. Under 300µs/10% pulse conditions it supplies a minimum of 500 W of peak output power with typical performance of 560 W, typically 12 dB gain and over 60 % efficiency. The device is rated for peak output power of 500 W with 10% duty factor and average power of 50W.

The IGN3135M130 operates over the 3.1–3.5 GHz instantaneous frequency band. Under 300µs / 20 % pulse conditions it supplies a minimum of 130 W of peak output power with typical performance of 150 W with 12dB gain. The device is rated for peak output power of 130W with 20% duty factor and average power of 26W.

When appropriately rated, both HEMTS are operable under a wide range of pulse widths and duty factors. Specified operation for both devices is with Class AB bias. All devices are 100% screened for large signal RF parameters in a fixed tuned broadband matching circuit / test fixture.

US university to use EVG tool for CS power device research

The wafer bonding tool should advance silicon carbide, gallium nitride and/or other CS technologies at Texas State University. The multifunctional tool can also be used for silicon based power devices

Austrian firm, EV Group (EVG), a supplier of wafer bonding and lithography equipment ,has installed an EVG501 wafer bonding system to Texas State University.

EVG501 Wafer bonding system

The highly flexible R&D system, which is configurable for a variety of wafer bonding processes, has been installed in the university's cleanroom facilities to support advanced compound semiconductor and silicon-based power device research and development.

"Following a thorough evaluation of a number of wafer bonding systems, we selected EVG's solution for its superior technology capabilities. The affordable R&D system demonstrated outstanding results, with high pressure conformity and bond consistency," says Edwin Piner, Associate Professor, Physics, at Texas State University.

He adds, "EVG has a strong support network and we will work closely with their experienced process teams to further the development of bonding processes for specialised compounds."

The EVG501 wafer bonding system can handle small substrate pieces up to 200mm wafers and supports a variety of bonding processes, such as anodic, glass frit, eutectic, diffusion, fusion, solder and adhesive bonds, as well as other thermal processes, including oxide removal and high-temperature bakes under a controlled atmosphere.

The system also offers quick re-tooling with a conversion time of less than five minutes, making it ideal for universities and R&D as well as small-volume production applications.

Garrett Oakes, North American Director of Technology for EV Group, comments, "Working with Texas State marks a further step in our partnering with leading universities and research firms around the world in their efforts to develop solutions to today's challenges as well as exploring advancements that will address future industrial needs. We look forward to a long-term collaborative partnership with Texas State University."

Microsemi SiC Schottky diodes enhance efficiency

The firm's latest silicon carbide devices are optimised for high power, high voltage industrial applications

Hot on the heels of Fairchild Semiconductor's announcement earlier this week, Microsemi Corporation is introducing a new family of 1200V devices based on SiC materials.

Fairchilds' Bipolar Junction Transistors are designed for power conversion applications, while Microsemi is using its SiC Schottky diodes for use in solar inverters, welding, plasma cutters, fast vehicle charging, oil exploration, and other high power, high voltage applications.

SiC offers a number of benefits compared to silicon, including a higher breakdown field strength and improved thermal conductivity. These attributes allow designers to create devices with better performance characteristics encompassing zero reverse recovery, temperature independent

behaviour, higher voltage capability, and higher temperature operation to achieve new levels of performance, efficiency and reliability.

In addition to the inherent benefits of the device, Microsemi claims it is the only manufacturer to offer a SiC Schottky diode in a large surface mount backside solderable D3 package allowing designers to achieve increased power density and lower manufacturing costs.

"We applied our more than 25 years of power semiconductor device design and manufacturing know-how to deliver a family of SiC diodes that offers unparalleled levels of performance, reliability and overall quality," comments Russell Crecraft, general manager of Microsemi's Power Products Group. "Next-generation power conversion systems require higher power densities, higher operating frequencies and higher efficiencies - and our new silicon carbide devices help system designers meet those needs."

The new 1200V SiC Schottky diode product portfolio includes:

APT10SCD120BCT (1200V, 10A, common cathode TO-247 package)
APT20SCD120B (1200V, 20A, TO-247 package)
APT30SCD120B (1200V, 30A, TO-247 package)
APT20SCD120S (1200V, 20A, D3 package)
APT30SCD120S (1200V, 30A, D3 package)

Microsemi's new SiC Schottky diodes are now in production.

RFMD GaN HEMT PAs suited to high peak-to-average ratio apps

RFMD's RFHA104x series of high-power gallium nitride broadband power transistors (BPTs) are optimised for military communications, commercial wireless infrastructure, and general purpose applications

RFMD's latest advanced 65V high power density GaN semiconductor process is optimised for high peak-to-average ratio applications.

The firm's new high-performance amplifiers achieve high power with high efficiency and flat gain over a broad frequency range in a single amplifier design.

Each is an input-matched GaN transistor packaged in an air cavity ceramic package providing excellent thermal stability. Ease of integration is accomplished through the incorporation of simple, optimised, matching networks external to the package that provide wideband gain and high efficiency, all in a single amplifier ideal for linear correction circuits.

The RFHA1042 has a peak power of 125W and a single circuit for frequency of 225MHz to 450MHz. The RFHA1043 can operate at 150W and single circuit for frequency of 1.2GHz to 1.85GHz.

48V CW broadband performance

At a POUT of 45.2dBm, the RFHA1042 has a gain of 18.5dB and the RFHA1043 a gain of 15.5dB. The drain efficiency of the RFHA1042 is 42 percent and is 30 percent for the RFHA1043.

48V CW broadband performance

The RFHA1042 has a POUT of 45.2dBm and the RFHA1043 a POUT of 52dBm. The RFHA1042 has a gain of 16dB and the RFHA1043 a gain of 13.5dB. The drain efficiency of the RFHA1042 is 60 percent and is 51 percent for the RFHA1043.

The devices are optimised for video bandwidth and exhibit minimal memory effects.

These products are currently available in production quantities. Large signal models are also available.

Cree raises the bar with 1200V SiC power device

The company says it is introducing industry's first fully qualified, production-ready all-silicon carbide power module

Cree is introducing the first commercially available all-SiC Cree power module, the CAS100H12AM1.

The new high frequency module, rated at 100A current handling and 1200V blocking, allows higher efficiency, compact and lighter weight systems that can result in lower total system costs compared to conventional silicon-based technologies.

CAS100H12AM1 1200V, 100A, SiC Half-Bridge Module

"An all-SiC module with these specifications enables us to meet our transit customers' demands for reduced size and weight of auxiliary power converters, while meeting efficiency and cost targets," says Fisal Al-Kayal, innovation and research engineer, Alstom Belgium Transport.

The module includes SiC MOSFETs and SiC Schottky diodes in a 50mm half-bridge configuration rated to 150°C maximum junction temperature.

The SiC components enable the module to be operated at exceptionally high switching frequencies that can reduce the size, weight and cost of the power conversion system. The new power module has demonstrated up to 100kHz switching frequency. Target applications include high power converters, industrial motor drives, solar inverters and uninterruptible power supplies.

"The 1200V, 100A dual module extends our existing discrete MOSFET and diode products into higher power applications," explains Mrinal Das, product marketing manager, Cree Power and RF. "The efficient switching characteristics of an all-SiC module should allow system designers to meet customer demands for reduced size, weight and cost of the end-system, while reducing global energy consumption. Already, Cree SiC power devices have eliminated an estimated one million metric tons of annual CO2 emissions – the equivalent to planting 95 million trees."

Parts are available for immediate shipping through Digi-Key Corporation and Mouser Electronics (CAS100H12AM1). Sample gate drivers are available upon request to Cree for module customers.

Major Japanese manufacturer selects DCG tool to inspect SiC

The firm's ELITE system comprises a laser marker, full IR lens options, double-sided probing and high voltage power analysis capability for silicon carbide device inspection.

DCG Systems has announced that a major power device manufacturer has purchased its DCG's ELITE system for inspection of their next generation SiC power devices.

DCG ELITE system

"Sensitivity of the system is much better than we had expected and beyond even some of the

claimed specifications provided by DCG," states the Manager of the customer's device development department. "The new laser marker was delivered on time and its performance has been much better than what had previously been available in the market."

This system is one of the most sophisticated ELITE systems yet delivered to a customer comprising the newly developed laser marker, full IR lens options, double-sided probing and high voltage power analysis capability.

"We believe this solution will help customers develop faster leading edge power devices. Employing new semiconductor materials such as SiC and GaN introduce increasing development and reliability challenges. The ELITE system is helping our customers strengthen their competitive edge in this growing market," explains Randy Schussler, VP and GM of the IRIS (InfaRed Imaging Systems) Business Unit at DCG Systems.

Skyworks Exceeds Updated Q4 FY12 Revenue and EPS Guidance

Skyworks Solutions reported fourth fiscal quarter and year end 2012 results for the period ending September 28, 2012. Revenue for the quarter was $421.1 million, up 8.2 % sequentially and exceeded the Company's updated guidance of $420 million provided during its analyst day on September 20, 2012.

Delivers $421 Million in Revenue, Up 8 % Sequentially

Posts $0.53 in Non-GAAP EPS ($0.32 GAAP), $0.01 Better than Updated Guidance
Expands Operating Margin 100 Basis Points Sequentially to 24.6 Percent on a Non-GAAP Basis (17.8 Percent GAAP)
Guides to 14 Percent Year-Over-Year Revenue Growth in Q1 FY13
On a non-GAAP basis, operating income for the fourth fiscal quarter of 2012 was $103.6 million, up from $91.7 million in the third fiscal quarter of 2012, reflecting a 13 percent increase.

Non-GAAP diluted earnings per share for the fourth fiscal quarter was $0.53 compared to $0.45 for the prior fiscal quarter, representing an 18 % sequential improvement. On a GAAP basis, operating income for the fourth fiscal quarter of 2012 was $74.8 million and diluted earnings per share was $0.32.

For fiscal year 2012, revenue was $1.569 billion, up 11 % versus $1.419 billion in fiscal 2011. For fiscal 2012, non-GAAP diluted earnings per share was $1.90 and GAAP diluted earnings per share was $1.05.

"Skyworks is capitalising on global mobile connectivity ubiquity and demand for high performance analogue solutions across a diverse set of vertical markets," said David J. Aldrich, president and chief executive officer of Skyworks.

"Interrelated macro trends such as social networking, cloud-based content and the explosion of audio and video streaming are driving increased semiconductor content and complexity in smartphones, tablets, ultrabooks and e-readers as well as within the supporting network infrastructure."

"At the same time, wireless and power management functionality is rapidly proliferating across adjacent applications spanning machine-to-machine, automotive, broadband, home automation, smart grid and medical markets. Given our differentiated product portfolio, engagements with all key OEMs and scale, Skyworks is well positioned to continue to gain market share, capture additional content per platform and, as a result, significantly outperform our addressed markets throughout fiscal 2013," he concluded.

RFMD recruits new marketing officer

Based in Silicon Valley, California, CMO, Alan Hallberg will oversee RFMD's global marketing activities

RF Micro Devices has appointed Alan Hallberg as the Company's corporate vice president and chief marketing officer (CMO).

In the role of CMO, Hallberg will oversee RFMD's global marketing activities and will be based in

RFMD's growing Silicon Valley, California, location. He will report to RFMD's president and CEO Bob Bruggeworth.

Alan Hallberg is a seasoned industry veteran with extensive experience in marketing and branding at technology leaders including Lenovo, Cisco, and Apple. Most recently, he served as vice president, global brand communications at Lenovo, where he led a two-year global re-branding and marketing effort that contributed to the company's rise from #4 to the world's #1 PC maker.

Commenting on the appointment Bruggeworth says, "We are pleased to welcome Alan to RFMD as chief marketing officer. His extensive industry experience is well suited to growing RFMD's global marketing activities and communicating our product and technology leadership to current and new audiences."

Hallberg comments, "I am thrilled to join a world-class innovator in the rapidly growing market for mobile Internet and always-on broadband connectivity. RFMD is leading the way with breakthrough products and technologies that enable true innovation at the enterprise and consumer device level, and I'm excited to lead their global marketing team to help drive growth."

Hallberg graduated from Pomona College and holds a law degree from the University of Virginia. He lives in Palo Alto, California, with his wife and two sons.

Cree's 50V GaN HEMTs boost cellular networks

The firm's gallium nitride power devices reduce operational and capital expenses and could help reduce global energy consumption

Cree is introducing a range of new 50V GaN HEMT devices which enable a significant reduction in the energy needed to power cellular networks.

The world's cellular network is estimated to consume more than 100TWh of electricity per year. This is approximately equivalent to a value of $12 billion. Fifty to eighty percent of the networks' power is consumed by the systems' power amplifiers and feed infrastructure.

Cree's radio base station power amplifiers have demonstrated performance improvements of more than 20 percent over incumbent technology at 2.6 GHz operating under the latest 4G LTE signals. This increased power amplifier efficiency could save an estimated 10 TWh per year, the equivalent power output of two nuclear power plants.

While operational cost savings from increased efficiency can be significant, additional substantial savings are also possible in the acquisition cost of the system. A higher efficiency power amplifier can help OEMs save capital equipment costs through simplified cooling, and the higher voltage GaN components can lower the cost of AC-to-DC and DC-to-DC converters. Overall, the impact on the total bill of materials can be as much as 10 percent, leading to significantly lower system costs.

"We believe our 50V GaN HEMT products can have a large impact in not only helping cellular network operators and OEMs reduce operational and capital expenses but also in helping to reduce global energy consumption," explains Jim Milligan, business director, Cree RF.

"Several tier one telecom OEMs have already incorporated lower voltage versions of our technology to begin realizing these benefits. To date, even at an early stage of deployment, we estimate as much as 2,400 MWh of energy has already been saved as a result. This is an equivalent carbon offset of 1,400 metric tons of CO2 and represents the offset created by planting approximately 36,000 trees," he adds.

Cree's 50V GaN HEMT transistors operating at 100W or 200W output powers are now released for both the 1.8 - 2.2 GHz and 2.5 - 2.7 GHz frequency bands. The devices are internally matched for optimum performance, enabling wide instantaneous bandwidths.

The 50V GaN HEMT transistors are ideal for use in high efficiency Doherty power amplifiers where power gains higher than 18dB at 2.14 GHz and 16 dB at 2.6 GHz can be achieved respectively.

The new Cree 50V GaN HEMT transistors are available in sample quantities now, with production quantities scheduled to be available in November,

2012.

Mitsubishi uses SiC to improve factory productivity

The silicon carbide power module for CNC drive units offers higher speed and torque for driving machine tool spindles and servo motors

Mitsubishi Electric Corporation has launched a drive unit equipped with a SiC power module for computerised numerical controllers (CNCs).

The MDS-DM2-SPHV3-20080 is a multi-hybrid, multi-axis integrated-drive unit for drive control of spindle and servo motors.

MDS-DM2-SPHV3-20080 multi-hybrid drive unit

Power conversion modules are widely used in inverters and converters of household appliances and industrial equipment. SiC power modules are superior to conventional silicon modules in terms of their significantly reduced switching loss and high tolerance to temperature.

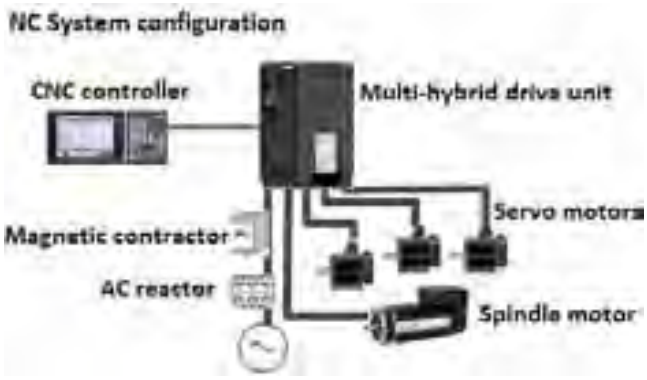
Until now, Mitsubishi Electric has commercialised SiC power modules for inverters in air conditioners and railcars. The new SiC power module for CNC drive units offers higher speed and torque for driving machine tool spindles and servo motors, which is expected to improve manufacturing productivity in factories.

The SiC power module offer high-speed switching operation and increased spindle motor speed up to twice that of its previous model (MDS-DM Series) under specific conditions. The SiC diodes also have a reduced power loss in drive unit results in 15 percent higher torque for spindle motors than the MDS-DM S series under specific conditions.

Power shut-off and other functions enable downsizing and reduced wiring.

What's more, the "Safe Torque Off" function for shutting off the power supply to motors reduces the number of magnetic reactors required, is available as a standard feature.

Also, an interface for linear scale enables direct detection and feedback of machine positions, meaning it requires no external interface unit.



TriQuint "incomes" still making a loss

Revenues for Q3 2012 were $200.8 million, down 7 percent from the Q3 2011

TriQuint Semiconductor has announced financial results for the quarter ended September 29th, 2012.

Revenues for the third quarter of 2012 were $200.8 million, down 7% from the third quarter of 2011.

GAAP net loss for the quarter was $11.2 million, or $(0.07) per share.

The Mobile Devices market revenue grew 13%, Networks grew 11% and Defence was up 16%, in each case sequentially. Revenue for the nine months ended September 29th, 2012 was $595.6 million, down 11% from the nine months ended October 1st, 2011.

Commenting on the results for the quarter ended September 29th, 2012, Ralph Quinsey, President and Chief Executive Officer, said, "TriQuint's third quarter results improved sequentially with 13% revenue growth driven by increased demand from our major smartphone customers and order strength for infrastructure and defence products. We are expecting ten to twelve percent revenue growth in the fourth quarter with continued strength in each of our major markets but with pressure on gross margins due to planned inventory reductions."

Gross margin for the third quarter of 2012 was 30.7%, up sequentially from 25.2%. Gross margin for the nine months ended September 29th, 2012 was 28.4%, down from 38.1% for the same period in 2011 due to lower factory utilisation.

Operating expenses for the third quarter of 2012 were $67.1 million, or 33% of revenue, down from $69.4 million in the previous quarter due to reduced litigation costs. Operating expenses for the nine months ended September 29th, 2012 were $202.6 million compared to $201.3 million for the same period in 2011.

Net loss for the third quarter of 2012 was $11.2 million or $(0.07) per share, compared with a net loss of $13.1 million, or $(0.08) per share, in the previous quarter. Net loss for the nine months ended September 29th, 2012 was $22.4 million or $(0.14) per share compared to a net income of $43.8 million or $0.25 per diluted share for the nine months ended October 1st, 2011.

Cash and investments decreased by $17.8 million to $144.6 million in the quarter due primarily to higher sales volume later in the quarter resulting in a higher accounts receivable ending balance.

The company believes fourth quarter 2012 revenues will be between $220 million and $225 million.

AMCAD's testing system ideal for GaN & SiC HV transistors

The 1kV/ 30A IV pulse tool provides high voltage signals and short pulse / fast switching capabilities in gallium nitride and silicon carbide devices simultaneously

French firm, AMCAD Engineering has upgraded its PIV semiconductor device analyser family for the next generation of High Voltage Fast Switching (HVFS) Transistors.

HVFS transistors open the way to new targets and new designs for high efficiency DC-DC converters, switches, hubs and servers, telecom base stations, and automotive applications. Other applications include LED drive circuits and Class D audio amplifiers.

The latest HVFS transistor technologies include Enhanced Mode GaN FET and SiC MOSFET. They offer very fast switching frequencies that are up to 10 times higher than previous solutions and permit designers to use lower duty cycles than they currently do.

AMCAD says that until now, there were no efficient testing solutions which highlighted the capabilities of these new technologies. Previous solutions could not provide simultaneously high voltage signals and short pulse / fast switching capabilities.

"AMCAD complements its existing Pulse IV system

portfolio by offering a new solution with pulse width down to 400ns@1KV to help customer testing High voltage Fast Switching transistors", says Tony Gasseling, General Manager. He continues, "Once again, we are very pleased to lead the innovation in the field of semiconductor pulsed characterisation".

AMCAD Engineering provides solutions to today's electronic design challenges. The company is dedicated to providing the most advanced solutions and tools in test and modelling to the RF, microwave IC and power electronic markets.

TriQuint's GaAs PAs & GaN transistors speed up customer designs

The firm is introducing four gallium nitride based power transistors and four gallium arsenide based pHEMT power amplifiers. They are suited to applications such as emergency responder radios, electronic warfare, radar solutions and test equipment

TriQuint Semiconductor is rolling out new processes to more quickly expand its catalogue of products for commercial and defence customers.

TriQuint's new set of products include a family of RF GPS diplexers that reduces PCB space by nearly three times compared to ceramic filter products.

The firm will also showcase new packaged transistors and amplifiers including four based on GaN and four based on gallium arsenide GaAs technology. The products support a wide variety of commercial and defence applications such as emergency responder radios, electronic warfare, radar solutions and test equipment.

"TriQuint's new integration approach and focus on broad-market products is allowing us to be more responsive to customer requests," says Infrastructure and Defence Products Vice President and General Manager, James L. Klein. "TriQuint's focus to expand our product lines and deliver more products to customers more quickly has resulted in a new approach to filter technology. This new design and manufacturing flexibility will enable our global customers to bring their products to market faster than ever."

TriQuint's new diplexer family grew out of customer needs for performance and faster delivery, along with the option to change filters throughout production lifetimes. The firm's new diplexer modules allow designers to incorporate any two filters from its extensive surface acoustic wave (SAW) CSP5 portfolio.

This new flexibility gives infrastructure and defence customers a customised solution using commercial off-the-shelf (COTS) products while avoiding the cost and time of a custom design. The solution also protects against performance compromises when trying to use a single device across multiple applications.

In addition to quicker product delivery, the new approach allows customers to reduce the space needed for filter designs. The new plug-and-play, 5 x 5 x 2mm integrated products are orders of magnitude smaller than lumped element diplexers and nearly three times smaller than similar high performance RF ceramic filter modules.

The presentation is a special program of European Microwave Week and will focus on new GaN products and integrated assemblies for the changing needs of global security and defence systems. Admission is free.

Technical Specifications for TriQuint EuMW Product Solutions: Sampling Now

Apart from four SAW diplexer modules designed for GPS, TriQuint will exhibit the following:

T1G6003028-FS
DC-6 GHz GaN RF power transistor. Specifications are as follows: 30W; 14dB gain at 3.5GHz; 10dB gain at 6 GHz; drain efficiency: 55% at 3.5 GHz / 44% at 6 GHz; 28V at 200 mA, withstands 10:1 VSWR, EAR99 flangeless package.

T1G6003028-FL
DC-6 GHz GaN RF power transistor. Specifications are as follows: 30W; 14dB gain at 3.5GHz; 10dB gain at 6 GHz; drain efficiency: 55% at 3.5 GHz / 44% at 6 GHz; 28V at 200 mA, withstands 10:1 VSWR, EAR99 flanged package.

T1G4003532-FS

DC-3.5 GHz GaN RF power transistor. Specifications are as follows: 37W CW; more than 16dB gain at 3.5 GHz; 10dB gain at 6 GHz; power-added efficiency: 60% at 5 GHz / 49.6% at 6 GHz; 32V at 2.4A; withstands 10:1 VSWR; EAR99 flangeless package.

T1G4003532-FL
DC-3.5 GHz GaN RF power transistor. Specifications are as follows: 37W CW, more than 16dB gain at 3.5 GHz; 10dB gain at 6GHz; power-added efficiency: 60% at 5 GHz / 49.6% at 6 GHz; 32V at 2.4A; withstands 10:1 VSWR; EAR99; flange mount package.

TGA2502-GSG
13-16 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 2.8W; 20dB large-signal gain; 25dB small-signal gain; 25% efficiency; 7V at 1.3A; 14-lead flange mount package.

TGA2704-SM
9-11 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 7W; 19dB large-signal gain; 22dB small-signal gain; 40% power-added efficiency; 9V at 1.05A; 7x7x1.27mm leadless SMT package.

TGA2710-SM
9.5-12 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 7W; 19dB large-signal gain; 20dB small-signal gain; 36% power-added efficiency; 9V at 1.05A; 7x7x1.27mm leadless SMT package.

TGA2575-TS
32-38 GHz GaAs pHEMT RF power amplifier. Specifications are as follows: 3W; 19dB small-signal gain; 22% power-added efficiency; 6V at 2.1A. TGA2575 die is mounted to an 8.92x5.31mm thermal spreader.

Samples and evaluation boards are available.

SemiSouth expected to shut up shop

Power Integrations says it will incur a third-quarter charge due to the expected closure of SemiSouth Laboratories, a developer of silicon-carbide power devices

Power Integrations has announced that its financial results for the quarter ended September 30th, 2012 will include a pre-tax charge of approximately $60 million, resulting in a net loss on a GAAP basis.

The charge stems from the expected closure of SemiSouth Laboratories, a Mississippi-based developer of SiC power devices. Power Integrations had announced a strategic partnership with SemiSouth in 2010.

CBalu Balakrishnan, president and CEO of Power Integrations comments, “The expected closure of SemiSouth is disappointing, but reflects the challenges and risks inherent in the quest for disruptive technologies. Our strategic direction remains unchanged, and we continue to invest in promising technologies to expand our market opportunity within the realm of high-voltage power conversion.”

Power Integrations further noted that it expects its third-quarter revenues to be between $77 million and $79 million, compared with its previous forecast of $76 million to $82 million. GAAP gross margin is expected to be between 49 percent and 50 percent, compared with the prior forecast of 48 to 49 percent. Operating expenses excluding the above-mentioned charge are expected to be consistent with the company’s prior forecast.

Power Integrations, Inc., is a Silicon Valley-based supplier of high-performance electronic components used in high-voltage power-conversion systems. The company’s integrated circuits and diodes enable AC-DC power supplies for a broad range of electronic products including mobile devices, TVs, PCs, appliances, smart utility meters and LED lights.

Keithley reveals mix & match power device characterisation software

The firm’s flexible parametric curve tracer solutions analyse silicon carbide and gallium nitride power devices

Keithley Instruments has introduced seven instrumentation, software, and test fixture

configurations for parametric curve tracing applications.

The software is suited to the characterisation of high power devices of up to 3,000V and 100A.

They're optimised to provide a cost-effective solution for characterising the growing number of high power semiconductor devices, including those based on SiC and GaN technology.

These systems offer the power required for the vast majority of high power device design and development applications. They address the characterisation and test needs of research, reliability, failure analysis for applications engineers, device designers, inspection technicians and many others.

Lee Stauffer, a Keithley staff technologist, notes, "Many power device developers have told us they like the dynamic range and ease of use of a traditional curve tracer, but they know they need more flexibility in configuring the measurement channels, as well as the accuracy, capability, and graphical user interface that a modern parametric analyser offers."

All seven Keithley configurations offer the flexibility to add new measurement channels economically as users' needs evolve, with no need to return the system to the factory to install new hardware.

For example, someone could start with an entry level Parametric Curve Tracer, then add the capabilities of additional System SourceMeter instruments, such as higher voltage and/or higher current, at a later date.

Six different System SourceMeter instrument models can be mixed and matched to create the optimum combination of voltage, current and power for the user's specific needs.

Keithley's TSP Link virtual backplane technology makes it easy to incorporate any number of Source-Measure channels. These are fully and automatically synchronised with other SourceMeter instruments in the system.

All seven configurations include the latest version of Keithley's ACS (Automated Characterisation Suite) Basic Edition software. This supports Keithley's newest SMUs and takes maximum advantage of the Series 2600B's TSP-Link connection trigger model, which allows for 500ns trigger synchronisation between instruments.

This tighter synchronisation capability maximizes the high speed pulse mode capabilities of the new Model 2651A and Model 2657A High Power System SourceMeter instruments.

The Windows-compatible ACS Basic Edition package provides control and analysis tools well-suited for high power device characterisation, including complete parametric test libraries for MOSFETs, BJTs, triacs, diodes, IGBTs, and other device types.

The software's "trace" mode uses an on-screen slider control that works much like the power control knob on a traditional analogue curve tracer, allows users to control the level of voltage and current levels sourced interactively and to see how the power device responds in real time.

The software's "parametric" mode provides a "fill-in-the-blanks" GUI to configure a test precisely and a comprehensive set of tools for precise parameter extraction. All seven bundles also include all cabling and adapters required for system assembly, as well as a number of sample power devices useful for training and demonstration purposes.

Sales of the parametric curve tracer configurations will begin immediately and units will ship within four weeks ARO.

Cree bounces back with revenues up 17 percent

The LED and power device chip manufacturer's quarterly net income increased 26 percent year-over-year to $16.1 million

Cree, Inc. has announced revenue of $315.8 million for its first quarter of fiscal 2013, ended September 23rd, 2012.

This represents a 17% increase compared to revenue of $269 million reported for the first quarter of fiscal 2012 and a 3% increase compared to the fourth quarter of fiscal 2012.

GAAP net income for the first quarter was $16.1 million, or $0.14 per diluted share, an increase of 26% year-over-year compared to net income of $12.8 million, or $0.11 per diluted share, for the first quarter of fiscal 2012.

"We started the year strong in our fiscal first quarter with record revenue and non-GAAP earnings per share at the high end of our target range," notes Chuck Swoboda, Cree chairman and CEO.

"Overall company backlog is stronger than it was at this point last quarter, although visibility is still limited and the macroeconomic environment remains a headwind. Our results are beginning to demonstrate the enormous leverage we have in our fully integrated vertical lighting model."

Gross margin increased 200 basis points from Q4 of fiscal 2012 to 36.8% on a GAAP basis.

Cash and investments increased $71.8 million from Q4 of fiscal 2012 to $816.3 million. Accounts receivable (net) increased $10.0 million from Q4 of fiscal 2012 to $162.3 million, with 46 days sales outstanding.

Inventory decreased $9.2 million from Q4 of fiscal 2012 to $179.7 million and represents 81 days of inventory.

Business Outlook:
For its second quarter of fiscal 2013 ending December 30, 2012, Cree targets revenue in a range of $320 million to $340 million with GAAP gross margin targeted to be 37.5%+/-. Its GAAP gross margin targets include stock-based compensation expense of approximately $2.6 million.

Operating expenses are targeted to increase by +/- $7 million on a GAAP basis. The tax rate is targeted at 22% for fiscal Q2. GAAP net income is targeted at $13 million to $19 million, or $0.12 to $0.16 per diluted share. The net income targets are based on an estimated 116 million diluted weighted average shares.

Advanced Photonix takes on Donald C. Pastor as non-executive chairman

The supplier of III-V based optoelectronic products has separated the roles of Chairman of the Board and Chief Executive Officer, consistent with current best governance practices

Advanced Photonix Inc. (API) has appointed Donald C. Pastor as Non-Executive Chairman of the Company.

Pastor became an independent director of the Company in July 2005 and is currently serving as the Chairman of the Compensation Committee and serves on the Audit Committee.

He has over 30 years of Senior Executive level experience in high technology and defense related industries, and has successfully served as a CEO, CFO and division level President in both start-up and turnaround situations.

In his new role Donald C. Pastor will take a more

prominent role in monitoring the implementation of the Board's business strategies, in the development of enhanced reporting mechanisms, and in the communications between the Board and API's principal executive officers.

Richard Kurtz, who has been the Company's Chief Executive Officer since February 2003 and President since June 2006, will continue to oversee the day-to-day operations of the company.

"The independent directors believe the Company is entering a critical phase as our investment in technology is beginning to propel the Company forward. This change will allow the management team to devote their full attention to meeting the day-to-day needs of our customers in our growing markets. As Chairman, I will work closely with Rick in support of the Company's overall strategic direction and brand positioning," states Pastor.

"I believe the time is right to separate the Chairman and Chief Executive Officer roles and I look forward to working more closely with Don as we grow and expand our business on a national and global level," adds Kurtz.

Lance Brewer, Chairman of the Governance and Nominating Committee stated, "the directors of API are excited to have an executive with Don's experience and record of success across a number of industries take a more active role in the oversight of the Company. We believe that at this time, separating the roles of Chairman of the Board and Chief Executive Officer will help API realize the full potential of its world class technology."

Cree GaN transistors PAs enable crystal clear HD

Along with Array Wireless, Cree is implementing its gallium nitride devices to enhance HD video

Cree and Array Wireless are helping to bring the clarity of high-definition (HD) video transmission to Sunday Night Football (SNF) on NBC.

The HD NFL games are broadcast using wireless video systems from Array Wireless that employ Cree's GaN RF components.

Array Wireless counts on Cree's RF GaN technology to create high efficiency, low distortion, robust power amplifiers that are essential for high-definition video transmission.

Cree GaN RF technology is deployed in Array Wireless' S-Band linear power amplifier product series, enabling smaller, lighter and more efficient power amplifiers than those based on GaAs.

Winged Vision, a leader in aerial sports broadcasting, uses high linearity amplifiers from Array Wireless to transmit SNF video transmissions and maintain unparalleled fidelity from pre-game to post-game.

According to Bob Mikkelson, president, at Winged Vision, the light weight Coded Orthogonal Frequency-Division Multiplexing (COFDM) amplifiers from Array Wireless are a key component in developing compact HD broadcast systems, with "performance and efficiency that are head and shoulders above the rest."

"Cree's GaN RF devices are ideal for meeting the stringent linearity requirements for wide bandwidth HD digital transmission at high efficiency operation," says Ed Takacs, president and founder, Array Wireless.

"The lighter weight systems they enable are extremely beneficial in lowering fuel consumption and operating costs for our customers. We migrated from GaAs devices to Cree GaN devices several years ago to offer increased transmission range while reducing our power amplifier size, weight and power consumption."

Array Wireless' TruPower Series Linear RF Amplifiers bring a new level of performance and reliability to microwave transmission of digitally modulated signals from UHF to 10GHz. TruPower amplifiers use patent-pending linearisation technology to minimise distortion and provide superior signal quality for complex multi-carrier modulations like OFDM while minimising DC power consumption, heat and weight.

Cree RF GaN HEMT and MMIC devices are available for linear and pulsed amplifier applications in frequency bands from DC to Ku-Band at 18GHz. The devices are available in a variety of output power ratings from 1W to 40W.

Anadigics markets GaN line amplifier

The company's high output gallium nitride power doubler amplifier delivers high linearity, low distortion, and low bit error rate for CATV applications

Anadigics has introduced the ACA2428 GaN line amplifier MMIC.

The new GaN power doubler line amplifier uses Anadigics' proprietary architectures to ensure distortion-free video and audio in 1 GHz CATV systems.

ACA2428 GaN amplifier

With high output power and low current consumption, the company's GaN line amplifier helps to save energy to enable green CATV infrastructure solutions.

"CATV networks are increasingly operating in a fully loaded spectrum to support high-definition television, video on demand, and high data rate internet," says Tim Laverick, vice president of infrastructure products at Anadigics.

"Anadigics' new GaN line amplifier provides a best-in-class combination of output power, linearity, bit error rate, and noise figure to ensure the highest quality of video delivery in these network conditions. This level of performance is coupled with exceptional efficiency and world-class reliability and ruggedness, enabling advanced green solutions that minimise power consumption and costly truck rolls."

Anadigics' ACA2428 GaN line amplifier MMIC is optimised for 50 to 1,000 MHz frequency band applications by delivering +58 dBmV output power and 21 dB gain at 1 GHz. Available in a 16 lead SOIC, the line amplifier is powered through the centre tap of the output impedance transformer with a single +24 V supply. The ACA2428 is optimised for several CATV infrastructure applications, including output power doublers for system amplifiers and deep fibre nodes.

Samples of the ACA2428 are available now for qualified programs.

GaN Systems opens new U.S. office

The gallium nitride power magnate aims to extend its business with a new director who will head a new office in Michigan

GaN Systems, a developer of GaN power switching semiconductors, is opening a new office located in Ann Arbor, Michigan.

The company has appointed Julian Styles, as Director of Business Development, to lead business development in the United States.

The expansion in the U.S. will aid the company in continuing to impact industries, like manufacturing and automotive. These are two industries where the need for clean technology power conversion applications continue to grow.

GaN Systems' head office is currently located in Ottawa, Canada.

"We're excited to better serve our clients in the U.S. with the addition of an experienced, well versed executive in the electronic and automotive sectors," says Girvan Patterson, chief executive officer of GaN Systems.

"We have worked hard to develop viable, effective GaN applications, including making hybrid and all electric vehicles cost effective. Julian's broad experience and strong technical background including electric vehicle and grid systems, will

complement the existing team to meet the needs of a growing company, like ours.," adds Patterson.

An experienced executive with over 20 years' track record of helping international companies bring new technologies to market, Styles most recently led U.S./Swedish company Movimento Group's entry into knowledge management for advanced automotive infotainment systems.

Previously he helped lead electronics company Pi Shurlok (now Pi Innovo) to rapid growth in the U.S., based around innovative products for the automotive, transport and aviation industries.

Using GaN to shrink communication devices

Laser cooling achieved with gallium nitride could enable scientists to observe novel quantum effects and make the HEMTS used in satellites more resistant to damaging ultraviolet rays

Light might one day be used to cool the materials through which it passes, instead of heating them.

This could be due to a breakthrough by engineers at Lehigh and Johns Hopkins Universities.

The discovery could lead to smaller, lighter and cheaper communication devices and enable faster switching times, higher operating voltages and increased output.

Yujie Ding from Lehigh and Jacob B. Khurgin at Johns Hopkins, have achieved what they say is the most favourable ratio to date between opposing types of light-scattering phenomena that occur in semiconducting materials.

Photons, units of light energy, typically maintain the same kinetic energy and wavelength when they exit a material as they do when they strike it.

Raman scattering, named after the 1930 Nobel Prize winner in Physics, refers to the small fraction of scattered photons whose kinetic energy and wavelength, or frequency, differ from those of incident photons. When this frequency is lower, it is called Stokes scattering. When it is higher, it is called anti-Stokes scattering.

The ratio of the occurrence of Stokes to anti-Stokes scattering, says Ding, is typically 35:1. Scientists would like to reduce this to 1:1, at which point a material neither heats nor cools when struck by light.

Ideally, they would like to reduce it even further, and initiate more anti-Stokes than Stokes scattering. In this case, the material imparts its energy, and thus its heat, to the light passing through it.

Ding and Khurgin, working with GaN, have succeeded in reducing the ratio of Stokes to anti-Stokes to 2:1.

GaN, considered one of the most important semiconducting material since silicon, is used in LEDs and laser diodes. Other applications include high-frequency, high-power transistors that can operate at high temperatures and solar cell arrays for satellites. And due to its relative biocompatibility, GaN can also be used in electronic implants in humans.

Laser cooling achieved with GaN could also enable scientists to observe novel quantum effects and could make the high-electron mobility transistors used in satellites more resistant to damaging ultraviolet rays.

"We are the only group to minimise the Stokes-anti-Stokes ratio from 35:1 to 2:1 at room temperature," says Ding. "We have accomplished this by exploiting the different resonance behaviours of Stokes and anti-Stokes scattering."

Researchers now achieve laser cooling, says Ding, by adding a dopant to the lattices of certain crystalline materials. But the portion of the lattice that actually cools represents only a tiny fraction of the entire lattice. If the right Stokes-anti-Stokes ratio can be achieved, every atom in the GaN lattice would cool and contribute to the cooling effect.

Ding and Khurgin plan next to build an optical resonator.

"We are still puzzled by the fundamental limit to the Stokes-anti-Stokes ratio and by the feasibility of reaching a ratio of 1 or less," says Ding. "We want to see, experimentally, how an optical resonator affects this ratio. We have already done the theoretical work for this. We want to conduct experiments inside a nanowire or other nanostructure to show how this ratio is affected by the structure.

The research, led by Ding and Khurgin, has been supported by the National Science Foundation and the Defence Advanced Research Projects Agency (DARPA).

Further details of this work have been published in an invited article titled, "From anti-Stokes photoluminescence to resonant Raman scattering in GaN single crystals and GaN-based heterostructures," in *Laser and Photonics Review,* Rev. 6, No. 5, 660–677 (2012). DOI 10.1002/lpor.201000028

Latest wired GaN broadband components to be showcased by RFMD

The firm will describe its gallium nitride based products which are claimed to deliver increased bandwidth and power efficiency for network upgrades at the SCTE conference

RF Micro Devices will showcase its portfolio of wired broadband components at the SCTE Cable-Tec Expo 2012 in Orlando, Florida.

RFMD's wired broadband components leverage the company's multi-chip-module (MCM) integration capabilities and broad access to all key process technologies. These include CATV, optical access, fibre-optic, and other applications.

During the Expo, RFMD will present a broad array of products, including its silicon-on-insulator (SOI) CATV control components and its GaN-based CATV amplifiers, which deliver increased bandwidth, improved power efficiency, and enhanced reliability for network upgrades.

EPC upgrades development boards featuring eGaN FETs

The EPC9003 and EPC2007, which incorporate the firm's gallium nitride technology, feature low-side gate drivers from Texas Instruments

Efficient Power Conversion Corporation (EPC) has launched two development boards, the EPC9003 and the EPC9006. Both feature the firm's enhancement-mode eGaN field effect transistors (FETs).

These boards demonstrate how the recent introductions of IC gate drivers, optimised for eGaN FETs, make the task of transitioning from silicon to eGaN technology simple and cost effective.

The EPC9003 development board is a half bridge configuration containing two 200V EPC2010 eGaN FETs. These have a 5A maximum output current using the low-side gate driver optimised for GaN devices, the LM5114 from Texas Instruments.

The EPC2010 is designed for use in applications such as solar microinverters, class D audio amplifiers, Power over Ethernet, and synchronous rectification.

Both the EPC9003 and the EPC9006 are intended to simplify the evaluation process of eGaN FETs by including all the critical components on single 2" x 1.5" boards that can be easily connected into any existing converter. Also, there are various probe points on the boards to facilitate simple waveform measurement and efficiency calculation.

What's more, EPC has also announced the availability of the EPC9006 development board containing two 100V EPC2007 eGaN FETs with 5A maximum output current. This board uses the LM5113 from Texas Instruments, a 100 V half bridge driver optimised for GaN transistors.

The LM5113 used on this board is packaged in a 2x2 BGA package allowing for a very compact power stage with the driver and two eGaN FETs. Applications suited to the EPC2007 include high-speed DC-DC power supplies, point-of-load converters, class D audio amplifiers, hard-switched and high frequency circuits.

The EPC9003 and EPC9006 development boards are priced at $95.00 each. These development boards, like all EPC products, are available for immediate delivery from Digi-Key.

Equipment and Materials

EVG expands cleanroom & opens R&D labs

The supplier of equipment related to the III-V industry has doubled its cleanroom space and is advancing long-term growth plans

EV Group (EVG), an innovator in the nanotechnology and semiconductor markets, has completed its newly expanded cleanroom IV facility at its corporate headquarters in Austria.

As part of the company's long-term growth strategy to address high-volume tool orders and speed time to market for its customer base, EVG doubled its cleanroom space for process development and pilot production services.

The company has also increased the size of its application labs, added new R&D facilities for internal tool development and testing, and opened a new customer and employee training centre.

Together with the new cleanroom expansion, EVG increased the number of fully automated high-volume manufacturing systems (for different wafer sizes) to strengthen its customer demonstration and process development capabilities.

While manufacturing and product development are centralised at EVG's corporate headquarters in Austria, technology and process development teams there work closely with the company's subsidiaries in the U.S, Japan, South Korea and Taiwan.

In these locations, additional application labs and cleanroom facilities are available for onsite customer demonstration and technology process development.

EVG works closely with many universities and R&D institutes worldwide, and plays a key role in numerous industry associations and consortia to contribute and continue the world's most advanced research and development for compound semiconductors and other materials used in high-tech devices.

The company's new customer and employee training centre at its corporate headquarters provides several new rooms for instructional training courses, as well as a large number of manual and automated EVG tools for training.

This new training centre provides EVG with additional flexibility and allows customers and employees worldwide who regularly attend training courses on EVG technologies to manufacturing processes, products and software, as well as equipment operation.

Earlier this year, the addition of a manufacturing facility doubling the production floor space marked the completion of the first phase of EVG's long term expansion plans.

Already contributing to the firm's continued, steady growth from the beginning of 2012, EVG increased its order intake in fiscal year 2012 (ended September 30th, 2012) by 5 percent over fiscal 2011 and increased its revenue by 20 percent within the same period.

In the last 12 months EVG added more than 100 new employees (to a current total of approximately 600 worldwide) and is continuing to recruit new employees in all departments.

Oxford Instruments seminar in Bangalore a hit

The seminar, describing compound semiconductor characterisation, was the largest one yet and attracted attendees from both academia and industry

A two day Nanotechnology Seminar organised by Oxford Instruments at IISc Bangalore, India last week attracted over 200 attendees from all over India.

With two parallel sessions running, Thin Film Processing and Materials Characterisation, this event proved to be the largest seminar organised by Oxford Instruments to date.

The aim of the seminar was to encourage interest

in developments within the industrial and research communities and to introduce the nanotechnology tools offered by Oxford Instruments.

It proved to be an ideal means for participants to learn more about latest techniques and findings in an informal atmosphere where participation and interaction was encouraged.

Oxford Instruments is a provider of technology tools and systems for research and industry, supplying equipment that can fabricate, characterise, manipulate and analyse matter at the atomic and molecular level. Many of the firm's instruments can be used in compound semiconductor characterisation.

Both the Thin Film Processing and Materials Characterisation seminar attracted guest speakers from IISc Bangalore, India, USA and Europe, with talks on etch and deposition processing, and plasma technologies, materials characterisation, surface science and cryogenic environments.

"This seminar has been very well organised with competent speakers covering a variety of processes and tools for nano fabrication. It is great to have practitioners of the art give talks and provide tips and solutions based on their experience, something that can you cannot find in books" said Rudra Pratap, Chairperson at the Centre for Nano Science and Engineering, Indian Institute of Science, Bangalore, "I hope Oxford Instruments organises such workshops on a regular basis. This is likely to engage researchers and industrial users alike in lively discussions on innovative usage.

Anurag Tandon, Managing Director of Oxford Instruments India added, "We were pleased to have attracted such a large, high calibre audience to our Seminar in Bangalore, and are extremely honoured that so many distinguished guest speakers gave their time to speak about their work in Plasma Processing and Materials Characterisation."

"We are expanding our presence in India and have just held the official opening of our new subsidiary office in Mumbai. This highly successful event showcased our state-of the art demonstration and customer support facility and introduced the wide range of tools and systems that Oxford Instruments supplies to the research and industrial communities," he concluded.

Spectris to acquire ASD for $14 million

The supplier of productivity-enhancing instrumentation and controls is branching out into NIR spectroscopy

Spectris plc. has signed an agreement to acquire Analytical Spectral Devices Inc. (ASD), a manufacturer of Near-Infrared (NIR) instrumentation solutions and applications expertise for materials measurement and research.

Near-infrared spectroscopy (NIRS) is a spectroscopic method that uses the near-infrared region of the electromagnetic spectrum (from about 800nm to 2500nm).

NIRS is based on molecular overtone and combination vibrations. Such transitions are forbidden by the selection rules of quantum mechanics. As a result, the molar absorptivity in the near IR region is typically quite small.

One advantage is that NIR can typically penetrate much further into a sample than mid infrared radiation. Near-infrared spectroscopy is, therefore, not a particularly sensitive technique, but it can be very useful in probing bulk material with little or no sample preparation.

With regards to compound semiconductors, techniques have been developed for NIR spectroscopy of microscopic sample areas for film thickness measurements, research into the optical characteristics of nanoparticles and optical coatings for the telecommunications industry.

Spectris is buying ASD for a debt and cash-free net consideration of $14 million (approximately £8.8 million).

The consideration will be met from existing cash and bank facilities and is subject to routine balance sheet adjustments. Spectris expects the acquisition to complete before the end of the year upon ASD shareholders' approval.

Also, a contingent consideration of up to $19 million (£11.9 million) may become payable to the sellers, based on achieving growth in sales targets for the 36 month period ending 31st December 2015.

The acquisition of ASD is in line with Spectris' established strategy of growing and strengthening its businesses via acquisition of complementary businesses. ASD will become part of the Materials Analysis segment and will be integrated with PANalytical.

Jim Webster, Spectris' Business Group Director, comments, "ASD's successful NIR solutions for the Remote Sensing, Mining and other Industrial markets complement and extend PANalytical's offering towards scientific and industrial customers and will add a new contiguous product line with portable, handheld, benchtop and online products. Furthermore, the acquisition of ASD will provide strong synergies in the combination of both companies' technologies, customer support capabilities and distribution channels."

ASD, based in Boulder, Colorado (USA), employs around 50 people. PANalytical is a supplier of instrumentation and services for X-ray diffraction (XRD) and X-ray fluorescence (XRF) spectrometry, with more than half a century of experience. The company offers analytical equipment for industrial and scientific applications as well as for the semiconductor market.

PANalytical, founded in 1948 as part of Philips, is headquartered in Almelo, the Netherlands. The firm is part of Spectris plc.

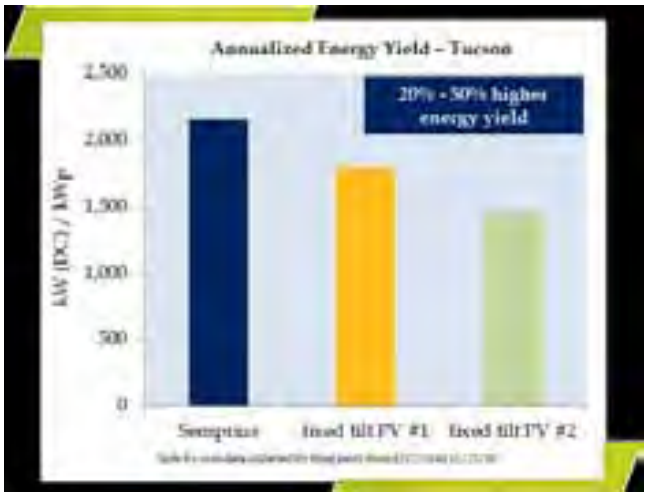
Spectris plc is a supplier of productivity-enhancing instrumentation and controls. The company's products and technologies help customers to improve product quality, performance, core manufacturing processes, and reduce downtime, wastage and time to market.

Semprius to provide III-V solar modules for U.S. DoD

The III-V solar cells will be used in the 200 kilowatt system at Edwards Air Force Base in 2013

Semprius will be providing its technology to Pratt & Whitney Rocketdyne's (PWR's) $2.3 million award from the Environmental Security Technology Certification Program (ESTCP) office of the U.S. Department of Defence (DoD).

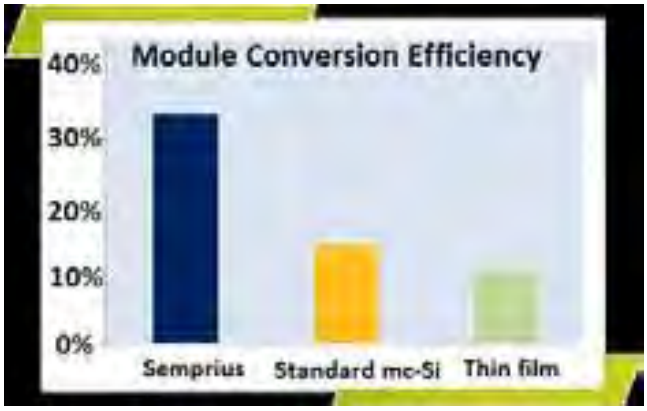
Semprius modules use III-V multi-junction solar cells and the design means they dissipate heat better and run cooler. This enables the modules to outperform traditional silicon and thin-film modules in hotter climates.



The project is designed to demonstrate the high-performance and cost-effectiveness of HCPV technology for use at DoD installations as well as in other commercial and utility scale applications.

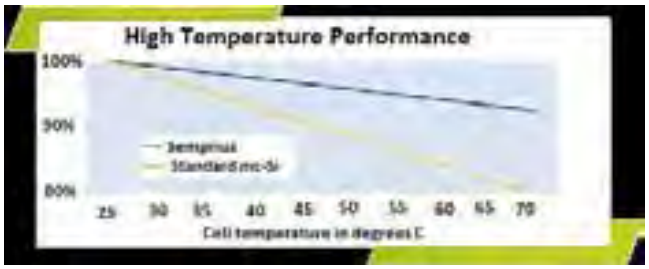
As part of the project, PWR will install a 200 kilowatt (kW) solar system at Edwards Air Force Base in California. The system will comprise 2,400 Semprius modules mounted on dual-axis trackers and will produce over 400,000 kWh of electricity annually, enough to power approximately 40 homes.

Semprius' manufacturing facility, located in Henderson, North Carolina, uses a proprietary process to deliver the world's highest efficiency solar modules. At 33.9 percent, Semprius says its modules are the first to convert over one-third of the sun's energy into electricity.



What's more, Semprius modules perform better than conventional modules under high temperature conditions, and in locations like the U.S. Southwest, Semprius says its systems can deliver up to 30

percent more energy than equivalent PV systems, as illustrated in the graph below.



"We are honoured to be working with PWR to deliver our HCPV modules to the DoD," says Joe Carr, CEO of Semprius. "We believe that our technology will play an increasingly important role in delivering cost-competitive, sustainable energy."

Semprius and PWR, part of United Technologiies began working together in 2011 to demonstrate Semprius' technology at the University of Alabama-Huntsville. Over the past 18 months, the companies have collaborated to scale-up the technology into a cost-effective, commercial-grade system.

"Having spent several years evaluating emerging PV technologies, we've selected Semprius because of the potential of their technology to drive down the cost of solar electricity significantly," says Randy Parsley, Renewable Energy Program Manager at PWR. "We look forward to executing this project with Semprius to help the DoD begin to achieve its energy independence and energy security goals."

Has Veeco violated federal security laws?

It is not yet known but Glancy Binkow & Goldberg LLP are on the case

Glancy Binkow & Goldberg LLP is investigating potential claims on behalf of purchasers of the securities of Veeco Instruments concerning possible violations of federal securities laws.

The investigation focuses on allegations that certain statements issued by Veeco were false and misleading concerning the company's financial performance.

Veeco, together with its subsidiaries, designs, manufactures and markets MOCVD equipments to make LEDs and hard-disk drives as well as other compound semiconductors.

On November 15th, 2012 Veeco issued a press release disclosing that it has filed a form 12b-25, Notification of Late Filing, with the Securities and Exchange Commission, related to the company's quarterly report on Form 10-Q for the period ended September 30th, 2012.

The press release stated that the additional time is needed because the Company "is in the process of evaluating the timing of recognition of revenue on the sale of certain Metal Organic Chemical Vapour Deposition (MOCVD) systems and related upgrades to these systems."

Veeco says that if it is required to change the timing of its recognition of any revenue, "there could be a shift in revenue between accounting periods which could constitute material changes to results of operations and financial condition for various periods."

Following this news, shares of Veeco fell $2.19, to a closing price of $26.68 on November 16th, 2012, on a heavy trading volume of more than 2.3 million shares traded.

Veeco informs late filing to SEC regarding MOCVD tools

The systems which are the subject of these transactions were delivered, accepted and paid for. The review focuses on determining whether revenue for these reactors was recognised in the appropriate accounting periods

Veeco Instruments has filed a form 12b-25, Notification of Late Filing, with the U.S. Securities and Exchange Commission (SEC) relating to the company's report on Form 10-Q for the period ended September 30th, 2012.

Additional time is needed because the company is in the process of evaluating the timing of recognition of revenue on the sale of certain MOCVD systems and related upgrades to these systems.

John R. Peeler, Veeco's Chairman and Chief Executive Officer, said, "We are currently reviewing

the timing of revenue recognition of MOCVD systems and related upgrades. The accounting issues do not relate to product performance or customer acceptance of our products. The systems which are the subject of these transactions were delivered, accepted and paid for in full by our customers. Our review focuses on determining whether revenue was recognised in the appropriate accounting periods."

Peeler added, "I want to reassure our customers, shareholders, suppliers and employees that Veeco's strong MOCVD market position, excellent product performance in the field, global operating strength and sound financial footing remain intact. Veeco is handling this issue as expeditiously as possible - it is our intention to resolve this matter and file our 10-Q as soon as we can."

Veeco is working with its independent auditor, Ernst & Young LLP, to address these matters. If the Company is required to change the timing of its recognition of any revenue, there could be a shift in revenue between accounting periods which could constitute material changes to results of operations and financial condition for various periods.

Veeco's process equipment solutions enable the manufacture of LEDs, power electronics, hard drives, MEMS and wireless chips.

5N Plus opens recycling facility in Malaysia

The producer of specialty metals such as indium, gallium and germanium used in MOCVD growth, has also acquired 100 percent of MCP Metals (Shenzhen) Co., Ltd gallium refining facility

5N Plus's new recycling Malaysian facility is now operational.

The facility which is located within the Kulim High Technology Park, one of Malaysia's highest profile industrial areas for technological firms, was completed under budget.

Providing recycling services for solar cell manufacturers, the facility is expected to gradually increase its range of products and services to address broader requirements and capture opportunities in the South-Asian market.

The company has also acquired the remaining 50 percent ownership interest in the joint venture company MCP Metals (Shenzhen) Co., Ltd, a gallium refining facility located in Shenzhen, China.

"Expansion of our activities in Asia is part of our growth strategy as we expect to see increasing demand for our products in this part of the world. Our Shenzhen and new Malaysian facilities will be instrumental in allowing us to leverage this demand and the corresponding business opportunities," explains Jacques L'Ecuyer, President and Chief Executive Officer of 5N Plus.

IQE wins Welsh 'Company of the Year' award

The global supplier of advanced semiconductor wafer products and services to the semiconductor industry, won the over £10 million turnover award

IQE plc. won the title of Company of the Year at the Western Mail / Institute of Welsh Affairs Business Awards staged at Cardiff City Hall on 9th November.

The Company of the Year for large companies with a turnover of more than £10 million, was presented by economics and media commentator Faisal Islam at a gala dinner celebrating the best in Welsh business and sponsored by business advisory firm PwC.

The Company of the Year (turnover more than £10 million) award category was sponsored by Cardiff School of Management at Cardiff Metropolitan University.

Major Japanese manufacturer selects DCG tool to inspect SiC

The firm's ELITE system comprises a laser marker, full IR lens options, double-sided probing and high voltage power analysis capability for silicon carbide device inspection

DCG Systems has announced that a major power device manufacturer has purchased its DCG's ELITE system for inspection of their next generation SiC power devices.

DCG ELITE system

"Sensitivity of the system is much better than we had expected and beyond even some of the claimed specifications provided by DCG," states the Manager of the customer's device development department. "The new laser marker was delivered on time and its performance has been much better than what had previously been available in the market."

This system is one of the most sophisticated ELITE systems yet delivered to a customer comprising the newly developed laser marker, full IR lens options, double-sided probing and high voltage power analysis capability.

"We believe this solution will help customers develop faster leading edge power devices. Employing new semiconductor materials such as SiC and GaN introduce increasing development and reliability challenges. The ELITE system is helping our customers strengthen their competitive edge in this growing market," explains Randy Schussler, VP and GM of the IRIS (InfaRed Imaging Systems) Business Unit at DCG Systems.

Aixtron hosts MOCVD short course in China

The course focussed on LED production and included costs, opportunities and potential in the industry

At this year's China SSL Conference, Aixtron hosted an MOCVD seminar along with the China Solid State Lighting Alliance (CSA), with presentations by leading industry experts.

More than 200 decision-makers from industry and research took part.

The China SSL conference is one of the largest annual events in the solid state lighting industry, where top industry elite and key government representatives meet.

"Prices for LED bulbs as replacements for 40W incandescent bulbs in some countries are below the US $10mark", remarks Bernd Schulte, COO & Member of the Aixtron Executive Board (pictured left), in his presentation.

"This is good news, because it will significantly expand the market for LED lighting. The question now is how to reduce manufacturing costs even further, which turns the focus onto MOCVD as a decisive manufacturing step."

"I am convinced that we can only achieve quality and cost efficiency by constantly improving the reactor design and through maximum process control. If we continue to strictly focus on these areas and, at the same time, help our customers to migrate to silicon wafers of up to 8 inches in diameter, we will be able to achieve a considerable further reduction of production costs," he continues.

"China has the potential to become the world's biggest market of end consumers for LEDs over the next few years," notes Tim Wang, General Manager of Aixtron China Ltd. "Over the past few months we have realigned and restructured our China organisations to be more customer focused. Our Demo & Training Centre is currently experiencing strong demand for supported process demo, training and development, which shows us that our customers recognize the benefit we have created for them locally."

Weak GaAs market affects AXT revenues

The firm's quarterly revenues have slid by over 25 percent

AXT, a manufacturer of compound semiconductor substrates, has reported financial results for the third quarter ended September 30th, 2012.

Revenues for the third quarter of 2012 were $20.8 million, compared to $28.3 million in the third quarter of 2011.

Total GaAs substrate revenue was $12.9 million for the third quarter of 2012, compared with $18.7 million in the third quarter of 2011.

InP substrate revenue was $1.6 million for the third quarter of 2012, compared with $1.5 million in the Q3 2011.

Germanium substrate revenue was $2 million for the third quarter of 2012 compared with $2.4 million in the second quarter of 2012. Raw materials sales were $4.3 million for the third quarter of 2012, compared with $6.5 million in the second quarter of 2012.

Gross margin was 26.3 percent of revenue for the third quarter of 2012. By comparison, gross margin in the second quarter of 2012 was 29.8 percent of revenue.

The drop in gross margin in the third quarter of 2012 was largely the result of lower selling prices of raw gallium, as well as lower tonnage sold, and lower volumes of sales in gallium arsenide substrates in both the wireless market and the LED market.

Operating expenses were $4.8 million in the third quarter of 2012, compared with $4.9 million in the second quarter of 2012.

Income from operations for the third quarter of 2012 was $0.7 million, compared with income from operations of $2.6 million in the second quarter of 2012.

Net interest and other income for the third quarter of 2012 was $544,000, which included a foreign exchange gain of $114,000. This compares with net interest and other income of $219,000 in the second quarter of 2012, which included a foreign exchange gain of $106,000.

Net income in the third quarter of 2012 was $0.9 million or $0.03 per diluted share, compared with net income of $1.3 million or $0.04 per diluted share in the second quarter of 2012.

"Business conditions in the third quarter were in keeping with the expectations that we outlined when we announced our results last quarter," said Morris Young, president and CEO.

"The compound semiconductor substrate market is currently experiencing a correction, largely driven

by weaker demand and a moderate amount of excess inventory in the channel. However, our solid execution over the last many quarters is allowing us to weather the current down cycle and we are using this time to support significant qualifications that are still ongoing and to focus our resources on strategic geographies and applications that are likely to benefit AXT in the future. We view improving market conditions, new customer qualifications and a bottoming of raw material pricing as key catalysts for our growth in the coming year and beyond."

Raman spectroscopy comes in blue, green and red

CRAIC is offering a tool which measures Raman spectra of micron-scale samples with multiple lasers ranging from 405 to 830nm

CRAIC Technologies has added more laser wavelengths to its Apollo Raman microspectrometer.

Designed to be added to many different types of light microscopes, the CRAIC Apollo enables scientists and engineers to measure the Raman spectra from microscopic samples or microscope sampling areas of large samples.

The CRAIC Apollo can also be added to a CRAIC Technologies microspectrophotometer, adding Raman microspectroscopy to UV-visible-NIR absorbance, reflectance and fluorescence microspectroscopy and imaging.

And because the CRAIC Apollo is now offered with lasers with peak wavelengths ranging from 405 nm through the 830 nm, a whole host of capabilities are now available to researchers and engineers including resonance Raman spectroscopy and more.

What's more, multiple lasers can be combined on a single microscope for maximum experimental flexibility. By offering these new lasers for the CRAIC Apollo Raman spectrometer, CRAIC Technologies is able to supply a more powerful tool for sample micro-analysis.

"CRAIC Technologies has been an innovator in the field of UV-visi ble-NIR microanalysis since its founding. We have helped to advance the field of microscale analysis with innovative instrumentation, software, research and teaching.

We have seen the need for Raman microspectroscopy in addition to our current capabilities of UV-visible-NIR and luminescence microspectroscopy. Therefore, we created the CRAIC Apollo Raman microspectrometer based around a large number of different lasers," says Paul Martin, President of CRAIC Technologies.

"And by combining the power of Raman spectroscopy with our UV-visible microspectrophotometers, the customer no longer has purchase a separate instrument, nor move the sample between instruments and acquire the data separately. You can analyse the same microscopic area of the sample under the same conditions without additional sample preparation or instrument alignment. Improved results and sample analysis throughput can be dramatically increased."

The CRAIC Apollo Raman microspectrometer is a self contained unit that features Raman grade lasers as the light source, an advanced optical interface to the microscope, a Raman spectrometer and sophisticated software for instrument control and data analysis.

Lasers are now offered throughout the visible and near infrared region and include 405, 473, 488, 546, 638, 660, 785 and 830 nm. Each module can be used either individually or the modules may be combined so that multiple laser wavelengths can be used to probe a single sample.

The idea is to provide a highly flexible Raman microspectrometer with the optimum laser wavelengths to enhance your spectroscopic

results. These rugged, self-contained units are also designed to be used either with an optical microscope or with a CRAIC Technologies microspectrophotometer.

With high sensitivity, durable design, ease-of-use, multiple imaging and spectroscopic techniques and the support of CRAIC Technologies, the CRAIC A

Quartz Sharpens SEM Images

A new feature of Quartz PCI software, works with a single image or a group of images of III-V semiconductors

Quartz Imaging Corporation is introducing a new SEM sharpness measurement tool.

Scanning Electron Microscopy (SEM) images can be measured regularly to monitor the performance of an SEM and a detailed report can be generated in just a few clicks. This is the latest feature of Quartz PCI.

Even with Preventive Maintenance programs provided by SEM manufacturers, it is still important for microscopy labs and their clients that the performance of SEMs and the quality of the images they create be monitored regularly. Image sharpness, which is related to resolution, is the primary indicator of SEM performance.

SEM is an invaluable tool in looking at interfaces in III-V semiconductors and it is far less laborious to make SEM samples than make ones for TEM. Transmission Electron Microscopy (TEM) has major advantages over SEM, but if time is of the essence, then SEM is a major asset. Especially as a wide area can be viewed in one sample, unlike in TEM.

Quartz Imaging has recently introduced its SEM Sharpness Measurement Tool, included in Quartz PCI version 9. With this tool, microscopists will be able to quickly and easily measure and monitor the performance of their SEM.

Regular sharpness (resolution) measurements can identify when an SEM is in need of service, before the performance becomes an issue. The SEM Sharpness Measurement Tool uses the FT (Fourier Transform) and DR (Derivative Method) methods to calculate the sharpness of an image. Both methods conform to the ISO standard “ISO/TS 245697 – Methods of evaluating image sharpness”.

In a matter of moments, the SEM Sharpness Measurement Tool calculates CNR (Contrast-to-noise ratio) along with FT and DR sharpness results to create an average score for each image and an overall score for the SEM.

Operators also have the option of dropping the best and worst average results when calculating the overall performance of the SEM utilising multiple images. A polar plot showing the sharpness value vs. angle can also be generated increasing the information available related to the resolution performance of the SEM. As with all PCI software a report can be easily generated including all images, their sharpness measurement results and polar plots.

Attolight & Leti to extend cathodoluminescence technology

A joint-development program between the two companies will extend applications for detecting defects and impurities in semiconductor chips

Attolight and CEA-Leti have entered into a joint-development program to apply Attolight’s cathodoluminescence microscopy to semiconductor materials.

Attolight’s innovative combination of electron and light microscopy reveals ultra-trace impurities and crystallographic defects not visible using other imaging techniques.

The company’s core expertise is a measurement technique called cathodoluminescence, a non-destructive characterisation method yielding a level of data that provides a deeper understanding of material structures and properties.

The program with Leti is designed to extend the technology for use in the chip industry and research applications.

"This joint-development program with CEA-Leti is a major milestone for Attolight. It is a clear indicator of the value of Attolight's innovative technology for state-of-the-art research in a variety of applications," says Attolight CEO Samuel Sonderegger. "We are very proud to collaborate with such a prestigious partner and this development clearly endorses the quality of Attolight's products."

"Our integrated cathodoluminescence approach opens new areas of investigation for research and development teams. For the first time in the marketplace, Attolight's non-destructive methodology generates quantitative high-resolution cathodoluminescence data for advanced material research," adds Olivier Gougeon, Attolight's vice president of sales and marketing.

"This joint development program will accelerate the build up of Attolight's product portfolio and will support the company's global strategy to provide innovative characterisation tools, services and technical expertise to the semiconductor industry and research laboratories."

"The introduction of the cathodoluminescence microscopy in our portfolio of advanced characterisation techniques is in line with our roadmaps, and made possible thanks to the French RTB program," continues Narciso Gambacorti, Leti's nanocharacterisation program manager.

"This new equipment will complete the unique offer in terms of material analysis already available in the world-class nanocharacterisation platform (PFNC) present at the MINATEC campus. Attolight's experience in the field of material analysis and cathodoluminescence, in particular, will significantly accelerate the introduction of this technique at Leti," concludes Gambacorti.

AMCAD's testing system ideal for GaN & SiC HV transistors

The 1kV/ 30A IV pulse tool provides high voltage signals and short pulse / fast switching capabilities in gallium nitride and silicon carbide devices simultaneously

French firm, AMCAD Engineering has upgraded its PIV semiconductor device analyser family for the next generation of High Voltage Fast Switching (HVFS) Transistors.

HVFS transistors open the way to new targets and new designs for high efficiency DC-DC converters, switches, hubs and servers, telecom tations, and automotive applications. Other applications include LED drive circuits and Class D audio amplifiers.

The latest HVFS transistor technologies include Enhanced Mode GaN FET and SiC MOSFET. They offer very fast switching frequencies that are up to 10 times higher than previous solutions and permit designers to use lower duty cycles than they currently do.

AMCAD says that until now, there were no efficient testing solutions which highlighted the capabilities of these new technologies. Previous solutions could not provide simultaneously high voltage signals and short pulse / fast switching capabilities.

"AMCAD complements its existing Pulse IV system portfolio by offering a new solution with pulse width down to 400ns@1KV to help customer testing High voltage Fast Switching transistors", says Tony Gasseling, General Manager. He continues, "Once again, we are very pleased to lead the innovation in the field of semiconductor pulsed characterisation".

AMCAD Engineering provides solutions to today's electronic design challenges. The company is dedicated to providing the most advanced solutions and tools in test and modelling to the RF, microwave IC and power electronic markets.

Asahi Kasei to develop III-V devices with Aixtron system

Apart from arsenide and phosphide optoelectronic device development, the Japanese firm will improve its antimonide-based magnetic sensors

Asahi Kasei has ordered an Aixtron 6 x 2-inch MOCVD system to develop its next generation arsenide-phosphide-based optoelectronic devices and antimonide-based sensor devices.

The order for the Close Coupled Showerhead

(CCS), was placed in the first quarter and delivery is due in the fourth quarter of 2012.

The Aixtron system will be initially used for R&D purposes and can be used to grow on small and large wafers. CCS-based processes can also be easily scaled-up later for volume production.

What's more, the CCS concept also allows high yields with larger area devices. Asahi Kasei has also ordered special features for its system including an EpiTT, an ARGUS multi-channel pyrometer, and Gap Adjustment.

Through its subsidiary, Asahi Kasei Microdevices Corporation, Asahi Kasei has been developing antimonide-based magnetic sensors for some time, based on the Hall Effect. Antimonide-based sensors benefit from some unique material properties which result in the highest sensitivity compared with sensors made from other materials.

Asahi Kasei Microdevices Corporation,a fully owned subsidiary of Asahi Kasei, is a manufacturer of Hall elements and Hall Effect ICs. Aixtron says it has more than 75 percent share in this market.

The main applications of Hall elements are brushless motors used in Blu-ray/DVD drives, cooling fans for electrical equipment, current sensors for home appliances and position detection sensors used in image stabiliser systems of digital still and video cameras.

Hall Effect ICs are also widely used in position and rotation detection for mobile phones, motors, industrial and automotive equipment.

Aixtron admits it will not return to profitability this year

The company has made €51.5m inventory write-downs due to dwindling MOCVD demand

Aixtron SE wrote-down EURO (€) 51.5 million of inventory due to a significantly slower than expected recovery of demand for MOCVD equipment.

The devaluation followed a comprehensive review of inventory held.

This concluded that despite the positive long-term outlook for the LED industry, the existing stock held was inappropriately high in comparison to the current subdued level of demand in the market.

These non-cash effects will lead to a negative operating result of around €78 million in Q3/2012 or €113 million for the first nine months of 2012.

However, for fiscal year 2012, Aixtron expects sequentially stronger fourth quarter revenues, albeit considerably less than previously expected. As a result of the unexpected slower demand recovery, the company will not report a profit in fiscal year 2012.

Aixtron anticipates for fiscal year 2012, that it will achieve full year total revenues of around €220 million. This would be mainly due to the write-offs and the expected negative operating result will be about €125 million.

For fiscal year 2013, the firm's management expects an increase of demand for LED manufacturing equipment. This would be driven by stronger projected demand in the LED lighting market and Aixtron expects to return to profitability during the year.

Riber loses member of its Supervisory Board

Jacques Kielwasser's position is not expected to be filled at the moment

Riber has announced the resignation of Jacques Kielwasser from the Supervisory Board as of 21stOctober.

Riber expresses its appreciation to Kielwasser for his contribution to the Board. His position is not expected to be filled at the moment, the number of Board members being above legal and statutory requirements.

Riber designs and produces MBE systems as well as evaporation sources and cells for the semiconductor industry. These tools are essential

for the manufacturing of compound semiconductor materials and new materials that are used in numerous consumer applications, from new information technologies to OLED flat screens and new generation solar cells.

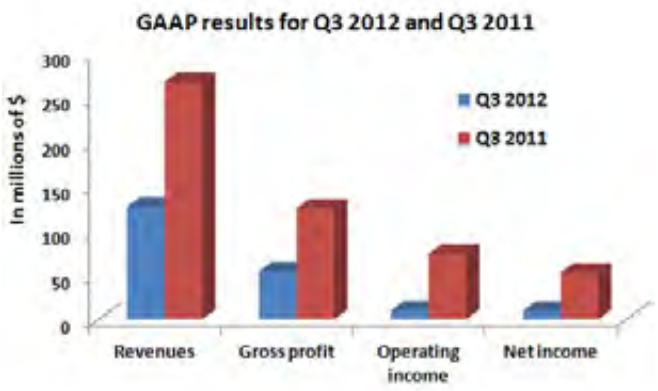
Riber recorded €29 million in revenues in 2011 and employs 105 people.

Veeco results slashed by lack of MBE & MOCVD orders

Third quarter LED & Solar revenues were $94 million: approximately $79 million in MOCVD and $15 million in MBE. Data Storage revenues were $33 million

Veeco Instruments Inc. has announced its financial results for the third quarter ended September 30th, 2012.

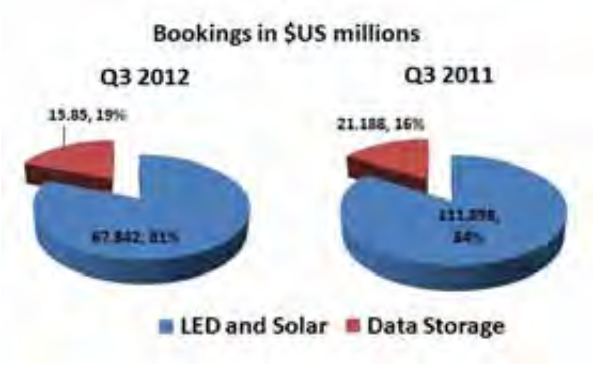
The company has reported its results on a U.S. GAAP basis. All results presented forthwith are for Veeco's "Continuing Operations."



John R. Peeler, Veeco's Chairman and Chief Executive Officer, comments, "Veeco's third quarter revenue was $127 million, and adjusted EBITA and non-GAAP earnings per share were $17 million and $0.34, in line with our guidance. Veeco generated $46 million in cash flow from operations, ending the quarter with $574 million in cash and short term investments."

Third quarter LED & Solar revenues were $94 million: approximately $79 million in MOCVD and $15 million in MBE. Data Storage revenues were $33 million.

Peeler continues, "Third quarter bookings were weak at $84 million, representing trough levels in all businesses. LED & Solar orders totalled $68 million: MOCVD continued to bump along the bottom at $63 million as LED customers work through overcapacity and delay significant fab expansions."



"MBE bookings declined 33 percent sequentially to $5 million, with customer consolidation causing a slowdown in production buys for wireless applications. Data Storage customers froze spending due to hard drive overcapacity and a weakening demand outlook, resulting in a 37 percent sequential decline in orders to $16 million," he continues.

Veeco's book-to-bill ratio was 0.66 to 1 and quarter-end backlog was $187 million.

Fourth Quarter 2012 Guidance & Outlook

Veeco's fourth quarter 2012 revenue is currently forecasted to be between $100 million and $115 million. Earnings per share are currently forecasted to be between ($0.09) to $0.03 on a GAAP basis.

Veeco is likely to take additional restructuring actions in the fourth quarter.

Peeler adds, "Taking into account our fourth quarter guidance, Veeco's 2012 revenue is forecasted to be over $500 million and we will have delivered double digit profitability, successfully managing through a challenging year."

"We are cautious about short-term business conditions since there is still no clear sign that the economy is improving," continues Peeler. "However, the LED market is getting better – general lighting is growing, excess capacity is being absorbed, and customers are reporting more

stable business conditions. An MOCVD order snap-back is inevitable as LEDs go from 5 percent of all lighting to over 30 percent over the next few years. Insatiable demand for storage will drive future hard drive industry capital expenditures and technology investments. We anticipate that Veeco's orders will improve in the coming quarters."

"In the meantime, we are focused on lowering our cost structure while protecting investments in R&D and new products," concludes Peeler. "Our goal is to remain profitable while funding our future. We are market leaders with exceptional technology and customer roadmap alignment. We are well positioned for future growth as our end markets recover and the world adopts solid state lighting."

Veeco's process equipment solutions include MBE and the MOCVD manufacture of LEDs and power electronics as well as wireless chips.

Veeco MOCVD systems popular with HC SemiTek

China's LED chip manufacturer has purchased several reactors from Veeco to mass produce gallium nitride based products

HC SemiTek Corporation has purchased additional Veeco TurboDisc MaxBright GaN MOCVD Systems.

The firm will use the reactors for the for high volume production of LEDs for display and general lighting applications.

The order, placed in the third quarter of 2012, was for Veeco's new High Performance (MHP) version of the system.

Rong Liu, President of HC SemiTek, states, "Veeco's MOCVD products offer stable process and have already helped us to successfully produce high quality, high brightness LEDs. The addition of MaxBright MHPs to our manufacturing line will allow us to ramp additional production quickly, due to the seamless process transfer from our existing Veeco toolset."

Jeff Hawthorne, Veeco's Senior Vice President, MOCVD, adds, "We are pleased HC SemiTek has once again chosen Veeco's MOCVD technology for their production requirements. The MaxBright MHP helps drive our customers' productivity and yield, while reducing manufacturing costs."

The MaxBright MHP MOCVD system is designed to manufacture high quality, high brightness LEDs. Veeco says it provides as much as 20 percent within-wafer wavelength uniformity improvement, enhanced serviceability and a 15 percent increase in footprint efficiency as compared to the MaxBright.

Interiror of Veeco's TurboDisc MaxBright MHP GaN MOCVD System

Higher yields are achieved from improved thermal and flow capability. This system leverages Veeco's production-proven Uniform FlowFlange technology and automation expertise by combining multiple high throughput MOCVD reactors in a modular 2- or 4-reactor cluster architecture.

HC SemiTek Corporation, formerly Wuhan HC SemiTek Co., Ltd., is an LED chip supplier based in Wuhan, China, and is committed to R&D, production and sales of high-quality LED chips, mainly in GaN-based blue and green LEDs.

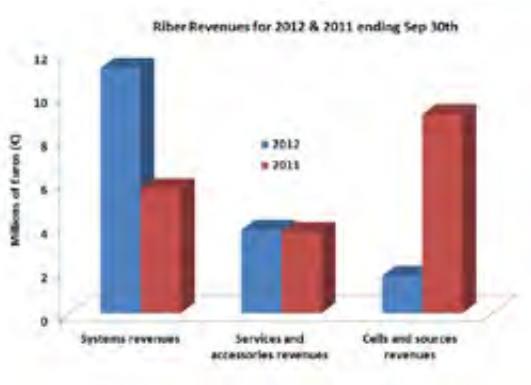
Riber revenues shift from cells & sources to systems

The firm has reported yearly and quarterly results

Riber, a provider of MBE kits, recorded €16.7 million euros in revenues at the end of September 2012.

Revenues for the third quarter of 2012 came to €7.3 million, compared with €5.5 million for the third quarter of 2011.

Revenues came to €16.7 million at the end of September 2012, reflecting a change in the product mix in favour of the MBE system sales business.



As of September 30th, 2012, 10 MBE machines were billed, compared with 5 during the same period in 2011. This commercial success is paving the way for gains in Riber's market shares, particularly in the research sector.

Sales of services and accessories are stable in relation to the previous year, in an environment marked by the economic downturn.

Sales of evaporation sources and cells are significantly lower than the previous year, which had benefited from high levels of sales of equipment for OLED production in 2011.

On September 30th, 2012, the breakdown of Riber's revenues was as follows: Europe (43 percent), Asia (40 percent) and North America (17 percent).

Outlook
During the third quarter of 2012, Riber recorded two research system orders for laboratories in China and India, compared with three research systems during the third quarter of 2011. On September 30th, 2012, the order book represented €18.0 million (€19.3 million one year ago), comprising 14 MBE systems to be delivered between 2012 and 2013.

For cells and sources, the order book is down following the difficulties currently faced by the photovoltaic sector, as well as the ongoing development of new ranges of OLED cells in anticipation of the next waves of investments.

The order book for services and accessories should be stable over the year.

Riber is able to confirm its target for revenues between €26 and 28 million in 2012, with an operating margin ratio representing 7 to 9 percent of revenues.

2012 full-year revenues will be released on January 23rd, 2013 (after close of trading).

Jenoptik unveils a wide-ranging photodiode portfolio

The photodiodes are made from a range of III-phosphides, arsenides, nitrides and silicon carbide

Jenoptik has developed a new product range of photodiodes with an angle-independent response spectrum.

Compared with conventional silicon photodiodes, the new photodiodes detect a predefined wavelength range without the need for the insertion of an additional filter.

The photodiodes are made from materials such as GaP, AlGaN, AlGaAs, InGaAs, or SiC and are designed for a spectral range of 150 to 1750nm.

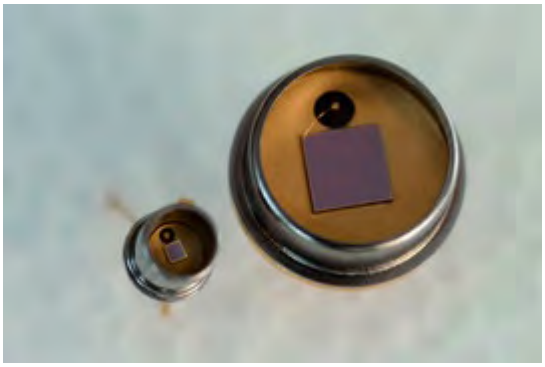
Unlike dielectric filters, they also provide spectral receiving characteristics that are independent of the angle of incidence of the radiation.

The new photodiodes are ideally suited for all photometric applications where an extended measurement range is required.

These new diodes can save space and follow the trend towards miniaturisation while simplifying assembly.

Jenoptik provides customer specific solutions and a wide range of photodiode products as preassembled standard products in SMD and TO

housings.
Their detection is wavelength-selective. Jenoptik says they have very good signal and noise performance. In hermetically sealed special housings, they are thermally stable up to 125°C.



UV-Photodiodes

Photodiodes provide safety.

They are widely-used in the automotive, security and health care industries in a wide range of applications. These include daylight/tunnel sensors or lane departure warning systems in vehicles.

They can be applied in monitoring safety levels in gas detectors, in water disinfection of UV radiation, as flame sensors for burner monitoring, as detectors in photoelectric sensors, and for analysis of body fluids concentration in medical technology.

Jenoptik has extended its assembly and packaging process chain by recent investments in wafer sawing and multi-chip bonding, and can processe wafers of up to 300mm.

This enables customers to realise economical solutions with high-precision production processes that are at the forefront of technology.

The new systems are particularly suitable for the processing of complex customised micro-electronic components such as image processing sensors.

Using the more powerful double-spindle wafer saw, the new fully automatic system cuts, cleans and exposes the wafers contained in a magazine.

Jenoptik says the two-spindle saw also reduces the cycle time by more than half when compared to semi-automatic processes.

Its intelligent water supply system makes the saw especially suitable for the processing of silicon-based image sensors and optical glass.

Jenoptik is now working with a multi-chip bonder to further process the 300mm wafers.

Depending on the quality of the source material, this chip bonder achieves a placement accuracy of up to ±10 µm and can process chips with an edge length of between 0.2 and 80mm.

The main advantage of 300mm wafer source material is that there is less waste.

Depending on the chip size required, there is a correspondingly higher yield per wafer. This substantially reduces manufacturing costs for semiconductor chips in comparison with smaller wafer diameters.

Jenoptik will be exhibiting examples of its products at its booth at the electronica trade fair. These exhibitions range from the basic wafer material to the complete micro-electronic component, including software.

The company will demonstrate its digital image processing, from application-specific CMOS imaging modules to microscope cameras from the ProgRes range and options for integrated, customised image-processing systems.

GSU selects Meaglow plasma source

The system will be used for the development of group III-nitride compound semiconductor materials

Meaglow has announced that Georgia State University (GSU) has received shipment of its patent pending hollow cathode plasma source.

The installed Meaglow plasma source extends the growth processing parameter space of GSUs presently utilised in low-pressure MOCVD reactors. This upgrades the tool so that it can produce type III-nitride materials under normal low-pressure growth conditions.

Meaglow hollow cathode plasma source

Meaglow's plasma source fosters a plasma-assisted gas phase and surface chemistry that provides a new path for the integration of dissimilar materials for ternary and quarternary III-nitride alloys.

Research in Dietz's group at GSU will study the migration enhanced afterglow chemistry and growth dynamics for III-nitride epilayers and nanocomposites. They will support Meaglow's effort in commercialising the growth technology.

Meaglow hollow cathode in use

Meaglow has previously applied its hollow cathode plasma source technology via its migration enhanced afterglow technique in the deposition of high indium content InGaN. More recently, the source has been demonstrated in a yellow LED in the green gap.

Meaglow is now focused on commercialising its hollow cathode plasma technology, and is fielding inquiries from partners interested in plasma source solutions for MBE or any surface modification to materials.

Mass-Vac explains the benefits of filtration for MOCVD

The firm has released a video which describes the benefits of filtration solutions. These can enhance the MOCVD growth of silicon germanium, MOCVD grown gallium nitride, gallium arsenide, indium phosphide and HVPE gallium nitride

Mass-Vac has introduced a new video that reviews filtration solutions for protecting vacuum pumps and systems in wafer processing applications.

"The MultiTrap Vacuum Trap Selection Criteria and Configurations Video," explains the decisions to be made for choosing the correct filtration components for a specific manufacturing process using its multi-stage vacuum trap.

The applications where the trap can be applied include LPCVD, PECVD, SiGe, MOCVD GaN, GaAs, InP, wafer processing and HVPE grown GaN.

The MultiTrap Vacuum Trap can be customised by the user to match their particular process requirements. There is also a cooling option available.

The video illustrates how the different stages and replaceable filter elements can be used for typical applications.

5N Plus subsidiary awarded $1.32 million for Ge substrates

The company will upgrade a portion of the NDS germanium metal inventory to unfinished germanium substrates to be used for multijunction solar cell production

5N Plus has announced that its 66.67% owned subsidiary Sylarus Technologies, LLC, has been awarded a US$1.32 million contract by the Defence Logistics Agency (DLA).

Sylarus will use the cash to upgrade a portion of the National Defence Stockpile (NDS) high purity germanium metal inventory to unfinished germanium substrates. These will be used in the manufacture of multijunction photovoltaic solar cells employed in National Security Space (NSS) applications.

Sylarus is the sole U.S. domestic space-qualified germanium substrate supplier to NSS customers, and says it is one of only two NSS-qualified germanium substrate suppliers worldwide.

The latest award brings the total Sylarus U.S. Government contract award value to over US$10 million.

The DLA award is strategic in nature as Sylarus now becomes part of the U.S. NDS for strategic materials. The company now believes it has the potential for a follow-on business, both as a strategic metal supplier and NDS inventory manager.

5N Plus manufactures purified metals such as gallium, germanium, indium, selenium and tellurium, used in the MOCVD growth of compound semiconductor wafers.

Novel Devices

Flexible, low-voltage circuits using CdSe nanocrystals

Scientists say that cadmium selenide nanocrystal devices can move electrons 22 times faster than in amorphous silicon

Electronic circuits are typically integrated in rigid silicon wafers, but flexibility opens up a wide range of applications.

In a world where electronics are becoming more pervasive, flexibility is a highly desirable trait, but finding materials with the right mix of performance and manufacturing cost remains a challenge.

Now a team of researchers from the University of Pennsylvania has claimed that nanoscale particles, or nanocrystals, of the semiconductor cadmium selenide (CdSe) can be "printed" or "coated" on flexible plastics to form high-performance electronics.

The research was led by David Kim, in the Department of Materials Science and Engineering in Penn's School of Engineering and Applied Science and the work was published in the journal *Nature Communications*.

"We have a performance benchmark in amorphous silicon, which is the material that runs the display in your laptop, among other devices," Kagan, a co-author of the publication, says. "Here, we show that these cadmium selenide nanocrystal devices can move electrons 22 times faster than in amorphous silicon."

Besides speed, another advantage cadmium selenide nanocrystals have over amorphous silicon is the temperature at which they are deposited. Whereas amorphous silicon uses a process that operates at several hundred degrees, CdSe nanocrystals can be deposited at room temperature and annealed at mild temperatures, opening up the possibility of using more flexible plastic foundations.

Another innovation that allowed the researchers to use flexible plastic was their choice of ligands, the chemical chains that extend from the nanocrystals' surfaces and helps facilitate conductivity as they are packed together into a film.

"There have been a lot of electron transport studies on cadmium selenide, but until recently we haven't been able to get good performance out of them," Kim says. "The new aspect of our research was that we used ligands that we can translate very easily onto the flexible plastic; other ligands are so caustic that the plastic actually melts."

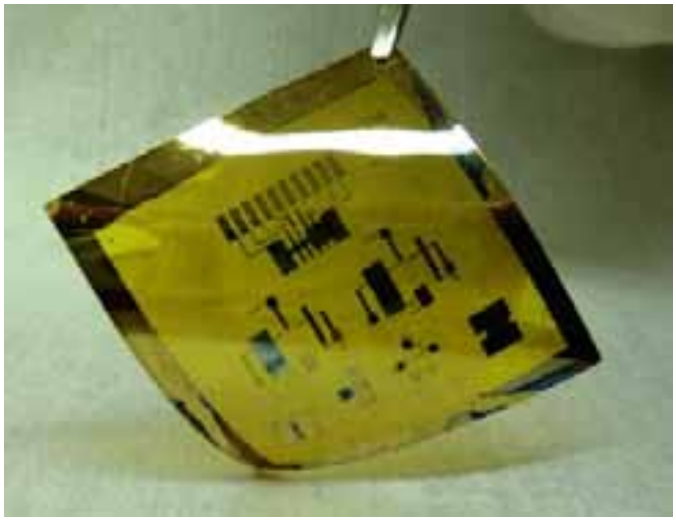
Because the nanocrystals are dispersed in an ink-like liquid, multiple types of deposition techniques can be used to make circuits. In their study, the researchers used spincoating, where centrifugal force pulls a thin layer of the solution over a surface, but the nanocrystals could be applied through dipping, spraying or ink-jet printing as well.

On a flexible plastic sheet a bottom layer of electrodes was patterned using a shadow mask, essentially a stencil, to mark off one level of the circuit. The researchers then used the stencil to

define small regions of conducting gold to make the electrical connections to upper levels that would form the circuit.

An insulating aluminium oxide layer was introduced and a 30nm layer of nanocrystals was coated from solution. Finally, electrodes on the top level were deposited through shadow masks to ultimately form the circuits.

“The more complex circuits are like buildings with multiple floors,” Kagan says. “The gold acts like staircases that the electrons can use to travel between those floors.”



Flexible circuit fabricated in the Kagan lab. (Photo: David Kim and Yuming Lai)

Using this process, the researchers built three kinds of circuits to test the nanocrystals performance for circuit applications: an inverter, an amplifier and a ring oscillator.

“An inverter is the fundamental building block for more complex circuits,” Lai, another co-author of the paper, comments. “We can also show amplifiers, which amplify the signal amplitude in analogue circuits, and ring oscillators, where ‘on’ and ‘off’ signals are properly propagating over multiple stages in digital circuits.”

“And all of these circuits operate with a couple of volts,” Kagan says. “If you want electronics for portable devices that are going to work with batteries, they have to operate at low voltage or they won’t be useful.”

With the combination of flexibility, relatively simple fabrication processes and low power requirements, these cadmium selenide nanocrystal circuits could pave the way for new kinds of devices and pervasive sensors, which could have biomedical or security applications.

“This research also opens up the possibility of using other kinds of nanocrystals, as we’ve shown the materials aspect is not a limitation anymore,” Kim points out.

More details of this work can be accessed in the paper, “Flexible and low-voltage integrated circuits constructed from high-performance nanocrystal transistors,” by David K. Kim *et al* in *Nature Communications,* 3, Article number 1216,. DOI: 10.1038/ncomms2218

The research was supported by the U.S. Department of Energy and the National Science Foundation.

New device is elusive to infrared cameras

A tuneable material using sapphire and vanadium dioxide developed at Harvard boasts nearly 100 percent absorption on demand

Now you see it, now you don’t.

A new device invented at the Harvard School of Engineering and Applied Sciences (SEAS) can absorb 99.75 percent of infrared light that shines on it.

When activated, it appears black to infrared cameras.

Composed of just a 180 nanometre (nm) thick layer of vanadium dioxide (VO2) on top of a sheet of sapphire, the device reacts to temperature changes by reflecting dramatically more or less infrared light.

Announced in the journal *Applied Physics Letters*, and featured on its cover, the absorber is ultrathin, tuneable, and well suited for use in a range of infrared optical devices.

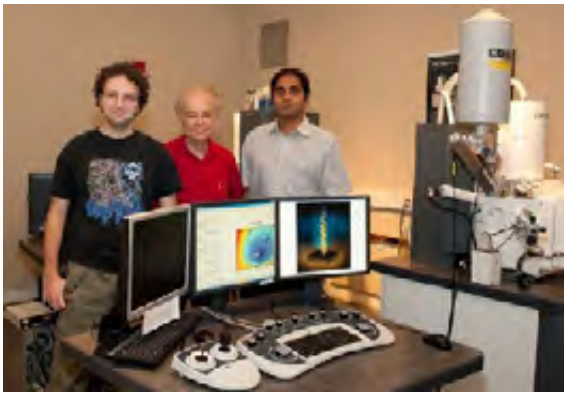
The researchers say that perfect absorbers have been created many times before, but not with such

versatile properties.

In a Fabry-Pérot cavity, for instance, used in a VCSEL, two mirrors sandwich an absorbing material, and light reflects light back and forth until it's mostly all gone. Other devices incorporate surfaces with nanoscale metallic patterns that trap and eventually absorb the light.

"Our structure uses a highly unusual approach, with better results," says principal investigator Federico Capasso at SEAS.

"We exploit a kind of naturally disordered metamaterial, along with thin-film interference effects, to achieve one of the highest absorption rates we've ever seen. Yet our perfect absorber is structurally simpler than anything tried before, which is important for many device applications," continues Capasso.



Mikhail Kats, Federico Capasso, and Shriram Ramanathan used unusual materials and interference effects to create a perfect absorber. They are pictured here in a scanning electron microscopy imaging suite at the Harvard Centre for Nanoscale Systems. (Photo by Caroline Perry, SEAS Communications.)

With collaborators at Harvard and at the University of California, San Diego, Capasso's research group took advantage of surprising properties in both of the materials they used.

Vanadium dioxide is normally an insulating material, meaning that it does not conduct electricity well.

Take it from room temperature up to about 680C, however, and it undergoes a dramatic transition.

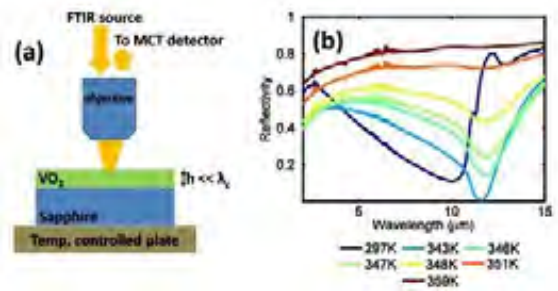
The crystal quickly rearranges itself as the temperature approaches a critical value. Metallic islands appear as specks, scattered throughout the material, with more and more appearing until it has become uniformly metallic.

"Right near this insulator-to-metal transition, you have a very interesting mixed medium, made up of both insulating and metallic phases," says co-authorof the paper, Shriram Ramanathan, Associate Professor of Materials Science at SEAS, who synthesised the thin film. "It's a very complex and rich microstructure in terms of its electronic properties, and it has very unusual optical properties."

Those properties, when manipulated correctly, happen to be ideal for infrared absorption.

Meanwhile, the underlying sapphire substrate has a secret of its own. Usually transparent, its crystal structure actually makes it opaque and reflective, like a metal, to a narrow subset of infrared wavelengths.

The result is a combination of materials that internally reflects and devours incident infrared light.



The image on the left shows the experimental setup used for measuring the reflectivity of the vanadium-sapphire device. The graph on the right illustrates that at just the right temperature (light blue line), the reflectivity of the device drops almost to zero (99.75 percent absorbance) for infrared light at a wavelength of 11.6μm. (Illustrations courtesy of Mikhail Kats.)

"Both of these materials have lots of optical losses, and we've demonstrated that when light reflects between lossy materials, instead of transparent or highly reflective ones, you get strange interface reflections," explains lead author Mikhail Kats, a graduate student at SEAS.

"When you combine all of those resulting waves, you can coax them to destructively interfere and

completely cancel out. The net effect is that a film one hundred times thinner than the wavelength of the incident light can create perfect absorption."

The challenge for Capasso, Ramanathan, Kats, and their colleagues was not only to understand this behavior, but also to learn how to fabricate pure enough samples of the vanadium dioxide.

"Vanadium oxide can exist in many oxidation states, and only if you have VO2 does it go through a metal-insulator transition close to room temperature," Ramanathan explains.

"We have developed several techniques in our lab to allow exquisite compositional and structural control, almost at the atomic scale, to grow such complex films. The resulting phase purity allows us to see these remarkable properties, which otherwise would be very difficult to observe."

Because the device can be easily switched between its absorbent and non-absorbent states, the possible applications are quite wide ranging and include bolometers (thermal imaging devices) with tuneable absorption, spectroscopy devices, tuneable filters, thermal emitters, radiation detectors, and equipment for energy harvesting.

"An ideal bolometer design needs to absorb all of the infrared light that falls on it, turning it to heat, and correspondingly its resistance should change a lot per degree change in temperature," notes Kats. "In principle, our new perfect absorber could be used to make incredibly sensitive thermal cameras."

Harvard's Office of Technology Development has filed patent applications on the novel invention and is actively pursuing licensing and commercialisation opportunities.

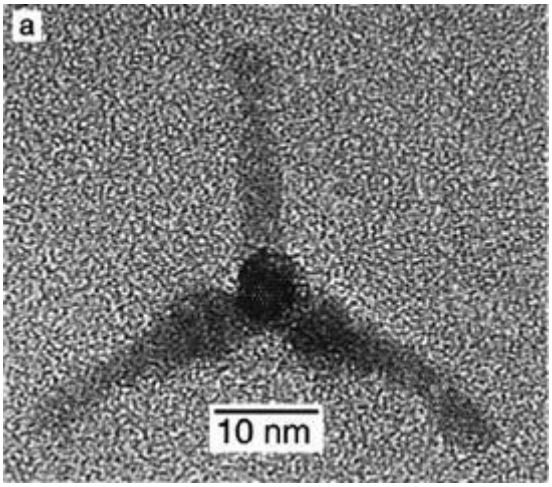
This work was supported in part by the Defence Advanced Research Projects Agency (DARPA). The researchers were also supported by a graduate research fellowship from the National Science Foundation; the Agency for Science, Technology, and Research in Singapore, the Office of Naval Research, the Jeffress Memorial Trust; and the Air Force Office of Scientific Research.

U.S. grants QMC tetrapod quantum dot synthesis patent

The patent, regarding a green method of manufacturing II-VI quantum dots, will provide precise control of both QD shape and dimension during synthesis

Quantum Materials Corporation, Inc. (QMC) has been granted the USPTO patent of a fundamental disruptive technology for synthesis of Group II-VI inorganic tetrapod quantum dots.

The patent, "Synthesis of Uniform Nanoparticle Shapes with High Selectivity," invented by Michael S. Wong's group at William Marsh Rice University, Houston, Texas, gives precise control of both QD shape and dimension during synthesis and is adaptable to quantum dots production of industrial scale quantities.



QMC II-VI tetrapod quantum dot

The new synthesis is a greener method using surfactants as would be found in laundry detergent instead of highly toxic chemicals used during industry standard small batch synthesis.

QMC has acquired the exclusive worldwide license for this patent and its wholly owned renewable energy subsidiary, Solterra Renewable Technologies, has the same rights specific to QD Solar Applications.

QMC recently announced a high quantum yield of 80 percent for a new class of tetrapod QD synthesised with this patented process.

According to a new market research report, "Quantum Dots (QD) Market – Global Forecast & Analysis (2012 – 2022)" published by MarketsandMarkets, the total market for Quantum dots is expected to reach $7.48 billion by 2022, at a CAGR of 55.2 percent from 2012 to 2022.

The Rice University QD synthesis produces the same-sized tetrapods, in which more than 92+ percent are full tetrapods, with a similar high degree of process control over QD shape, size, uniformity, and selectivity. The synthesis is applicable to a wide range of mono and hybrid Group II-VI tetrapod QD with/without shell and can optimise specific characteristics by modifying process parameters.

Across the broader QD industry however, other companies have been striving to increase production, but none have predicted scaling quantum dot production remotely close to multiple kilograms per day.

QMC's development of breakthrough software-controlled continuous flow chemistry process allows scaling of tetrapod quantum dot production to 100kg/day. Increasing production will transform tetrapod quantum dots from a novelty to a commodity, available across industries and applications where prior limited availability and high prices restricted product development.

For example, 100kg daily QD production can support a QD Solar Cell Plant producing one Gigawatt/year of R2R flexible QD solar cells at an industry competitive .75 cents/Watt at the start.

Tetrapod QDs are claimed to offer inherent advantages over spherical QDs including higher brightness, and more colours, the use of less active material (QDs) for any application, higher photostability and therefore longer lifetime; which together more than justify their product development.

OLEDs, for example, share design architecture similarities and would not require entirely new research to adapt to TQD-LEDs. Spherical quantum dots, at the low price of $2000/gm. are 30 times more expensive than gold today.

Until now, it has not been economically feasible to commercialise QD applications due to their high cost, which stems from the difficulty of small batch manufacture, the inability to produce uniform, same size QD from batch to batch, and to promise a reliable, timely supply.

Over the last half dozen years university and corporate quantum dot research has increased dramatically and there are ready QD applications that may now be "business planned" for joint ventures or possible licensing with QMC and Solterra Renewable Technologies.

Stephen B. Squires, CEO and President of Quantum Materials Corporation, Inc. and Solterra Renewable Technologies, Inc., says, "With the granting of the US Patent, tetrapod quantum dots are well positioned to revolutionise several industries in offering dramatic performance at cost effective levels."

"While the technology has been under review, we have continued to execute our vision to establish global manufacturing centres and strategic partnerships for creating dramatic value in our companies."

Squires continues, "We are excited to continue our business plan with the IP protection offered by the granted allowances. Adoption of quantum dots will result in new classes of products with advanced features, improved performance, energy efficiency, and lower cost."

Art Lamstein, Director of Marketing for QMC and SRT adds, "The timeline is moved forward to present day and market forecasts will need be rewritten for quantum dot based renewable energy, photovoltaics, biotech diagnostic assays, drug delivery platforms, theranostic cancer and other biomedicine treatments, QD-LED and opto-electronic devices, photonics, low power SSL lighting, batteries, fuel cells, thermo-QD applications, quantum computing, memory, and conductive inks (to name a few)."

Novel process can improve quantum dots for solar cells

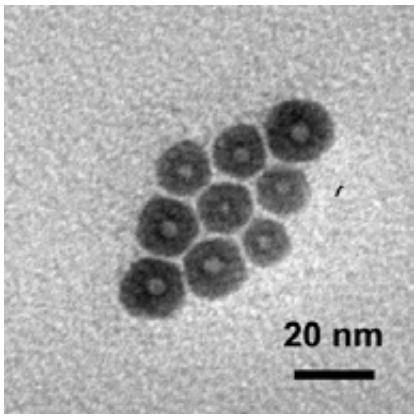
Using a novel molten droplet method to make lava dots out of zinc sulphide, cadmium sulphide and zinc selenide, hollow particles can exceed some performance metrics of quantum dots in a solar-cell test device

Serendipity proved to be a key ingredient for the latest nanoparticles discovered at Rice University.

The new "lava dot" particles were discovered accidentally when researchers stumbled upon a way of using molten droplets of metal salt to make hollow, coated versions of a nanotech staple known as quantum dots.

The results appear online this week in the journal Nanotechnology.

The researchers also found that lava dots arrange themselves in evenly spaced patterns on flat surfaces, thanks in part to a soft outer coating that can alter its shape when the particles are tightly packed.



A nine-pack of lava dots created at Rice (Photo by Sravani Gullapalli)

"We're exploring potential of using these particles as catalysts for hydrogen production, as chemical sensors and as components in solar cells, but the main point of this paper is how we make these materials," says co-author Michael Wong, professor of chemical and biomolecular engineering at Rice.

"We came up with this 'molten-droplet synthesis' technique and found we can use the same process to make hollow nano-size particles out of several kinds of elements. The upshot is that this discovery is about a whole family of particles rather than one specific composition."

Like their quantum dot cousins, Rice's lava dots can be made of semiconductors like cadmium selenide and zinc sulphide.

Wong's lab has been working steadily to improve the synthesis of quantum dots for more than five years.

In 2007, Wong's team discovered a cleaner and cheaper way to synthesise four-legged quantum dots - particles smaller than a living cell that look like tiny versions of children's jacks. These "nanojacks," which are also called quantum tetrapods, can be used to harvest sunlight in a revolutionary new kind of solar panel.

The key step in the 2007 discovery was the use of a surfactant called CTAB.

In 2010 Rice graduate student Sravani Gullapalli was attempting to refine the "nanojack" synthesis even further when she discovered lava dots.

"This new chemistry to make the tetrapods was fairly cheap, but we were looking for an even cheaper way," Wong said. "Sravani said, 'Let's get rid of this expensive phosphorus surfactant and just see what happens.' So she did, and these little things just popped out on the electron microscope screen."

When sitting by themselves, lava dots appear round, but their soft outer shells flatten when they are packed near one another. (Graphic by Sravani Gullapalli)

Wong recalled the team's initial surprise. "We said, 'What is going on here? How do you go from four-legged nanojacks to these little balls?'"

He said it took the team more than a year to

decipher the unusual formation mechanism that yielded the hollow, soft-shelled particles.

To make the particles, Gullapalli added three kinds of solid powder - cadmium nitrate, selenium and a tiny amount of CTAB - to an oil solvent. She then slowly heated the mixture while stirring. The cadmium nitrate melted first and formed tiny nanodroplets that cannot be seen with the naked eye.

“Nothing happens until the temperature continues to rise and the selenium melts,” Gullapalli said. “The molten selenium then wraps around the cadmium nitrate droplet, and the cadmium nitrate diffuses out and leaves a hole where the droplet once was.”

She said the cadmium selenide shell surrounding the hole is nanocrystalline and is enveloped in a soft outer shell of pure selenium.

When Gullapalli examined the lava dots with a transmission electron microscope, she found them to be bigger than standard quantum dots, about 15-20 nanometres (nm) in diameter. The holes were about 4-5 nm in diameter.

She also noticed something peculiar. When sitting by themselves they appeared round, and when tightly packed, the shell appeared to become compressed, even though neighbouring dots never came into actual contact with one another.

“That’s one of the twists to this weird chemistry,” Wong said. “The solvent forms its own surfactant during this process. The surfactant coats the particles and keeps them from touching each other, even when they are tightly packed together.”

Wong’s team later found it could use the molten droplet method to make lava dots out of zinc sulphide, cadmium sulphide and zinc selenide.

“We found that the hollow particles met and even exceeded some performance metrics of quantum dots in a solar-cell test device, and we’re continuing to examine how these might be useful,” Gullapalli concluded.

The research was supported by the Shell Centre of Sustainability at Rice University and SABIC Americas.

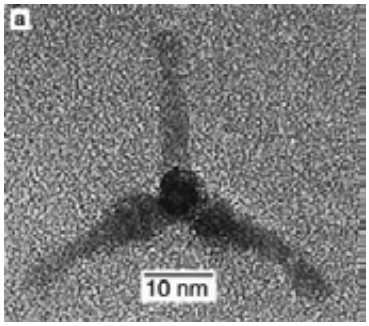
QMC develops high brightness tetrapod quantum dots

At a quantum yield greater than 80 percent, the II-VI dots are bright enough to be utilised as novel probes into not fully understood biological systems

Quantum Materials Corporation (QMC) has developed tetrapod quantum dots with a quantum yield greater than 80 percent.

This brightness increases the performance of this fluorescent marker alternative in biological assays and other applications.

Millions of laboratory tests and biological assays are conducted every year to explore cellular processes. QMC has now developed II-VI based tetrapod quantum dots, improved fluorescent markers that can more effectively gain knowledge of how body systems function and chronic conditions and diseases such as cancer metabolise and impact health and longevity.



QMC Tetrapod quantum dot

The semiconductor materials used by QMC include CdSe.

Conventionally, fluorescent tags or tracers have been used to “light up” and distinguish one type of cell from another to gain these insights into biological functions. However, these tags and other dyes have drawbacks to use, including quick fading and tedious procedures to differentiate more than one type of cell or bio-molecule at a time.

The discovery of quantum dots as a fluorescent marker has made these biochemical assays quicker and more robust for scientific discovery. The quantum dots are proving to be more stable

and have a unique capability to shine in multiple colours under a single light source excitation so that a single assay can produce much more information for researchers.

QMC has now increased the brightness of its tetrapod-shaped quantum dots for this application. At a quantum yield greater than 80 percent, the dots are bright enough to be functionalised in a wide variety of ways to perform as novel probes into as-of-yet-not-fully-understood biological systems. This functionalisation typically will allow researchers to modify the base quantum dot so that a biological tag can be made with an appropriate protein or antibody for a very specific marking within the laboratory sample.

Quantum Materials' CEO Stephen Squires notes, "We believe that the brightness of our Tetrapod Quantum Dots along with other unique features, will give key players in the pharmaceutical and biological industries a much awaited, high performance tool to dig in deeper to the mysteries of physiological conditions that have eluded efforts for cures."

In combination with Quantum Materials use of high throughput microreactor technology the production of the high quantum yield, bright quantum dots will potentially enable the millions of annual assays to expand significantly in number and provide desperately needed information to be quickly available to the world's leading researchers.

In addition to the performance increases for biomedical applications, Quantum Materials believes that the technology breakthrough will also enable its subsidiary, Solterra Renewable Materials to increase conversion efficiencies for its thin-film quantum dot solar cell. With advances in the solar cell, QMC expects to then apply insight gained in the added performance to other quantum dot applications such as LED lighting and displays.

Silicon carbide advances graphene electronics

A new technique could potentially allow the fabrication of entire integrated circuits from graphene without the need for interfaces that introduce resistance

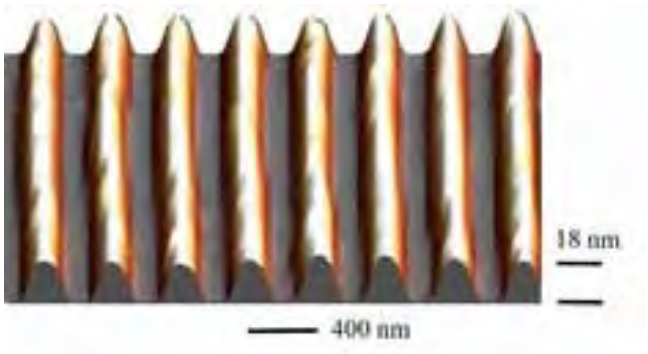
By fabricating graphene structures atop nanometre-scale "steps" etched into silicon carbide (SiC), researchers say they have for the first time, created a substantial electronic bandgap in the material suitable for room-temperature electronics.

Use of nanoscale topography to control the properties of graphene could facilitate fabrication of transistors and other devices, potentially opening the door for developing all-carbon integrated circuits.

Scientists have measured a bandgap of approximately 0.5 electron-volts in 1.4 nm bent sections of graphene nanoribbons. The development could provide new direction to the field of graphene electronics, which has struggled with the challenge of creating bandgap necessary for operation of electronic devices.

"This is a new way of thinking about how to make high-speed graphene electronics," says Edward Conrad, a professor in the School of Physics at the Georgia Institute of Technology. "We can now look seriously at making fast transistors from graphene. And because our process is scalable, if we can make one transistor, we can potentially make millions of them."

Researchers don't yet understand why graphene nanoribbons become semiconducting as they bend to enter tiny steps - about 20 nm deep – that are cut into the SiC wafers. But the researchers believe that strain induced as the carbon lattice bends, along with the confinement of electrons, may be factors creating the bandgap. The nanoribbons are composed of two layers of graphene.



Perspective atomic force microscope (AFM) view of graphitised trenches that are 18 nm deep

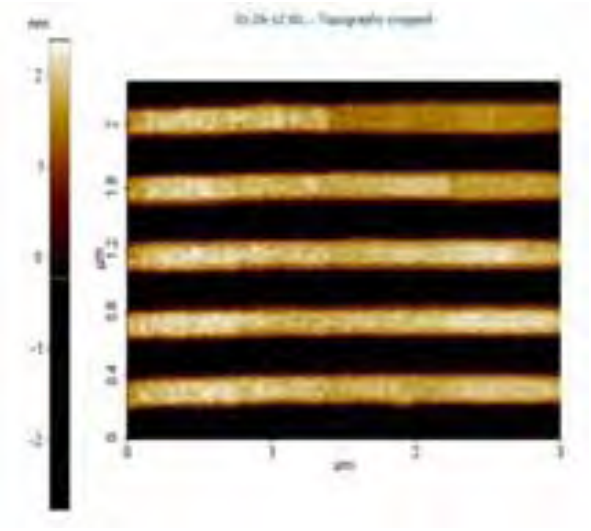
Production of the semiconducting graphene structures begins with the use of e-beams to cut

trenches into SiC wafers, which are normally polished to create a flat surface for the growth of epitaxial graphene. Using a high-temperature furnace, tens of thousands of graphene ribbons are then grown across the steps, using photolithography.

During the growth, the sharp edges of "trenches" cut into the SiC become smoother as the material attempts to regain its flat surface. The growth time must therefore be carefully controlled to prevent the narrow SiC features from melting too much.

The graphene fabrication must also be controlled along a specific direction so that the carbon atom lattice grows into the steps along the material's "armchair" direction. "It's like trying to bend a length of chain-link fence," Conrad explains. "It only wants to bend one way."

The new technique permits not only the creation of a bandgap in the material, but potentially also the fabrication of entire integrated circuits from graphene without the need for interfaces that introduce resistance. On either side of the semiconducting section of the graphene, the nanoribbons retain their metallic properties.



Atomic force microscope (AFM) top view of side wall graphene nanoribbons showing their long range order

"We can make thousands of these trenches, and we can make them anywhere we want on the wafer," said Conrad. "This is more than just semiconducting graphene. The material at the bends is semiconducting, and it's attached to graphene continuously on both sides. It's basically a Schottky barrier junction."

By growing the graphene down one edge of the trench and then up the other side, the researchers could in theory produce two connected Schottky barriers - a fundamental component of semiconductor devices. Conrad and his colleagues are now working to fabricate transistors based on their discovery.

Confirmation of the bandgap came from angle-resolved photoemission spectroscopy measurements made at the Synchrotron CNRS in France. There, the researchers fired powerful photon beams into arrays of the graphene nanoribbons and measured the electrons emitted.

"You can measure the energy of the electrons that come out, and you can measure the direction from which they come out," says Conrad. "From that information, you can work backward to get information about the electronic structure of the nanoribbons."

Theorists had predicted that bending graphene would create a bandgap in the material. But the bandgap measured by the research team was larger than what had been predicted.

Beyond building transistors and other devices, in future work the researchers will attempt to learn more about what creates the bandgap - and how to control it. The property may be controlled by the angle of the bend in the graphene nanoribbon, which can be controlled by altering the depth of the step.

"If you try to lay a carpet over a small imperfection in the floor, the carpet will go over it and you may not even know the imperfection is there," Conrad explains. "But if you go over a step, you can tell. There are probably a range of heights in which we can affect the bend."

He predicts that the discovery will create new activity as other graphene researchers attempt to utilize the results.

"If you can demonstrate a fast device, a lot of people will be interested in this," Conrad said. "If this works on a large scale, it could launch a niche market for high-speed, high-powered electronic devices."

The research, conducted at the Georgia Institute of Technology in Atlanta and at SOLEIL, the French national synchrotron facility, has been supported by the National Science Foundation' Materials Research Science and Engineering Centre (MRSEC) at Georgia Tech, the W.M. Keck Foundation and the Partner University Fund from the Embassy of France.

Further details of this work have been published in the paper, "A wide-bandgap metal-semiconductor-metal nanostructure made entirely from graphene," by J. Hicks *et al* in *Nature Physics* (2012). DOI: 10.1038/nphys2487

InAs quantum dots offer a new route to large-scale quantum computing

Indium arsenide QDs offer a better alternative to gallium arsenide and may allow quantum researchers to manipulate a large number of qubits, enough for a practical machine

In a step towards creating a working quantum computer, Princeton researchers have developed a method that may allow the quick and reliable transfer of quantum information throughout a computing device.

The finding, by a team led by Princeton physicist Jason Petta, could eventually allow engineers to build quantum computers consisting of millions of quantum bits, or qubits. So far, quantum researchers have only been able to manipulate small numbers of qubits, not enough for a practical machine.

Jason Petta

"The whole game at this point in quantum computing is trying to build a larger system," says Andrew Houck, an assistant professor of electrical engineering who is part of the research team.

Andrew Houck

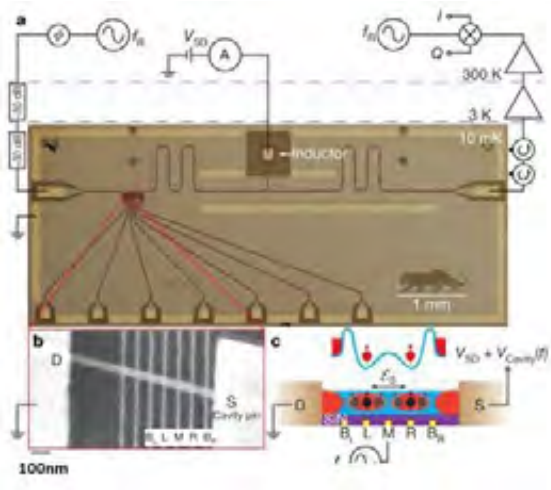
To make the transfer, Petta's team used a stream of microwave photons to analyse a pair of electrons trapped in a tiny cage called a quantum dot (QD). The "spin state" of the electrons - information about how they are spinning - serves as the qubit, a basic unit of information. The microwave stream allows the scientists to read that information.

The researchers used InAs for their QDs and developed an architecture allowing them to achieve a charge-cavity coupling rate of about 30 megahertz. This, they say, is consistent with coupling rates obtained in GaAs quantum dots.

"We create a cavity with mirrors on both ends – but they don't reflect visible light, they reflect microwave radiation," Petta explains. "Then we send microwaves in one end, and we look at the microwaves as they come out the other end. The microwaves are affected by the spin states of the electrons in the cavity, and we can read that change."

The distances involved are very small with the entire apparatus operating over a little more than a centimetre. But on the subatomic scale, they are vast. It is like coordinating the motion of a top spinning on the moon with another on the surface of the earth.

"It's the most amazing thing," says Jake Taylor, a physicist at the National Institute of Standards and Technology and the Joint Quantum Institute at the University of Maryland, who worked on the project with the Princeton team. "You have a single electron almost completely changing the properties of an inch-long electrical system."



Hybrid quantum dot-superconducting resonator device. (a) Circuit schematic and micrograph of the hybrid device design. Scanning electron micrograph (b) and cross-sectional schematic view (c) of the InAs nanowire double quantum dot (DQD). The left and right barrier gates (BL and BR), left and right plunger gates (L and R), and middle gate (M) are biased to create a double-well potential within the nanowire. The drain contact of the nanowire, D, is grounded, and the source contact, S, is connected to an antinode of the resonator, oscillating at a voltage VCavity. (Credit Petersson et. al.)

For years, teams of scientists have pursued the idea of using quantum mechanics to build a new machine that would revolutionise computing. The goal is not to build a faster or more powerful computer, but to create one that approaches problems in a completely different way.

Standard computers store information as classical "bits", which can take on a value of either 0 or 1. These bits allow programmers to create the complex instructions that are the basis for modern computing power. Since Alan Turing took the first steps toward creating a computer at Princeton in 1936, engineers have created vastly more powerful and complex machines, but this basic binary system has remained unchanged.

The power of a quantum computer comes from the complex rules of quantum mechanics, which describe the universe of subatomic particles. Quantum mechanics says that an electron can spin in one direction, representing a 1, or in another direction, a 0.

But it can also be in something called "superposition" representing all states between 1 and 0. If scientists and engineers can build a working machine that takes advantage of this, they would open up entirely new fields of computing.

"The point of a quantum computer is not that they can do what a normal computer can do but faster; that's not what they are," says Houck. "The quantum computer would allow us to approach problems differently. It would allow us to solve problems that cannot be solved with a normal computer."

Mathematicians are still working on possible uses for a quantum system, but the machines could allow them to accomplish tasks such as factoring currently unfactorable numbers, breaking codes or predicting the behaviour of molecules.

One challenge facing scientists is that the spins of electrons, or any other quantum particles, are incredibly delicate. Any outside influences, whether a wisp of magnetism or glimpse of light, destabilises the electrons' spins and introduces errors.

Over the years, scientists have developed techniques to observe spin states without disturbing them. (This year's Nobel Prize in physics honoured two scientists who first demonstrated the direct observation of quantum particles.) But analysing small numbers of spins is not enough; millions will be required to make a real quantum processor.

To approach the problem, Petta's team combined techniques from two branches of science: from materials science, they used an InAs quantum dot to hold and analyse electrons' spins; and from optics, they adopted a microwave channel to transfer the spin information from the dot.

To make the quantum dots, the team isolated a pair of electrons on a small section of material called a "semiconductor nanowire." Basically, that means a wire that is so thin that it can hold electrons like soda bubbles in a straw. They then created small "cages" along the wire. The cages are set up so that electrons will settle into a particular cage depending on their energy level.

This is how the team reads the spin state; electrons of similar spin will repel, while those of different spins will attract. So the team manipulates the electrons to a certain energy level and then reads their position. If they are in the same cage, they are

spinning differently; if they are in different cages, the spins are the same.

The second step is to place this quantum dot inside the microwave channel. This allows the team to transfer the information about the pair's spin state - the qubit.

Petta said the next step is to increase the reliability of the setup for a single electron pair. After that, the team plans to add more quantum dots to create more qubits. Team members are cautiously optimistic. There appear to be no overwhelming problems at this point but, as with any system, increasing complexity could lead to unforeseen difficulties.

"The methods we are using here are scalable, and we would like to use them in a larger system," Petta says. "But to make use of the scaling, it needs to work a little better. The first step is to make better mirrors for the microwave cavity."

The research was reported in the journal Nature on Oct. 18

This research was supported by the National Science Foundation, the Alfred P. Sloan Foundation, the Packard Foundation, the Army Research Office, and the Defence Advanced Research Projects Agency Quantum Entanglement Science and Technology Program.

Using GaN to shrink communication devices

Laser cooling achieved with gallium nitride could enable scientists to observe novel quantum effects and make the HEMTS used in satellites more resistant to damaging ultraviolet rays

Light might one day be used to cool the materials through which it passes, instead of heating them.

This could be due to a breakthrough by engineers at Lehigh and Johns Hopkins Universities.

The discovery could lead to smaller, lighter and cheaper communication devices and enable faster switching times, higher operating voltages and increased output.

Yujie Ding from Lehigh and Jacob B. Khurgin at Johns Hopkins, have achieved what they say is the most favourable ratio to date between opposing types of light-scattering phenomena that occur in semiconducting materials.

Photons, units of light energy, typically maintain the same kinetic energy and wavelength when they exit a material as they do when they strike it.

Raman scattering, named after the 1930 Nobel Prize winner in Physics, refers to the small fraction of scattered photons whose kinetic energy and wavelength, or frequency, differ from those of incident photons. When this frequency is lower, it is called Stokes scattering. When it is higher, it is called anti-Stokes scattering.

The ratio of the occurrence of Stokes to anti-Stokes scattering, says Ding, is typically 35:1. Scientists would like to reduce this to 1:1, at which point a material neither heats nor cools when struck by light.

Ideally, they would like to reduce it even further, and initiate more anti-Stokes than Stokes scattering. In this case, the material imparts its energy, and thus its heat, to the light passing through it.

Ding and Khurgin, working with GaN, have succeeded in reducing the ratio of Stokes to anti-Stokes to 2:1.

GaN, considered one of the most important semiconducting material since silicon, is used in LEDs and laser diodes. Other applications include high-frequency, high-power transistors that can operate at high temperatures and solar cell arrays for satellites. And due to its relative biocompatibility, GaN can also be used in electronic implants in humans.

Laser cooling achieved with GaN could also enable scientists to observe novel quantum effects and could make the high-electron mobility transistors used in satellites more resistant to damaging ultraviolet rays.

"We are the only group to minimise the Stokes-anti-Stokes ratio from 35:1 to 2:1 at room temperature," says Ding. "We have accomplished this by exploiting the different resonance behaviours of

Stokes and anti-Stokes scattering."

Researchers now achieve laser cooling, says Ding, by adding a dopant to the lattices of certain crystalline materials. But the portion of the lattice that actually cools represents only a tiny fraction of the entire lattice. If the right Stokes-anti-Stokes ratio can be achieved, every atom in the GaN lattice would cool and contribute to the cooling effect.

Ding and Khurgin plan next to build an optical resonator.

"We are still puzzled by the fundamental limit to the Stokes-anti-Stokes ratio and by the feasibility of reaching a ratio of 1 or less," says Ding. "We want to see, experimentally, how an optical resonator affects this ratio. We have already done the theoretical work for this. We want to conduct experiments inside a nanowire or other nanostructure to show how this ratio is affected by the structure.

The research, led by Ding and Khurgin, has been supported by the National Science Foundation and the Defence Advanced Research Projects Agency (DARPA).

Further details of this work have been published in an invited article titled, "From anti-Stokes photoluminescence to resonant Raman scattering in GaN single crystals and GaN-based heterostructures," in *Laser and Photonics Review,* Rev. 6, No. 5, 660–677 (2012). DOI 10.1002/lpor.201000028