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semiconductorTODAY

COMPOUNDS & ADVANCED SILICON

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Deposition for nitride LEDs
News from IMS 2010

Mimix merges with M/A-COM • First 50V GaN-on-Si device
Epistar takes stake in Huga • Kaai starts shipping blue laser

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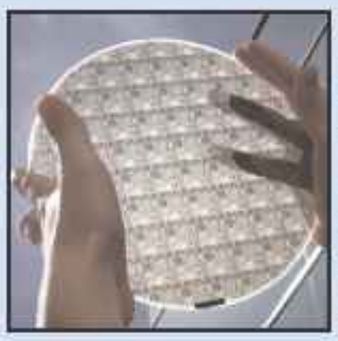
p65 Osram Opto inaugurates its first LED chip fab in Asia, at its LED chip packaging site in Penang, Malaysia.

p85 Fraunhofer ISE researchers Andreas Bett and Frank Dimroth win Fraunhofer Prize for record 41.1%-efficient multi-junction solar cells.



Cover: Peregrine Semiconductor is to jointly develop its UltraCMOS RF IC process at 180nm, 130nm and 90nm technology nodes for manufacturing by IBM (adding to its RF silicon-on-insulator portfolio) in what will be the first commercial use of 200mm wafer processing for silicon-on-sapphire. **p10**

editorial

Nitride materials show power to cut costs

This issue we cover news from the IEEE International Microwave Symposium (IMS 2010) in late May. In addition to gallium arsenide product launches from RFIC makers like RF Micro Devices, Skyworks, Toshiba and Freescale as well as silicon-germanium RFICs from NXP, IMS saw a particular focus on gallium nitride, with launches from Toshiba, Fujitsu, Cree and RFMD.

In particular, as well as adding high-power integrated passive to its foundry portfolio, RFMD announced the qualification of its second GaN foundry process (GaN2, optimized for higher linearity, higher gain and lower-voltage operation for cable TV broadband transmission products etc — see page 30). Meanwhile, Fujitsu has doubled the power output record for amplifiers based on GaN high-electron-mobility transistors operating over the C- to Ku-bands (to 12.9W — see page 34). In addition, California's Integra launched products using what it claims is the first 50V GaN-on-silicon HEMT process, with drain–source breakdowns exceeding 200V (page 37).

However, despite the developing applications for GaN HEMTs in wireless infrastructure, CATV etc, the driver for the GaN microelectronic components market will remain military applications until at least 2014, representing nearly half of the $376m market in 2014, according to a new report from market research firm Strategy Analytics (see page 8).

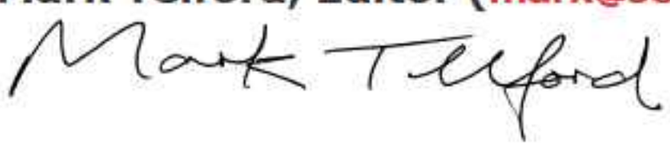
In another new report by Yole Développement, the market for green laser diodes (also based on GaN) is forecast to rise to $500m by 2016, driven by pico-projector applications (see page 6). This will provide added incentive for firms developing green semiconductor diode lasers such as University of California, Santa Barbara (UCSB) spin-off Kaai Inc (now merged with parent firm Soraa Inc, which is also funded by Khosla Ventures and co-founded by Shuji Nakamura, Steven Denbaars and James Speck). While just having given an update on its green laser commercialization at Projection Summit 2010 in Las Vegas, the firm has also just started shipping its new blue laser for display and specialty applications (see page 68). Meanwhile, firms including Germany's Osram Opto Semiconductors and Japan's Sumitomo Electric Industries continue to make progress in both blue and green lasers, based on both c-plane polar and non-c-plane semi-polar and non-polar nitride materials (to be reported next issue).

Apart from blue- and green-emitting nitride-based devices, researchers in South Carolina recently demonstrated the first semi-polar nitride ultraviolet LEDs, emitting at 307nm (claimed to be the shortest wavelength reported for a non-c-plane nitride LED) — see article on page 105. As with all UV LED development, work is underway to boost the optical output power.

Hong Kong University of Science and Technology and Taiwan's National Chiao Tung University have also been working on boosting output from nitride LEDs grown on silicon, with the aim of lowering costs (page 108).

Finally on page 110 we cover a US Department of Energy Solid-State Lighting project in which silicon-focused equipment maker Applied Materials is aiming to lower LED production costs by combining high-throughput HVPE with the incumbent MOCVD technique in one deposition platform.

Mark Telford, Editor (mark@semiconductor-today.com)



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- feature articles (technology, markets, regional profiles);
- conference reports;
- event calendar and event previews;
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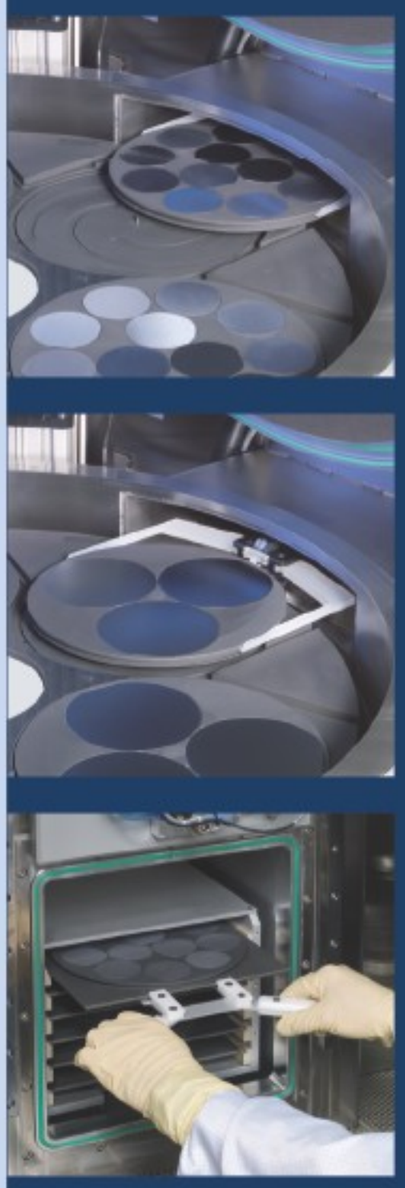

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news

Electro-optic optical modulators to gain market share as 40 and 100Gbps deployments intensify

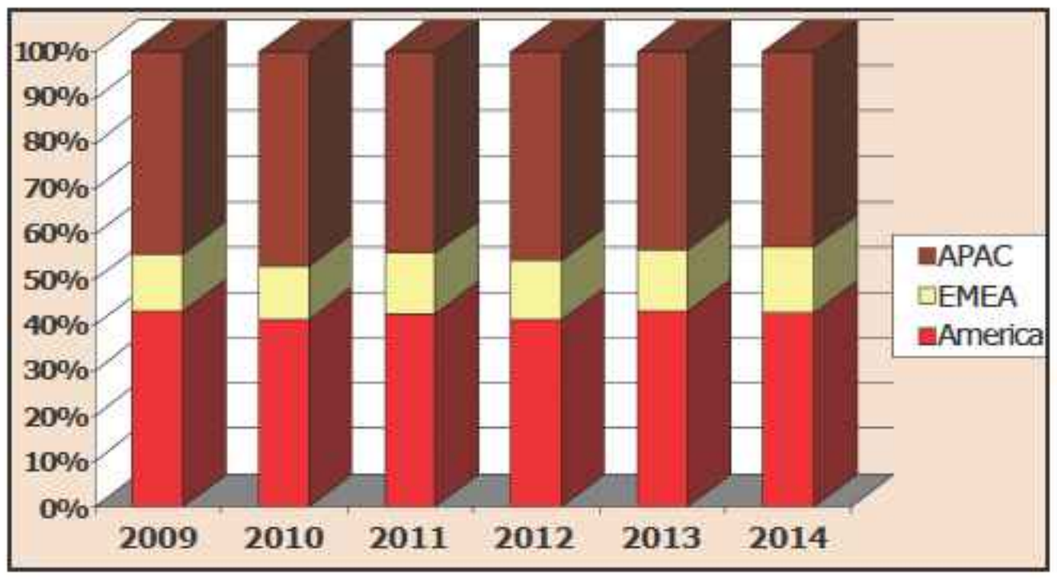
ElectroniCast Consultants has released a forecast of the market consumption and technology trends of external optical modulators used in commercial communication transmission links, in terms of quantity (units), average selling prices (ASPs) per unit, and consumption values.

"In terms of volume (quantity/units), electroabsorption (EA) modulator types held a 57% share versus the electro-optic (EO) types in 2009; however, the EO-types are priced higher, so in terms of consumption value, EO-types are grabbing nearly 60% of the market in 2010," says Stephen Montgomery, president of International Business at ElectroniCast. "As we look at 2014, the electro-optic types will gain more market share as the 40 and 100Gbps deployments intensify," he adds.

www.electronicastconsultants.com

EMEA gaining on Americas and Asia Pacific in planar waveguide circuit

According to a report by ElectroniCast Consultants on market consumption of and technology trends of planar waveguide circuits (PWCs) — or planar lightwave circuits (PLCs) — the Americas (North, Central and South) and the Asia-Pacific are forecasted to stay relatively close in value throughout 2009–2014, while Europe, Middle East and Africa (EMEA) will remain in a distant third place in market share but growing at a faster pace.



Regional market share (%) of PWCs used in optical communications, based on consumption value.

'Planar Waveguide Circuits Used in Optical Communications Global Market Forecast & Analysis' provides a 2009–2014 forecast of the use of PWCs used in arrayed waveguide gratings (AWGs) devices; photonic switches; variable optical attenuators (VOAs); optical splitters; lithium niobate modulators; interconnect waveguides; other discrete; as well as PWCs used in devices that are capable of two or more functions (integrated multifunction devices).

"PLCs are used in discrete (single-function) devices, as well as a growing menu of integrated devices, which accommodate multiple functions in compact (small footprint), proven and reliable packages; therefore, optical communications will continue to benefit from this product category," says Stephen Montgomery, president of International Business at ElectroniCast.

"Athermal AWGs are providing the avenue needed to push along cost-effective solutions, bringing optical fiber closer to the home and businesses," Montgomery adds.

www.electronicastconsultants.com

LED lighting to comprise 46% of commercial building lamps by 2020

Lighting accounts for about 17.5% of global electricity use and, within the USA, most lighting energy is consumed in commercial buildings. Recent innovations, particularly the development of solid-state lighting using LEDs, hold significant long-term potential for energy savings in the commercial building sector. LED lighting will become an increasingly important segment of the market, and by 2020 it will achieve 46% penetration of the $4.4bn US market for lamps in the commercial, industrial, and outdoor stationary sectors, according to the report 'Energy Efficient Lighting for Commercial Markets' from Pike Research.

"LED lighting will reach an inflection point in the next five years," says managing director Clint Wheelock. "As solid-state lighting costs come down and performance increases, LEDs will become a practical option for an increasing number of commercial applications." LEDs are already widely used in traffic signals and exit sign lighting, and those markets will become saturated within the next few years, reckons Pike. The outdoor stationary sector will be the next growth area for LED lighting, followed by retail and office/professional and institutional buildings, the firm adds.

However, despite the strong long-term prospects for LED lighting, the sector still faces technological and economic hurdles, cautions Pike. While the cost and efficacy of solid-state lighting are improving rapidly, it will be a number of years before LEDs lead the commercial lighting market. During this period of transition, fluorescent T8 and T5 lamps, which offer good efficacy and life at very reasonable prices, will overtake incandescent lamps as the leading technology prior to the coming of age for LED lighting products, forecasts Pike Research.

www.pikeresearch.com

LED market explosion hampered by materials shortage

20% price rise indicates short-term constraints

The fast-growing market for high-brightness LEDs in LCD TVs will be restricted by a shortage of key semiconductor materials in second-half 2010, forecasts Strategy Analytics.

Rapid penetration of LED backlighting modules in LCD TVs has already seen demand soar for capital equipment, particularly for MOCVD reactors for making GaN LEDs. A similar trend is now evident in consumables, specifically the metal-organic precursor material trimethylgallium (TMG) and sapphire wafers.

Demand for TMG already exceeds the available supply, so manufacturers need to absorb a 20% price rise in the near term. A shortage of sapphire wafers (upon which most blue and white LEDs are produced) is also likely in second-half 2010.

The report outlines the challenges facing LED makers in 2010, as supply constraints and increasing material prices serve to restrict the rapid market expansion.

"Concerns have previously been raised over the ability of MOCVD equipment vendors to meet rapidly increasing demand," notes Asif Anwar, director of the GaAs and Compound Semiconductor Service at Strategy Analytics. "The concern for short supply of materials will create a bottleneck for LED market growth over the short term."

Taiwanese LED makers in particular need to adjust to the new reality of the supply chain, Strategy Analytics says. Historically, they have bargained for the price of key materials, but the balance of power has changed, with competitors backed by huge corporations (e.g. Samsung and LG) better positioned to absorb higher material costs and to guarantee their supply in a constrained market.

"Capacity expansions already in progress should relieve these constraints by mid-2011," says Steven Entwistle, VP of the Strategy Analytics Strategic Technologies Practice. "Until then, the average selling price of high-brightness LEDs based on GaN should hold up well."

www.strategyanalytics.com

AU Optronics cutting number of LEDs in TV backlights

Taiwanese LCD maker AU Optronics (AUO) says the number of LEDs used in TV backlight unit (BLU) will be cut by about 30% by the end of this year, according to market research firm Displaybank. This is enabled by one-bar edge-type LEDs, which will start to be applied in BLUs for TVs from 2011 onwards.

AUO says that LED BLU-equipped models have a 90% share of the market in notebooks and 20% in TV and monitor applications and that, by the end of 2010, the penetration for TV applications will reach 30–40% (depending on whether the supply of LEDs can meet the growing demand).

Lee Biing-Jye, president of Taiwan LED chipmaker Epistar, says that LED-backlit LCD TVs showed just 5% penetration in early 2010, but this should rise to 35% at the end of 2010 and will most likely show 20% overall penetration this year. This should rise to 45% in 2011.

TV vendors have sharply increased LED orders, leading to a 30–40% shortage in Q1/2010. Order periods have stretched to two quarters and prices are expected to rise, reflecting increases in the bill of materials.

However, Lite-On Technology's CEO Teng Kuang-Chung says that the LED shortage should not continue long term as LCD TV makers aim to cut costs by cutting the number of LEDs used.

www.displaybank.com

HB-LED lighting market to exceed $3.2bn by 2013

High-brightness light-emitting diodes (HB-LEDs) have penetrated a variety of niche lighting applications and are beginning to be used in several white-light applications that could be considered part of the general illumination market, according to the new report 'The Market for High-Brightness LEDs in Lighting: Application Analysis and Forecast — 2010' by Strategies Unlimited on the demand side of HB-LEDs for lighting-specific applications.

The report addresses the market for LEDs used in illumination applications, i.e. in which light from an LED is used to illuminate an object or surface, rather than being viewed directly to provide information (e.g. LED signs) or a signal.

In 2007, the market for HB-LEDs in lighting applications amounted to $340m (just 5% of the total HB-LED market). The largest application was architectural lighting, where the ability of LEDs to provide multiple colors and color-changing effects was a major driver, says Strategies Unlimited. Indeed, in spite of its small share of the overall HB-LED market, lighting was one of the fastest-growing segments during 2007–2009, and is forecast to grow to more than $3.2bn by 2013.

The report includes a 5-year market forecast for ten product applications, and is broken out by material (InGaAlP red-orange-yellow, InGaN blue/green, white) and package type (low, medium and high power).

http://su.pennnet.com

Green laser diode market to rise to $500m by 2016 as pico-projector market drives growth

The market for direct- and indirect-emitting semiconductor green laser diodes will reach about $500m in 2016 (representing over 45 million devices), according to market research firm Yole Développement in its new report 'Green Laser for Projection Devices, 2010'.

The green laser market is currently highly segmented into many niche applications, from medical to military as well as laser shows etc. These applications can use existing solid-state lasers or the more recent combination of semiconductor lasers with nonlinear crystals (via SHG, or second-harmonic generation).

In the emerging market for pico-projectors as well as other display techniques such as head-mounted display (HMD) or head-up display (HUD), the ideal light-emitting device would be a laser due to the capability to deliver highly saturated colors in the widest possible gamut. Additional features include focus-free operation and an expected improvement in wall-plug efficiency (reducing power consumption for battery operation). Yole adds that the market for green lasers in particular will be driven by pico-projectors, due to the laser's ability to deliver highly saturated colors in the widest possible gamut.

In 2009, the first LED-based pico-projectors became available on the market. However, market take-off was slow (with no more than 300,000 units sold) due possibly to poor brightness (10 lumens) for a relative high price. Nevertheless, the stand-alone projector market will take off in 2010, with a sales volume of 0.5–1 million units, forecasts Yole. During this first phase, most pico-projectors will be LED-based.

However, last year some impressive progress was reported on shifting blue laser diodes towards green wavelengths. The direct-emission semiconductor laser should hence be available in 2011–2012 for projection display applications.

Yole hence forecasts that 10–20% of projectors will be laser-based by 2011 and 50–75% by 2016. Yole also envisions a move from stand-alone devices to embedded devices as the technology will step-by-step become compatible with size and cost constraints.

The cell-phone market will also start using green lasers in late 2010 in high-end devices (Samsung 'Android' etc), says Yole. Laser-based systems will be slowly implemented as costs reduce, but Yole remains very conservative, saying that LEDs remain dominant until at least 2016. However, according to the requirement for small size, direct-emission green laser will be much in demand.

Media players are the perfect application for embedded pico-projectors, says Yole, with fewer constraints on cost and size compared to the cell phone. The boom in demand should occur by 2012, with 2.6–5 million units equipped with projection functionality, forecast the firm. SHG green lasers will dominate first, forecasts Yole, during the wait for direct-emission green lasers to become compatible on price and performance.

Cameras and camcorders are forecast to offer only slow market penetration for laser-based technologies, as battery life-time and cost can be critical parameters. LED technology should dominate in these applications, believes Yole market & technology analyst and report co-author Regis Hamelin.

Laptop computers represent probably the most unclear segment for green laser applications, says Yole, as it is hard to predict consumer behavior accurately: will they go for an all-in-one solution (PC plus projector) with an embedded projection device that will probably be less efficient than a desktop projector? Yole says that it remains very conservative on this application.

Currently, only SHG green laser diodes are available on the market. Corning, Osram and QD Laser each have proprietary solutions. "However, given the complex package of these lasers, it seems difficult to reach a reasonable target price. Moreover, these components seem to suffer from a shortage," explains Yole project manager and report co-author Philippe Roussel.

Japan's Sumitomo Electric Industries (SEI), University of California Santa Barbara spin-off Kaai and Germany's Osram Opto Semiconductors are the most advanced players for direct-emission green laser diodes. If performance can meet the minimum requirements for optical power, wall-plug efficiency and lifetime, some of these could offer products in limited quantities as soon as mid-2011, says Yole.

The battle over direct-emission green sources will also take place at the substrate stage, where gallium nitride crystal of both non-polar and semi-polar orientations can play a positive role in green light emission, comments Yole.

The light-engine module — a combination of a light source and image management (LCD, micro-mirrors, LCOS etc) — is expected at a target price of $40, notes Yole. This implies a price target of $10 per color. Red should not be a problem, but GaN blue lasers have not yet reached that price target despite their maturity. Green laser will also have to be in the $10 range to penetrate the market, comments the firm.

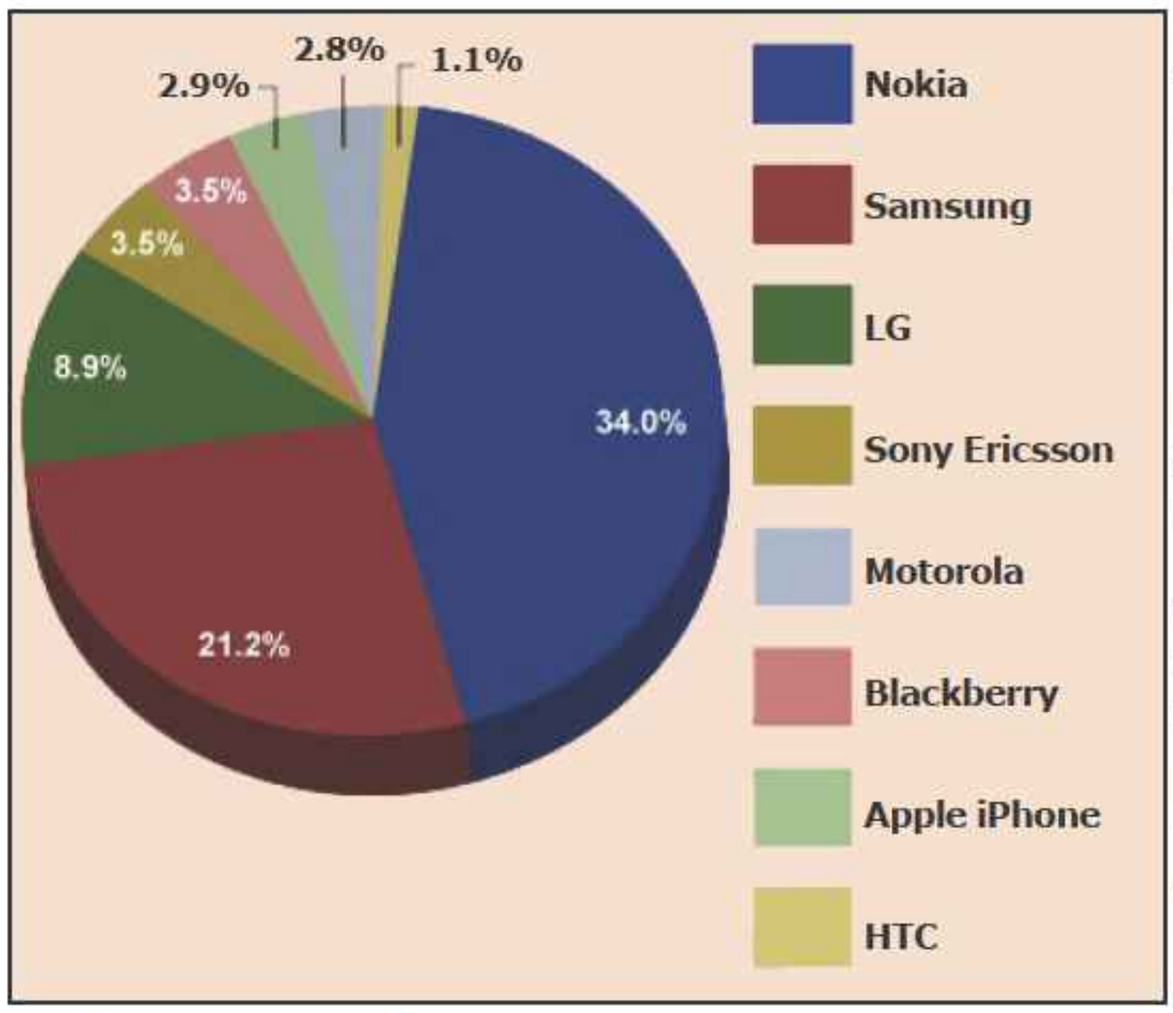
Yole also cautions that LEDs and high-brightness HB-LEDs are serious competitors, since some pico-projectors have already been announced with a brightness of up to 30 lumens. The capability of lasers to deliver bright images therefore becomes less 'unique'. So, if green and blue lasers from GaN-based materials are not delivered in the expected target price range, the market share for green lasers could be limited to high-end products, Yole concludes.

www.yole.fr

Q1 handset shipments of 303 million show 3G eclipsing 2G

"Despite ash clouds over Europe, handset shipments globally for 1Q-2010 powered ahead to 303 million, up 19% year-on-year," says Jake Saunders, VP for Forecasting at market analyst firm ABI Research. "This bodes well for 2010 as a whole: shipments could well reach 1.3bn," he adds. "It is also notable that 3G handset shipments eclipsed 2G handset shipments."

The strongest handset shipment growth was seen in the Middle East and Africa (20% year-on-year) followed by the Americas, particularly the US (11%). However, Europe is languishing with single-digit growth.



Global handset vendor market share, Q1/2010.

Nokia's market share was 34%. New smartphones such as the N8 are helping to shore up its handset portfolio, as its loss of traction in the smartphone sector hit sales hard. In response, revamped efforts with Symbian ^3 and ^4 are intended to help it regain momentum, says ABI. Nokia is counting on smartphones expanding into the mid-tier and low-tier segments where it believes it has strength.

Samsung had a strong quarter, securing 21% market share. Over the past year, Samsung has been cultivating deeper relationships with US and European carriers, which helped grow its shipments 40.2% year-on-year, says ABI.

LG's market share (8.9%) has suffered from a weak smartphone portfolio in the North American market. The firm has been traditionally strong in the enhanced phone sector, and has been giving some of its older enhanced phones a smartphone twist (for example, its Chocolate phone has gone wide-screen). LG's shipments grew 20% year-on-year.

Motorola (2.8%) is benefiting from its initial success with the Droid and is keen to back it up with new products such as the Quench, but the market is overtaking it. The firm is hoping that the strong social networking theme to its smartphone line-up will help it to curry favor with the youth and prosumer markets.

Q1/2010 proved to a strong quarter for Apple, with 8.75m devices shipped (giving it 2.9% market share), which is up a remarkable 130% year-on-year. iPhone OS release 4, which brings multi-tasking and in-app advertising capabilities, should help to maintain momentum. Nevertheless, Apple should diversify its lineup, says ABI.

www.abiresearch.com

Smartphone shipments jump 50% to 54m in Q1/2010

Global smartphone shipments reached 54 million units in first-quarter 2010, up a huge 50% from 36 million a year ago and accounting for 18% of total handset shipments, according to market research firm Strategy Analytics in its 'Q1 2010 Global Smartphone Market Share Update' report. This was the strongest period of growth for almost three years as the high-value smartphone market continues to lead the handset industry out of recession.

"Sales are being driven by healthy operator subsidies, vigorous competition between vendors and a growing tide of lower-cost models using operating software like Symbian and Android," says Strategy Analytics' director Tom Kang.

"The global smartphone market will head in two broad directions this year," comments Strategy Analytics' director Neil Mawston. "Some smartphone vendors, such as Nokia, will chase growing mid-tier volumes in emerging markets such as China and India. Other brands, such as Motorola, will focus on mature markets like the US and explore a new wave of services beyond Internet browsing and e-mail, such as high-quality video and navigation."

In Q1/2010, Nokia shipped a record 21.5 million smartphones worldwide, rising an above-average 57% from 13.7 million units a year earlier. China, South America and Africa Middle East were regional hotspots for Nokia, while North America remains a problem-child and one that is crimping profits and still badly needs attention, comments Strategy Analytics.

RIM shipped 10.6 million smartphones, comfortably beating Apple's record 8.8 million units during the quarter. RIM has become the largest mobile device vendor of North American origin, ahead of rivals Apple and Motorola. However, its annual growth rate slowed to just 45% in Q1/2010 and its new Blackberry OS 6.0 upgrade (due in Q3) is badly needed.

www.strategyanalytics.com

Handset sales grow 19% year-on-year to Q1 record 291m

Global shipments of mobile-phone handsets grew 19% year-on-year in Q1/2010, from 245 million a year ago to a record 291 million for first-quarter sales, according to market research firm Strategy Analytics.

Touchphones, smartphones and dual-SIM models are pulling the handset industry away from recession, says the firm, but emerging markets also drove growth, with volumes surging in Latin America, Africa and Eastern Europe.

The top 10 handset vendors are going through an unprecedented shake-up as new American and Chinese brands muscle their way into the market, says Strategy Analytics. RIM captured fourth position, which is its first time in the top five, and Apple reached a record high of 3% global market share. Meanwhile, Alcatel surged almost 200% and became the fastest-growing major vendor, adds the market research firm.

www.strategyanalytics.com

Short-range gigabit radio poised for rapid growth

60 GHz and 802.11n to lead in TV equipment

Shipments of short-range gigabit radios for display links, HDMI cable replacement, streaming multimedia and last-hundred-meter internet access will reach tens of millions of units per year in 2014, forecasts Strategy Analytics RF & Wireless Component market research service in its report 'Outlook for Short-Range Gigabit Radio', which explores the market for short-range 60GHz radio, 802.11n 4 x n / 802.11ac, inductive coupling, and proprietary ISM-band approaches such as WHDI.

"Demand for HD video is driving bandwidth for content delivery to the home, leading to exciting prospects for short-range gigabit radio for in-home and last-hundred-meter distribution," says the report's author Christopher Taylor. "More than 2 billion electronic devices ship each year that could potentially use short-range gigabit radio for display links, fast wireless file transfer, and HDMI cable replacement," he adds.

"With combined benefits of established Wi-Fi plus 60GHz for ultra-fast transfers, WiGig appears to have the best chance of ultimately taking the leading share of what could become the next wireless chip gold rush," reckons Stephen Entwistle, VP of the Strategic Technologies market research practice at Strategy Analytics.

www.strategyanalytics.com

Defense to remains driver in GaN electronics market

...as power management supplements slow wireless adoption

The US defense industry will continue to provide the key applications for GaN microelectronics, as the emerging technology sector moves into a new phase of commercial development, according to market research firm Strategy Analytics in its report 'GaN Microelectronics Market Update 2009–2014'.

Deployments in the military applications of electronic warfare, next-generation radar and covert communications will represent nearly half of the $376m market for GaN microelectronic components in 2014. For commercial applications, the emerging demand in low-voltage power conversion will begin to supplement the sluggish adoption of GaN components in wireless infrastructure that will continue through 2012, forecasts the firm.

"Much depends on the success of new entrants targeting applications in power management," says Asif Anwar, director of the Strategy Analytics GaAs and Compound Semiconductor Service. "After the initial launch of these products in the opening quarter of 2010, we expect a number of major suppliers to enter the market over the next two years, prior to significant RF deployments in wireless infrastructure from 2012 onwards," he adds.

The emerging demand in low-voltage power conversion will begin to supplement the sluggish adoption of GaN components in wireless infrastructure

The report details the increasing impact that GaN technology will have in the power management sector. A complementary report 'GaN Device and Material Vendor Summary' reveals the strategies being employed by the growing base of firms supplying GaN-based products for both military and commercial applications.

"GaN has already cemented its place in the optoelectronics market, and is now emerging as a key enabling technology for the commercial microelectronics sector," notes Steve Entwistle, VP of the Strategy Analytics Strategic Technologies Practice. "Strategy Analytics anticipates several years of strong growth fueled by both RF and power management applications."

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Peregrine and IBM co-develop 180nm RF CMOS

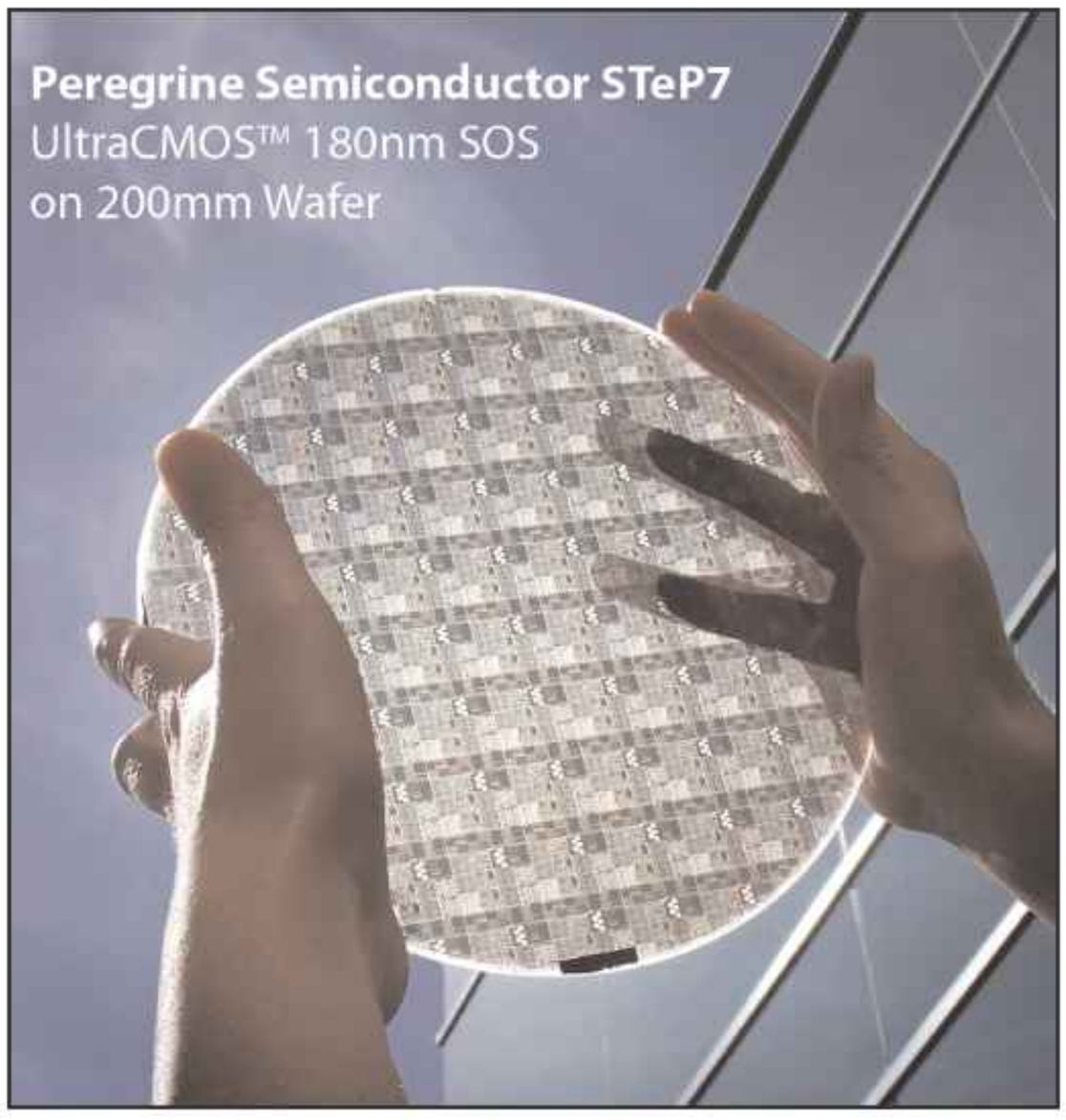
First commercial use of 8" wafers for silicon-on-sapphire

Peregrine Semiconductor Corp of San Diego, CA, USA, which designs and supplies RF CMOS and mixed-signal communications ICs based on its patented UltraCMOS silicon-on-sapphire (SOS) process technology, has announced an exclusive joint development agreement with IBM Microelectronics for the manufacture of future generations of UltraCMOS, which is claimed to be the industry's highest-performance radio-frequency complementary metal-oxide semiconductor (RF CMOS) process. When fully qualified, the next-generation UltraCMOS RF ICs will be manufactured by IBM for Peregrine in the jointly developed 180nm process at IBM's 200mm fabrication plant in Burlington, VT.

Peregrine claims that its UltraCMOS technology delivers unmatched levels of RF performance and monolithic integration for high-growth applications such as the RF front-end of mobile phones and multi-mode, multi-band mobile wireless devices; broadband communications including 4G LTE equipment and base stations; mobile DTV/CATV RF signal conditioning; and space satellite systems.

Peregrine's UltraCMOS technology is a patented variation of silicon-on-insulator (SOI) technology that incorporates an ultra-thin layer of silicon on a highly insulating sapphire substrate. IBM's addition of 180nm UltraCMOS to its portfolio of RFSOI technologies marks the first commercial use of 200mm (8-inch) wafer processing for silicon-on-sapphire process, says Regina Darmoni, director of IBM's Analog/Mixed-Signal and Digital Foundry business. This will drive the next decade of UltraCMOS engineering, reckons Peregrine.

Migration to 200mm wafers facilitates the evolution of Peregrine's UltraCMOS process to 180nm, 130nm and 90nm nodes, as well as providing access to advanced manufacturing toolsets and enabling much expanded digital integration capability. The agreement with IBM also provides — through its Technology Alliance partners — unprecedented levels of manufacturing capacity and a robust supply chain, says Peregrine.



"Our company has long been committed to driving technological change in RF by bringing our silicon-on-sapphire RF process into the global mainstream," says Peregrine's president & CEO Jim Cable. "By combining the strengths of our two companies, we are continuing to deliver the promise of Moore's Law for high-performance RF CMOS."

Collaboration between the two firms began in 2008 as the ability to use CMOS for RF designs emerged as a viable alternative to compound semiconductor processes such as gallium arsenide, Peregrine claims. The benefits of CMOS include reliability, cost-effectiveness, high yields, portability, scalability and integration. In addition, one of the earliest innovations for Peregrine's UltraCMOS technology is the HaRP design methodology, which brought about what are claimed to be unprecedented levels of harmonic performance. More recently, Peregrine introduced DuNE technology, which produced digitally tunable capacitors that solve long-standing industry design challenges in RF tuning.

"The realization of our 180nm UltraCMOS process on 200mm sapphire wafers is a very important phase of our long-term process development strategy," comments Mark Miscione, Peregrine's VP & chief strategist for technology solutions. "Throughout the last several years, we have invested significant capital and effort with our partners to strengthen the overall SOS supply chain and improve the economics of the base sapphire substrate material. This has been accomplished by the global acceptance of SOS technology, as evidenced by the more than 600 million UltraCMOS RF ICs shipped from our foundries within the past few years," he adds. "These improvements have also been fueled by the tremendous volume of sapphire now being used by the rapidly expanding LED lighting industry."

The first 180nm UltraCMOS RFICs have sampled to a key customer, and commercial production release is expected in 2011. Initial product roadmaps include configurable RF cellular front-ends in the form of high-power RF switches, tunable components, and power amplifiers.

www.psemi.com

Peregrine expands with European RFIC design, manufacturing and sales center

Peregrine Semiconductor Corp of San Diego, CA, USA, which designs and makes RF CMOS and mixed-signal communications ICs based on its UltraCMOS silicon-on-sapphire (SOS) technology, has expanded its European design and manufacturing operations by opening a new facility in Aix-en-Provence, France.

Operating as a subsidiary directed by Pascal LeBohec, Peregrine Semiconductor Europe (PSE) incorporates RFIC design and engineering at the design center in Aix-en-Provence; IC wafer manufacturing from wafer foundry Sapphicon in Australia and UMC in Taiwan; assembly & packaging from Hybritech Composants Microelectroniques (HCM) France; and back-end testing at partner Rood Microtec in Germany. PSE's activities will focus on developing new RFIC products of European content to better support specific European design requirements, and providing design services for Peregrine's proprietary next-generation UltraCMOS RFIC portfolio sold worldwide.

The region has been instrumental to global adoption of UltraCMOS for RF designs, comments Peregrine Semiconductor Corp's CEO & president Jim Cable. "In a time of widespread economic turmoil, Peregrine is among the exceptions in being able to post positive revenue growth and expand our design and manufacturing capabilities to further demonstrate our commitment to the European RF engineering community," he adds.

As well as heading PSE, LeBohec also manages international sales for Peregrine's high-reliability IC business, which originated more than a dozen years ago and has customers such as Astrium, Thales Alenia Space, and Tesat and RUAG — all member companies of the European Space Agency (ESA), which has qualifying Peregrine's UltraCMOS-based phase-locked loop frequency synthesizers (PLLs) for adoption into its space satellite programs. Peregrine devices are in flight with some of the world's largest satellite programs, including Globalstar, ExoMars, Glonass and Gallileo. "Some of the world's most visionary RF designs originate in Europe, and Peregrine's UltraCMOS technology provides the ideal RF front-end solution," says LeBohec.

The first devices originating from the new European operation are next-generation PLLs providing the RF performance demanded by the rigors of rad-hard space and other high-reliability applications. Peregrine adds that there are fundamental properties of UltraCMOS technology that make it exceptionally 'green': devices built on UltraCMOS consume much less power than high-voltage processes such as silicon-germanium (SiGe) or gallium arsenide (GaAs), it is claimed, and enable high levels of monolithic integration, resulting in smaller die, fewer external components in the design and less environmental waste. In particular, while Reduction of Hazardous Substance (RoHS) initiatives across Europe are pressing the prohibition of carcinogens such as GaAs and associated arsenic slurries, UltraCMOS RFICs — based on sapphire substrates — offer a more environmentally friendly option, it is claimed.

www.psemi.com

E-Band and Aviat partner on 70/80GHz backhaul

E-Band Communications Corp of San Diego, CA, USA, which makes ultra-high-capacity 70/80GHz point-to-point wireless backhaul transmission systems, has entered into an original equipment manufacturer (OEM) strategic partnership agreement with Aviat Networks Inc (a wireless expert in advanced IP network migration, formerly known as Harris Stratex Networks Inc) to jointly and independently market and support E-Band's radios worldwide.

E-Band's flagship product is the E-Link 1000EXR, a full duplex fiber-equivalent speed Gigabit Ethernet point-to-point radio that provides what is claimed to be an industry-leading +22dBm of output power and extremely low latency (<5μs). The firm says that its products have won wide acceptance in major 4G network deployments and achieved the highest market share in the USA in 2009 (based on publicly available annual FCC license data). It adds that the achievement was enabled by implementing advanced monolithic microwave integrated circuit (MMIC) technologies (via an exclusive long-term field-of-use license from Northrop Grumman).

"Aviat's global customer base, core competency in network management and strong IP product portfolio in support of 4G networks are a natural fit for our product and technology," says E-Band's president & CEO Sam Smookler.

The agreement enables Aviat to provide its carrier and enterprise customers with a complete portfolio of end-to-end transformational 4G network solutions. Aviat's backhaul solutions now cover frequencies of 4–86GHz (claimed to be the broadest range of products available).

"E-Band's radios complement our portfolio of products and services," says Aviat's senior VP & chief sales officer Michael Pangia. "This win–win relationship will increase opportunities for both companies worldwide and enable us to provide our customers with industry-leading GigE backhaul solutions at a competitive price."

www.e-band.com
www.aviatnetworks.com

SiBEAM launches first dual-mode WirelessHD/WiGig RF transceiver and development kit

Fabless semiconductor firm SiBEAM Inc of Sunnyvale, CA, USA, which develops millimeter-wave solutions and high-speed wireless communications platforms, has announced availability of what it claims is the first WirelessHD/WiGig solution, the SB8110 WirelessHD/WiGig RF transceiver and the associated SK8100 development kit.

The WirelessHD Consortium was formed in 2005 as the first 60GHz standards organization for wireless A/V applications in consumer electronics, personal computing and mobile devices, and is now a part of the IEEE 802.15.3c standard. As new 60GHz specifications have recently entered the market, SiBEAM says it has evaluated the 60GHz market opportunity as a member of the Bluetooth, Wi-Fi, Wireless Gigabit (WiGig) Alliance and WirelessHD, and hence developed products to encourage market adoption and gauge demand for 60GHz in different wireless applications.

SiBEAM has been shipping 60GHz chipsets based on the WirelessHD standard since 2008. Its semiconductor systems provide what is claimed to be the only available option to deliver lossless, uncompressed multi-gigabit wireless high-definition video, audio and data. Consumer electronics products from Panasonic, LG Electronics, Best Buy's Rocketfish brand, Sony, Gefen, and Cables To Go have been shipping over the last year.

"There are three key wireless applications: wireless local area networking (WLAN) using Wi-Fi, wireless personal area networking (WPAN) using Bluetooth, and wireless video area networking (WVAN) using WirelessHD," says CEO John LeMoncheck. "Upon review of the WiGig specification, we believe that WirelessHD will continue to provide the best solution for WVAN. As for other application areas, WiGig can potentially serve as a good platform for support of data and WLAN applications," he adds.

"Membership in these organizations provides SiBEAM with the necessary tools to encourage market growth of 60GHz solutions while delivering the optimal user wireless experience in a variety of devices and applications," says LeMoncheck.

The SB8110 transceiver supports both single-carrier and OFDM modulation schemes and can be used to create either a WirelessHD-only, WiGig-only or dual-mode WirelessHD/WiGig product. The SK8100 kit includes the SB8110 and all supporting system and IC documentation.

www.sibeam.com

SiBEAM's CEO named to GSA's Emerging Company CEO Council

SiBEAM's CEO & president John LeMoncheck has been appointed a member of the Global Semiconductor Association's (GSA) Emerging Company CEO Council, after being a GSA member since 2007.

The council consists of CEOs from firms representing 25 countries worldwide throughout the supply chain with proven technical and market leadership and promising new technologies, to advise GSA's board of directors on emerging company needs and to support GSA's focus on entrepreneurship.

Since its inception in 1994, the GSA has aimed to accelerate semiconductor industry growth and increase return on invested capital by fostering a more effective fabless ecosystem through collaboration, integration and innovation. GSA addresses challenges within the supply chain including IP, EDA/design, wafer manufacturing, test and packaging to enable industry-wide solutions. Providing a platform for global collaboration, it identifies and articulates market opportunities, encourages and supports entrepreneurship, and provides members with market intelligence.

Founded in 2004, SiBEAM is the only firm to fabricate 60GHz chipsets using standard CMOS silicon. It is also a founding member of the WirelessHD Consortium. The first applications for its technology are based on the WirelessHD specification for home multimedia content delivery and A/V connectivity. SiBEAM is driving the architecture and semiconductor implementation for the distribution and presentation of high-definition content in consumer electronics and personal computing. Solutions for wireless personal area networks (WPAN) and automotive will follow.

Winner of the GSA's 'Startup to Watch' award, SiBEAM is the only company to ship 60GHz communication systems for consumer electronics, personal computing and mobile devices. It is now shipping second-generation 60GHz chipsets, based on WirelessHD. Its technology can reach up to 4Gb/s data rates (ten times faster than existing consumer wireless). Products from Best Buy's Rocketfish private label brand, LG Electronics, Panasonic, Sony and others have been shipping since early 2009.

"We depend on our members to help us advance our goals, and SiBEAM brings a valuable combination of insight, innovation and industry-leading technology for a rapidly growing market segment," says GSA president Jodi Shelton. "Participation in this council will serve a mutual industry goal of advancing the fabless semiconductor business model," says LeMoncheck.

www.gsaglobal.org

Mimix Broadband merges with M/A-COM Tech

M/A-COM Technology Solutions Inc of Lowell, MA, USA, a supplier of semiconductors, components and subassemblies for RF, microwave and millimeter-wave applications, has completed its merger of Mimix Broadband Inc of Houston, TX, USA. Mimix Holdings Inc and subsidiaries become subsidiaries of M/A-COM Technology Solutions Holdings Inc.

With offices in Houston, Sydney in Australia, Belfast in Northern Ireland, UK and Hsinchu in Taiwan, fabless firm Mimix combines semiconductor design expertise and communications systems background to develop GaAs semiconductors from DC to 50GHz for RF, microwave and millimeter-wave applications. The firm has a diversified product line serving top-tier telecom, satellite and defense companies worldwide.

Founded in the 1960s, M/A-COM was acquired by Pennsylvania-based AMP Inc in 1995, before becoming Tyco Electronics' Wireless Systems Segment after Tyco International bought AMP in 1999. In September 2008, the defense & aerospace and commercial segments of M/A-COM were acquired by UK aerospace technology firm Cobham plc, which in March 2009 sold off the commercial segment (renamed M/A-COM Technology Solutions Inc) for $90m to John Ocampo, co-founder, owner & president of Silicon Valley-based private equity fund GaAs Labs LLC (and co-founder of Sirenza Microdevices Inc). GaAs Labs provides financing and operational expertise to help grow firms addressing communications semiconductor and related markets, partnering with entrepreneurs and management teams to increase their profitability.

M/A-COM Tech uses GaAs, InGaAs, InP, SiGe and silicon technology at facilities in Lowell and Torrance, CA, while infrastructure products are made at its plant in Cork, Ireland and Laser Diode products at a plant in Edison, NJ, USA.

Benefits of the merger include:

- adding breadth to M/A-COM Tech's portfolio of high-performance semiconductors, as well as scope for margin expansion and cross-selling;
- increasing penetration of high-growth, profitable markets, including point-to-point radio and MoCA applications;
- boosting M/A-COM Tech's block diagram solution selling approach;
- deepening of both firms' relationships with key global customers;
- applying M/A-COM Tech's quality excellence and operational efficiencies to the Mimix supply chain; and
- augmenting M/A-COM Tech's hybrid fab business model.

"This strategic merger with Mimix enables us to expand our product offering of high-performance, multi-function MMIC solutions, which Mimix has deep expertise in developing," says M/A-COM Tech's CEO Joe Thomas. "Combining this innovative technology with our quality excellence and operational efficiencies solidifies our leadership position as a multi-market supplier and enables more rapid growth and margin expansion," he believes.

The merger is favorable for both firms, because it creates a robust combined firm leveraging unique areas of expertise, says Mimix's CEO Rick Montgomery. "Little overlap exists between the two product offerings, and there is significant synergy to be realized through our customer relationships, which will accelerate growth and market penetration."

The merger creates "a superior business model that positions the combined M/A-COM Tech for profitable growth," says John Ocampo, who is M/A-COM Tech's chairman.

The M/A-COM Tech and Mimix management teams will be combined to maximize growth opportunities created by the merger. Thomas will continue as CEO. Montgomery will maintain a strategic role, pursing new technology and business opportunities.

"This advantageous merger with Mimix provides a highly complementary combination of technology, instantly creating the most compelling offering of silicon- and GaAs-based high-performance products," reckons Thomas. "Together, we can offer our global customers full block diagram solutions to address their most demanding system needs," he adds. The combination of the two organizations establishes a solid foundation for continued growth by offering a best-in-class set of solutions, comments Montgomery.

www.macomtech.com
www.mimixbroadband.com

M/A-COM Tech appoints head of Strategic Marketing

M/A-COM Tech has appointed Jihye Whang as its head of Strategic Marketing, focused on new business initiatives.

"Jihye has a successful track record in finding new business opportunities for small start-up businesses as well as large corporations," says chief strategy officer Robert Donahue.

Most recently, Whang was director of Corporate Development for SK Telecom Americas Inc, responsible for investment growth strategies in digital media and unified communications. She also worked as director of Product Management & Marketing at hand-held PC start-up OQO. Previously, Whang was chief of staff for Intel's Service Provider Business Group, which grew as a new business initiative for WiMAX. In the late 1990s, she worked for M/A-COM as an engineer, performing device modeling and characterization.

Whang has an MBA from Stanford University and a B.S. and M.Eng. in Electrical Engineering & Computer Science from MIT.

Cobham launches GaAs MMIC products for aerospace & defense

At the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA (24–28 May), UK-based aerospace technology developer Cobham plc launched five microwave circuit products bringing robust and cost-effective microwave sensor alternatives to electronic warfare, missile defense, communication, and space systems: a 2–6GHz high power amplifier, a 2.5–6GHz driver amplifier, a 4–20GHz broadband gain block, a 1–6GHz digital attenuator, and an L-Band phase shifter.

Fabricated at Cobham's new Sensor Systems facility in Blacksburg, VA, USA and designed by Cobham engineers in Blacksburg and in Richardson, TX, the GaAs MMICs will provide sensor solutions for systems such as integrated defensive electronic counter-measures jamming systems used in jet fighter aircraft, as well as ground-based systems such as the counter-fire target acquisition radar system.

In March, Cobham Sensor Systems (a strategic business unit of Cobham Defense Systems) completed the relocation from Roanoke, VA to Blacksburg and the consolidation of its semiconductor microwave circuits fabrication operations. The move expanded cleanroom capacity from 8000ft^2 to 11,000ft^2 and brought all operations into one facility.

"Today's product announcement demonstrates the success of this move, which has enabled us to introduce new and highly reliable MMIC systems that can be produced at lower cost and in less time," comments Jeremy Wensinger, president of Cobham Defense Systems.

www.cobham.com

NXP offering 50 SiGe:C BiCMOS-based RF/microwave products

At May's IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA, USA, NXP Semiconductors of Eindhoven, The Netherlands demonstrated a series of new products developed in its latest silicon-germanium technology .

Addressing demand for more robust, cost-effective and highly integrated silicon-based technology, NXP will offer more than 50 SiGe:C-based products by the end of 2010. Delivering high power gain and dynamic range, NXP's QUBiC4 SiGe:C process targets the needs of real-life, high-frequency applications in the wireless, broadband communications, networking, and multimedia markets.

With over a dozen SiGe products in the market, NXP has developed and shipped over 25 million RF products using QUBiC4, demonstrating the maturity of the process as well as industry acknowledgement of how SiGe:C can deliver the performance of GaAs technology, NXP claims.

"NXP is committed to the development of products produced with SiGe:C technology to address the fast-moving dynamics of the RF/microwave markets," says Ronald van Cleef, NXP's general manager, RF small-signal business. "We endeavor to provide cost-effective, integrated, high-frequency solutions with the performance of GaAs technologies using a silicon-based process."

NXP says that its SiGe:C QUBiC4 process allows wireless equipment makers to add more functionality onto devices with less space, competitive cost, reliability and manufacturing advantage. It adds that QUBiC4 speeds migration from GaAs to silicon by enabling low-noise performance and IP availability.

NXP offers three QUBiC4 variants: QUBiC4+, a silicon-based process for applications up to 5GHz such as medium-power amplifiers; QUBiC4X, a 0.25µm SiGe:C process introduced about 6 years ago, typically for applications up to 30GHz and very-low-noise applications such as GPS; and the most recent 0.25µm QUBiC4Xi SiGe:C process, offering an f_T in excess of 200GHz, suited to applications above 30GHz and those requiring minimum noise figure, e.g. VSAT and radar.

NXP says that, with proven IP and in-house fabrication for volume production, QUBiC4 SiGe:C aims to boost overall RF performance and make the components less costly, while offering higher and more flexible performance than GaAs. With over 45 years of experience in RF modeling, design and packaging, NXP says that QUBiC4 combines the performance of GaAs technologies with the reliability of a silicon-based process. With the continued growth of high-speed-digital data transmission and wireless communications technology, it adds that QUBiC4 is advancing solutions traditionally offered only by GaAs technologies at a lower cost, with higher integration and added features, as well as addressing the need for low power consumption.

Applications for QUBiC4-based products range from mobile platforms, personal navigation devices, AESA radars, satellite DBS/-VSAT, e-metering, software-defined radios (SDR), base-stations, point-to-point radio links, and WLAN, where high frequency and high integration are essential. End users can benefit from increased functionality on smaller and lighter-weight mobile phones.

More than 50 products based on the SiGe:C process will be available by end 2010. A dozen are already available, including GPS low-noise amplifiers like the BGU7005, medium power amplifiers like the BGA7124, and LO generators like the TFF1003HN. Another 40 are being released in 2010, including 6th- and 7th-generation wideband transistors, low-noise amplifiers, medium power amplifiers, variable gain amplifiers and LO generators.

www.nxp.com

Freescale enters GaAs MMIC market with four devices for base-stations

Freescale Semiconductor of Austin, TX, USA, which designs and makes embedded semiconductors for the automotive, consumer, industrial and networking markets, has launched four GaAs MMICs optimized for macro base-stations, repeaters and femtocells in wireless networks.

The devices address low-noise amplifiers and transmit power amplifiers — elements of wireless infrastructure equipment for which high RF performance is critical. The devices are also designed for low power consumption, yielding optimized energy efficiency and long-term reliability, the firm claims.

While focusing on silicon RF LDMOS power transistors used in wireless base-stations, Freescale holds many GaAs-related patents, and was one of the first firms to develop GaAs-based devices. Its growing family of general-purpose amplifiers (GPAs) based on InGaP HBTs and GaAs HFETs covers an array of RF and microwave applications.

"Freescale's high-performance MMIC devices offer comprehensive RF active solutions for applications requiring high performance such as 3G and 4G cellular base-stations, repeaters and femtocells," says Gavin P. Woods, VP & general manager of Freescale's RF Division. "We developed the new MMIC products with the same standards as our advanced LDMOS RF technology in terms of quality and reliability... Our GaAs MMICs also come with the software and hardware tools necessary to extract optimal performance with minimal overhead costs."

MML09211H is an enhancement-mode pHEMT MMIC low-noise amplifier suited to applications ranging from W-CDMA base-stations in the 865–960MHz band to the high-data-rate networks being implemented in the 728–768MHz band. The device offers a low noise figure of 0.6dB including circuit losses, and supports operation from 400 to 1400MHz. Small-signal gain is 20dB at 900MHz, P1dB output power is 21dBm, isolation is –35dB, and third-order output intercept point (IP3) is 32dBm at 900MHz.

MMA20312B is a two-stage InGaP HBT power amplifier for wireless base-stations as well as repeaters and femtocells (for which it enables high energy efficiency while meeting linearity requirements). Covering 1800–2200MHz, it delivers P1dB output power of 31dBm at 2140MHz and small-signal gain of 26dB.

The two other new broadband MMIC amplifiers are equally suited for use as driver amplifiers in the transmit chain or as second-stage low-noise amplifiers in the receive chain, with what is said to be high linearity and lower current consumption than typical HBT solutions. Covering 500–2800MHz, the MMG15241H pHEMT has a noise figure of 1.6dB at 2140MHz, P1dB output of 24dBm, IP3 of 39dBm, and small-signal gain of 15dB. The MMG20271H low-noise amplifier covers 1500–2400MHz, with a noise figure of 1.8dB at 2140MHz, P1dB output of 27dBm, IP3 of 42dBm, and small-signal gain of 15dB.

To complement the new MMICs, Freescale has also introduced application boards and RF characterization data for its MMG3004NT1, MMG3005NT1 and MMG3006NT1 GPAs, showcasing the MMICs' capabilities in actual base-station transmitter device line-ups. The latest data shows that current consumption can be reduced by almost 50% from the initial data sheet conditions with little penalty in linearity, says the firm.

The new MMICs are the first of many planned MMIC devices under development to cover popular wireless bands and applications.

The new devices are planned for limited sampling by June and general sampling by August. Product support includes reference designs and other design support tools.

www.freescale.com

IN BRIEF

GCS announces THz diode foundry process for mm-wave transceivers

Pure-play III-V compound semiconductor wafer foundry Global Communication Semiconductors Inc (GCS) of Torrance, CA, USA says that its proprietary terahertz diode monolithic microwave integrated circuit (MMIC) foundry process is now being offered to address millimeter-wave transceiver requirements.

"Until now, a THz diode has only been available as a discrete device. The integration of a discrete THz diode into a circuit assembly with other active and passive components required wire bonding. Although this approach was not desired, it was unavoidable for many millimeter-wave applications due to the lack of a monolithic solution," says CEO Jerry Curtis.

"Our engineering team has overcome the technical challenges by developing a planar Schottky diode process with THz performance," he adds. The fully monolithic process, with MIM capacitor, spiral inductor, thin-film resistor and backside via features, is now offered as a standard foundry process.

The THz diode process has been demonstrated as a mixer in a W-band up-converter with a conversion loss of 6dB, with a LO frequency of 91.8GHz (12dBm) and an IF of 2.25GHz. The process suits applications in mm-wave frequency transceivers, as well as terahertz imaging systems, GCS concludes.

GCS showcased its new THz diode foundry process at the IEEE MTT-S International Microwave Symposium (IMS) in Anaheim, CA (24–28 May)

www.gcsincorp.com

TriQuint grows 52% despite dip from last quarter

driven by rebound in networks and continued strength in smartphones

RF front-end product and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA has reported first-quarter 2010 revenue of $180.8m, down 6.5% on $193.3m last quarter though more than the forecast $170–175m and up 52% on $118.9m a year ago.

TriQuint produces devices for three sectors: Mobile Devices (63% of sales in Q1/2010), Networks (25%), and Defense & Aerospace (12%). During 2009, the firm reclassified wireless networking devices (WLAN) from Networks into Mobile Devices (5% of total billings in Q1/2010). The year-on-year (Y/Y) increases in sales in these sectors were networks 42%, mobile 63% and defense 35%. The network market came in above company expectations, suggesting a recovery in the sector that president & CEO Ralph Quinsey says "appears to be broad-based across many of our network customers".

In the defense sector, TriQuint receives R&D support directly from government and industry sources and contributes devices to advanced radar systems destined for installation in Joint Strike Fighter, Unmanned Aerial Vehicles, and radar retrofits for F-15, F-16 and F-18 fighters. The direct defense R&D investment was up 37% over Q1/2009. For the radar sector, the increase was 70%.

Utilization in the company's gallium arsenide facility is 76% (which is much better than a typical first quarter, due to better-than-seasonal revenue and expected strong revenue growth into the second quarter).

However, Quinsey comments that this "metric is not a good indicator of growth or growth potential as we have been and will continue to increase capacity."

Capacity expansion (largely at the firm's GaAs facility in Oregon, begun several months ago) will start to have an impact on TriQuint's operations in June. The increase in capacity in Oregon should be 15–20%

Nevertheless, together with improved product sales mix, increased utilization has contributed to non-GAAP basis gross margin rising from just 21% a year ago and 38.4% last quarter to 39% (exceeding the forecast 36–38%).

Compared to a loss of $11m a year ago, non-GAAP net income was $18.7m, although this is down from $22.6m last quarter.

During the quarter, cash flow from operations was $12.1m, and cash, cash equivalents, and investments rose to $159.6m ($1.00 per diluted share). Capital spending was $12.9m, compared with depreciation of $11.6m.

For second-quarter 2010, TriQuint expects revenue of $200–210m, up more than 13% sequentially. Solid demand in Networks and strong factory utilization should lead to non-GAAP gross margin rising to about 40%. Non-GAAP operating expenses are expected to rise from Q1/2010's $55m to $57–58m, largely to cover a $3m legal expense from litigation with Avago, as well as increases in R&D and selling expenses.

Growth in cash is expected to be modest due to increased capital expenditure and working capital. Capacity expansion (largely at the firm's GaAs facility in Oregon, begun several months ago) will start to have an impact on TriQuint's operations in June. The increase in capacity in Oregon should be 15–20%.

www.triquint.com

Author: Mike Cooke

TriQuint wins TechAmerica Oregon's System/Hardware Company of the Year award for 2nd consecutive year

As part of the Technology Awards program of TechAmerica Oregon (formerly the Oregon Council of AeA) at the Portland Art Museum in early May, RF product maker and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA received the System/Hardware 'Company of the Year' award from TechAmerica Oregon for the 2nd consecutive year. (Last year, TriQuint's president & CEO Ralph Quinsey was also recognized as TechAmerica Oregon's 2009 Technology Executive of the Year.)

"TriQuint has been a solid contributor to the technology community, and has persevered through 2009's economic challenges," said TechAmerica Oregon's chairman Allen Alley. "Guided by strong leadership and thoughtful risk taking, we applaud TriQuint for its accomplishments in the industry and contributions to the community."

"In Q1/2009 we looked across the chasm and saw great opportunity," said Quinsey on accepting this year's honor. "We maintained staffing levels, invested in the business and focused on the future. Our employees attended to customers, and we grew the business nearly 15%," he added. "And 2010 looks to be another great year."

www.oregontechawards.com

www.techamerica.org

Anadigics revenue rises 4% as loss is cut further

Non-GAAP profit targeted in Q2/2010

For first-quarter 2010, GaAs-based wireless and broadband communications component maker Anadigics Inc of Warren, NJ, USA has reported a fourth consecutive quarter of revenue growth, to $43.5m ($30.4m wireless and $13.1m broadband).

This is up 42.7% on $30.5m a year ago and up 4.1% on last quarter's $41.8m (despite seasonal softness, and surpassing expectations of being flat sequentially). This is driven by 22% sequential growth in the wireless product line due to the high level of handset design wins secured in second-half 2009, which continued to move into production.

"New product releases and design-win activity remains strong as we are gaining increased market share in wireless and across our customer base," says CEO Mario Rivas.

Core drivers are Anadigics' strength in the growing 3G and 4G markets, fueled further by its top customers gaining share in their respective markets and rising power amplifier content in 3G handsets, says Rivas.

There was also better-than-expected growth in WiMAX, dual-band wideband CDMA, and cable business (benefiting from recent infrastructure build-out in developing countries, which is expected to be consistent for the rest of 2010). Anadigics is also gaining market share in China with some leading handset suppliers in TD-SCDMA.

Gross margin was 32.3%, exceeding the expected 29–30% and up from 29.1% last quarter due mainly to better product mix.

On a non-GAAP basis, net loss has been cut from $12.8m a year ago and $3.2m last quarter to $2.7m.

"Over the last year, we increased our revenue by approximately $13m, or over 40%, and reduced our non-GAAP loss by $10.1m, nearly double the percentage rate of the improvement in revenue," says executive VP & chief financial officer Tom Shields.

During the quarter, cash, cash equivalents and short and long-term marketable securities fell further from $92.5m to $90.4m after using $2.1m principally to fund accounts receivable on increased net sales.

For Q2/2010, Anadigics expects revenue of $48.7m (up 12% on Q1), driven by 20% growth in wireless sales (again, due to demand for 3G wideband CDMA products). Target gross margin is 35%.

"We anticipate crossing another key milestone for the company by generating a non-GAAP profit in the second quarter of 2010 by capitalizing on the operating leverage created from our product mix and manufacturing operations," says Shields. Excluding non-cash stock compensation expense, non-GAAP income should be $0.1m.

www.anadigics.com

High-linearity power amplifiers for femtocells unveiled

Anadigics has made available engineering samples of two power amplifiers (PAs) designed for femtocells, picocells and in-home customer premises equipment (CPE).

Such applications are growing in popularity among service providers as an effective way to expand wireless network coverage. Femtocells solve the problem of weak wireless broadband signals in homes and offices by allowing mobile devices to connect to their carrier's network through a high-speed Internet backhaul link.

Fabricated using InGaP HBT MMIC technology, the PAs incorporate RF matching networks optimized for output power, efficiency and linearity in a 50Ω system. They support complex modulation schemes (e.g. WCDMA, HSDPA and LTE) by providing margin to adjacent channel power (ACPR) requirements at rated output power, with up to +24.5dBm of WCDMA power with –50dBc ACPR. Operating in the most popular 3G bands, the AWB7123 supports UMTS band 2 in North America and the AWB7127 band 1 in Europe, Asia and parts of South America. Anadigics says it has designed the PA modules for easy incorporation into virtually any small-cell base-station platform. Designs are standards-flexible, and support products developed for networks in which evolution to LTE will occur.

"Femtocells are a fundamentally new approach to mobile network architecture, and offer an attractive option for upgrading the existing network infrastructure as well as deploying the latest 4G technologies," says Joe Cozzarelli, senior director, Broadband RF Product Line. "We've drawn on our extensive experience in the design and development of power amplifiers for both mobile handsets and broadband cable infrastructure to balance the appropriate level of integration, performance and reliability in a cost-effective way. Our design approach provides the flexibility to support multiple standards with one device," he claims.

As femtocell technology matures, the market will grow to 49 million access points by 2014, reckons industry organization Femto Forum, with 114 million users accessing mobile networks via femtocells. Such small base-stations in homes or offices use the customer's own broadband connection to shuttle data and voice traffic between a mobile device and its network. Femtocells in a building can also boost coverage, as cellular signals often can't penetrate dense structures. Suppliers like Qualcomm are increasing their focus on femtocells, with plans for reference designs announced already this year.

Kopin's III-V revenue doubles year-on-year in Q1

Growth driven by mobile connectivity and smart-phone demand

For first-quarter 2010, Kopin Corp of Taunton, MA, USA has reported revenue of $25.4m, down 23% on $33m last quarter but up 18.5% on $21.5m a year ago. Revenue for CyberDisplays was $10.9m, down on $18m last quarter and $14.6m a year ago. However, revenue for the III-V product family was $14.5m, down only 3% on $15m last quarter and up 110% on $6.9m a year ago.

"Revenue from our III-V product family more than doubled year-over-year, reflecting strong growth trends in mobile connectivity and smart-phone proliferation," says president & CEO Dr John C.C. Fan. "Consumer and professional users alike are looking for greater functionality, higher speeds and lower power consumption," he adds. "Our proprietary GaAs-based HBT technology is core to our product portfolio and is strategic to the competitiveness of our integrated circuit customers." In particular, the performance of the HBT technology plays a leading role in the growth of advanced 3G devices, which require up to three times more wafer content than conventional handsets, Kopin says.

Net income of $1m was down on $1.9m a year ago and $5.3m last quarter. Nevertheless, with no debt, cash and marketable securities rose $4.5m during the quarter to $119m.

To enhance its III-V technology and new product development efforts, Kopin recently hired Dr Wayne Johnson as director of New Business & Product Development and at its Taiwan subsidiary KTC it hired Dr Patrick Chin as VP of technology. "Operationally, we are beginning to realize the benefits of our strategic investments in six-inch wafer fabrication equipment," says Fan. "In addition, we are planning to further expand our III-V capacity and capability for 2011 in response to the increasing market demand for our products," he adds.

"We began 2010 with solid financial performance reflecting the competitiveness of our technology, the strength of our end markets and the discipline of our operations," Fan said. "Kopin is strategically well positioned to benefit from a number of key technology themes, including mobile connectivity and smartphone adoption as well as micro-display and 3D capability. Each of these is critical to improving and extending the concept of the mobile Internet," he adds. "Our technology-focused company, supported by 200-plus issued and pending patents, is well-positioned to advance each of these related trends."

Kopin remains on pace to achieve its full-year 2010 revenue guidance of $120–130m (up 5–13% on 2009's $114.7m).

www.kopin.com

Multi-year order placed with Aixtron to expand capacity by 50%

Kopin has completed a multi-year purchase and supply agreement with Aixtron for additional high-volume MOCVD reactors. The investment supports Kopin's latest capacity ramp to meet consumer demand for smart phones, e-books and other wireless communication devices.

"These new Aixtron systems are the most advanced multi-wafer machines for HBT manufacturing," says Kopin's president & CEO Dr John C.C. Fan. "They will enable us to further increase our 6" wafer capacity to meet the rapidly increasing customer demand for more devices, as well as for more complex device structures required for smart phones," he adds. "For the past few years, we have been using the same type of systems for manufacturing 6-inch wafers. We have gained tremendous know-how that has enabled us not only to increase throughput and yield, but to achieve better and more consistent device performance.... the purchase of the same advanced manufacturing platform will further shorten the time to manufacturing and increase our operational efficiency and consistency," he believes.

"Kopin has again selected our 7x6" 'Integrated Concept (IC) Platform' tool," says Aixtron's president & CEO Paul Hyland. "Our relationship with Kopin is now in its second decade... our technology and services remain a key part of Kopin's wafer manufacturing platform," he adds.

Kopin first installed Aixtron's 7x6"-wafer IC tools in its Taunton, MA manufacturing facility four years ago to fully develop and optimize the tools' performance with its proprietary HBT, BiFET, pHEMT and BiHEMT manufacturing processes. The first two systems of the new multi-year order will be installed at Kopin Taiwan Corp (KTC) in Hsinchu Science Park, Taiwan by the end of this year. Kopin expanded its investment in KTC in August 2009, and has since been expanding capacity and capability there.

"Over the past two years, we have executed our plan to support our customers' conversion to 6" wafers from 4" wafers, expanded our III-V product offerings to pHEMT and BiHEMT, and successfully achieved a 50% increase in overall manufacturing capacity," says Daily Hill, Kopin's senior VP & general manager of the III-V Group. "This newest tool order with Aixtron starts our next plan for an additional 50% capacity expansion in our facilities in the US and Taiwan," he adds.

www.aixtron.com

Kopin adds key technical staff to meet growing demand

Kopin has appointed Dr Patrick Chin as VP of technology at Kopin Taiwan Corp (KTC) and Mark Stovall as general manager of its Application & Design Center in Scotts Valley, CA.

"Chin will lead KTC's technical efforts to support the increasing demand from Taiwan-based customers and to augment Kopin's domestic capabilities," says Daily Hill, senior VP & general manager of Kopin's III-V Group. "Kopin is experiencing growth drivers from both the rapid adoption of smart phones around the world and increased market penetration in Asia," he adds. "Chin's strong technical background in HBT and HEMT products is a tremendous asset for Kopin in developing the next generation of products to support the continuously expanding capabilities of wireless devices."

Chin was most recently with Solapoint in Taiwan as VP of Advanced Technology heading development and integration for photovoltaic production and wafer foundry business. Previously, he worked at OEpic Inc, TRW Space Electronics, and Northrop Grumman Space Technology (as Semiconductor Materials Department manager, leading a group of 40 in developing and producing III-V devices). He has co-authored more than 60 technical publications in III-V semiconductors and holds three US patents.

Stovall joins Kopin from BAE Systems. He has more than 20 years of experience in managing US Army and Marine Corps programs, including the Mine Resistant Armor Protected Vehicle, the Bradley Fighting Vehicle and US Marine Corps Amphibious Assault Vehicle.

"A strong current trend in outsourcing solution-based projects by key defense companies continues to increase the number of opportunities for our military products," says Michael Presz, Kopin's VP of Government Programs. "Stovall's vast experience in proposal preparation and management of Department of Defense (DOD) programs will be instrumental in responding to the fast-paced development programs we are currently engaging," he adds.

"The markets we serve are growing significantly and our customers are demanding increased technical and manufacturing support from us," says president & CEO Dr John C.C. Fan. "Strong management and technical resources are one of the key components for our continued growth strategy. The addition of these two important leaders and the three technical personnel we announced recently represents the execution of this strategy," he adds. "Together with our continual installation of advanced equipment and facilities, we are well positioned for the rapidly growing opportunities."

www.kopin.com

Boston Globe 100 ranks Kopin 26th, Skyworks 42nd, Hittite 52nd in Massachusetts

Kopin Corp of Taunton, MA, USA, which makes III-V HBT epiwafers and CyberDisplay LCDs microdisplays for consumer, industrial and military applications, has entered The Boston Globe's 22nd annual 'Globe 100' list of Massachusetts-based companies publicly traded on NASDAQ, New York Stock Exchange or American Stock Exchange, after being ranked 26th.

To be eligible, a firm must have been public for the whole of 2009 and have reported a positive net income for both 2008 and 2009. "These companies show vision and set examples for how to adapt to a tough economic climate," comments The Boston Globe's business editor Shirley Leung. This year, 82 firms were named to the Globe 100, making the list the most exclusive to date, while acting as a reminder of the challenging economic climate.

Ranking is based on a composite score (with the least being the best) derived from four financial criteria for the four quarters of 2009: full-year 2009 revenue, return on average equity, one-year change in revenue, and one-year change in profit.

Kopin's composite score of 131 came from 2009 revenue of $114.7m, return on average equity of 13.0%, one-year change in revenue of –0.1%, and one-year change in profit of 652.8%.

Kopin was also ranked 6th position among technology companies. "Having recently celebrated our 25th anniversary in business, these rankings are a reflection of our emphasis on being technologically aggressive but financially conservative," comments Kopin's founder, president and CEO Dr John C.C. Fan.

Skyworks Solutions Inc of Woburn, MA, which makes linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, was down from 15th the prior year to 42nd, with a composite score of 165 based on 2009 revenue of $837.5m, return on average equity of 9.4%, a 1-year change in revenue –2.6%, and a 1-year change in profit of –11.8%.

Hittite Microwave Corp of Chelmsford, MA, which designs and supplies analog and mixed-signal RF, microwave and millimeter-wave ICs, modules and subsystems, was down from 34th for the prior year to 52nd, with a composite score of 179 based on 2009 revenue of $163m, return on average equity of 18.1%, and a 1-year change in revenue 38.3%, but a 1-year change in profit of –78.8%.

www.boston.com

Skyworks' 38% year-on-year growth beats Q1 guidance

June quarter to see 10–15% growth as $1bn targeted for 2010

For its fiscal second-quarter 2010 (ended 2 April), Skyworks Solutions Inc has reported revenue in the seasonally low March quarter of $238.1m, down 3% on last quarter's $245.1m but up 38% on $173m a year ago (and exceeding its guidance of $230–235m, which itself had been revised upwards on 1 March from 20 January's original guidance of $225m). Growth benefited from Skyworks' broad diversification, shipping to nearly 1000 customers, of which only Samsung exceeded 10% of total revenue.

Driven by a product mix that increasingly includes higher margin, vertical market and 3G solutions, a volume ramp of new products, continued manufacturing productivity enhancements, product end-to-end yield improvements, and significant material cost reductions, non-GAAP gross margin has risen from 40% a year ago and 42.2% last quarter to 42.3%.

Operating expenses have been cut from $68.6m a year ago and $60m last quarter to $52m. Despite this, operating income has fallen from $52.3m (21.3% operating margin) last quarter to $48.7m (20.5%), although this is still more than double the $21.2m (12.3%) a year ago.

Operating cash flow was $60m. So, even after a $40m outlay for retiring March 2010 convertible debt, $11m of depreciation and $20m in capital expenditure, cash and cash equivalents still rose during the quarter from $402m to $411.5m.

"Skyworks is capitalizing on the rapidly expanding opportunity for analog semiconductor solutions, which are increasingly at the heart of smart phone, broadband access, network infrastructure and smart grid applications," says president & CEO David J. Aldrich. "At the same time, we are gaining traction in new vertical markets and making substantial progress towards our long-term financial targets," he adds.

During the quarter, Skyworks:

- received initial orders from Honeywell for wireless home security systems;
- secured first design wins with LG's Consumer Appliance Group with ZigBee front-end modules;
- developed customized set-top box solutions for Thomson in support of DirectTV;
- launched highly integrated multimode front-end solutions for next-generation smart phones and embedded wireless devices;
- ramped integrated radio subsystems for TD-SCDMA and WCDMA base stations at China's Huawei; and
- started shipments of 3G power amplifiers enabling high-volume data-card applications at ZTE.

"The unique combination of our innovative product roadmaps, design-win pipeline and scale advantages are setting the stage for an even stronger second half of fiscal 2010 and a widening of the gap between overall market growth and our performance," says Aldrich. "Growth across our set of diversified markets and customers, coupled with new program ramps, is translating into improving order visibility," notes VP & chief financial officer Donald W. Palette. Hence, for fiscal Q3, Skyworks expects 10–15% sequential revenue growth. "Operationally, we plan to drive further improvements in both gross and operating margins," he adds. Assuming revenue of $268m (the midpoint of the forecast range), gross margin should be 43% and (even with operating increased expenses of $54–55m) operating margin should rise to nearly 23%.

"This trajectory is consistent with our medium-term financial targets outlined previously, namely operating margins in the mid-20s on revenues in the $280–300m range," says Palette. "This model was highly achievable in the near term and strikes the right balance between gaining market share, enhancing margins and, most importantly, maximizing our return on invested capital," he continues. "Given the strengthen of our business model, we expect additional leverage well beyond the mid-20% range as we continue to scale and further diversify Skyworks," concludes Palette.

"By simply annualizing our June-quarter outlook, we are on a greater than $1bn revenue run-rate... even before our second-half 2010 ramp — yet another step in the transformation of Skyworks into a high-margin, diversified analog semiconductor market leader," says Aldrich

www.skyworksinc.com

In May, Skyworks retired an extra $20.4m of convertible notes with an original maturity date of March 2012.

With early retirement of the debt, Skyworks has eliminated potential future dilution of 2.1 million shares.

At the end of fiscal Q2/2010 Skyworks maintained $412m in cash and cash equivalents with a principal value of $47m in long-term convertible debt. By comparison, at the end of fiscal Q2/2008, it held $228m in cash and cash equivalents and $200m in long-term debt.

"Skyworks has generated $323m in cash flow from operations over the past six quarters, enabling us to efficiently deleverage our balance sheet," says chief financial officer Donald W. Palette. "This financial strategy has supported increasing business throughout the economic downturn as customers, suppliers and partners appreciate the strength of our balance sheet in today's market environment," he adds. "As a result, we intend to outperform our addressed markets and further improve our capital structure going forward."

Skyworks captures GSM/GPRS and EDGE design wins at Taiwanese mobile phone maker MediaTek for next-generation platforms targeting emerging markets

Skyworks Solutions Inc of Woburn, MA, USA, which makes linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, has captured design wins at MediaTek Inc of Hsinchu Science Park, Taiwan in support of several of its next-generation platforms targeting low-cost handsets in emerging markets.

MediaTek, a fabless semiconductor company for wireless communications and digital multimedia, supplies complete chipset solutions using its own baseband processor, radio, multimedia and connectivity product offerings as well as the necessary software. The firm then leverages front-end solutions to offer a turnkey approach to manufacturers supplying mobile handsets.

Skyworks' front-end solutions for MediaTek's MT6253 platform and other top-tier customers contain what is claimed to be the best power-added efficiency performance over a broad power range, increasing talk and extended standby times for handsets and data card modules. In addition, the firm's compact and integrated total transmit solutions — consisting of a power amplifier (PA), switch module, and automatic power controller — reduce bill-of-material costs and overall board space.

"MT6253 is our first 2.5G system-on-chip, integrating all essential electronic components, including DBB, ABB, power management unit and RF transceiver," says MediaTek executive VP JiChang Hsu. "It is rapidly ramping and is expected to be one of the main, high-volume runners in the coming years," he adds. "Together with Skyworks' front-end modules, the MT6253 platform further reduces the material count and size of a complete mobile phone," he claims.

The SKY77542 (880–915 and 1710–1785MHz) and the SKY77543 (824–849 and 1850–1910MHz) are transmit and receive (Tx–Rx) front-end modules (FEMs) with integrated power amplifier control (iPAC) for dual-band cellular handsets comprising global system for mobile communications (GSM) and personal communications system (PCS) operation. Designed in a low-profile, compact form factor, the 6mm x 7mm multi-chip modules (MCMs) offer a complete transmit solution and provide receive paths from antenna to surface acoustic wave (SAW) filter. The FEMs also support Class 12 general packet radio service (GPRS) multi-slot operation.

The MT6253 platform further reduces the material count and size of a complete mobile phone, says MediaTek

The SKY77546 is a Tx–Rx FEM designed in compact 6mm x 7mm form factor for dual-band cellular handsets comprising GSM900 and DCS1800 operation. The FEM offers a complete transmit VCO-to-antenna and antenna-to-receive SAW filter solution that supports Class 12 GPRS multi-slot and enhanced data GSM environment (EDGE) operation for handsets and modules. Benefits include: easy power control, excellent current consumption to improve talk times, simple phone board implementation, easier layout for best performance, and tremendous harmonics performance.

The SKY77552 is a quad-band Tx–Rx FEM with iPAC for cellular handsets comprising GSM and DCS/PCS operation. The device has quad-band capability in applications of USA or European dual-band platforms. Designed in a low-profile, compact form factor, the FEM offers a complete transmit solution and provides receive paths from antenna to SAW filter. The device also supports Class 12 GPRS multi-slot operation.

www.mediatek.com
www.skyworksinc.com

Huawei recognizes Skyworks' base transceiver station RF customized devices with Technical Support Award

Skyworks has received the Technology Support Award from Chinese telecom solutions provider Huawei in recognition of its base transceiver station RF customized devices.

"Skyworks is honored to be recognized by Huawei for our work in developing customized base transceiver station solutions which leverage the strength of our RF portfolio," says Liam K. Griffin, senior VP, sales & marketing. "Our engagement with Huawei is just one example of how we are able to significantly increase content in base station applications, allowing us to meet customers' needs for reduced size and complexity while improving reliability, capacity and efficiency."

Huawei has been a customer of Skyworks' RFICs and analog components since 2006.

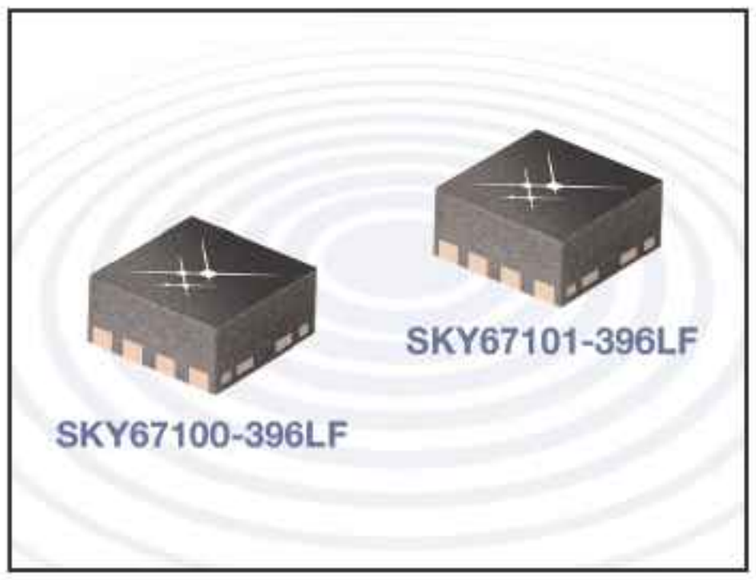
"We look forward to strengthening our partnership with Huawei as they focus on addressing the market challenges and needs to consistently create maximum value for operators and carriers."

Skyworks launches next-gen LNAs for multiple cellular infrastructure receiver applications

At the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA, USA (25–27 May), Skyworks Solutions Inc of Woburn, MA, USA introduced two next-generation low-noise amplifiers (LNAs) for multiple cellular infrastructure receiver applications, including GSM, CDMA, WCDMA and LTE base-stations and repeaters.

The new monolithic microwave integrated circuit (MMIC) amplifiers allow infrastructure providers to meet a wide range of demanding performance requirements with a single device that minimizes system noise figure, improves receiver sensitivity and delivers unconditional stability, says the firm.

"Estimates for mobile data traffic are expected to double every year through 2014," highlights David Stasey, VP of analog components.



Skyworks' next-generation LNAs.

Estimates for mobile data traffic are expected to double every year through 2014

"These solutions are just one of several devices that help reduce the size and complexity of networking equipment while enabling greater reliability, capacity and efficiency."

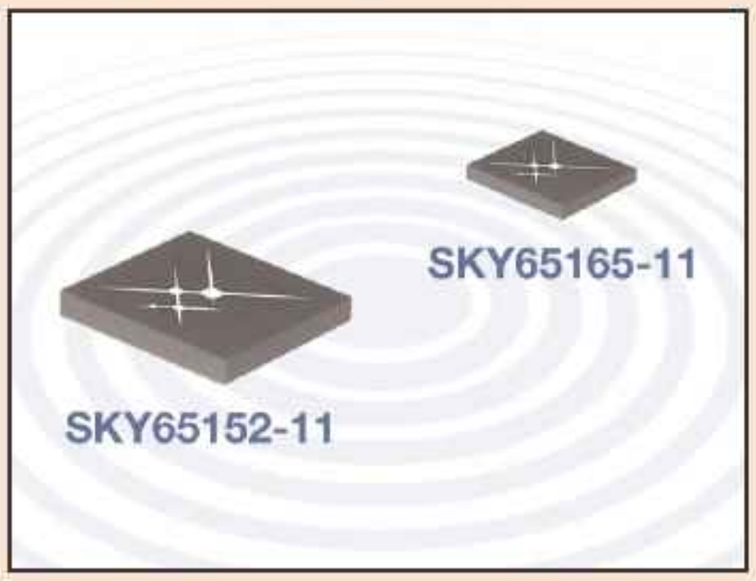
The 1.7–2.0GHz SKY67100-396LF and 0.7–1.0GHz SKY67101-396LF are GaAs enhancement-mode pHEMT LNAs designed for low noise figure down to 0.49dB while providing unconditional stability and high-linearity performance up to OIP3 of 34dBm. The addition of an internal active bias circuitry provides stable performance over temperature. The new LNAs are available in a small, industry-standard 0.75mm x 2mm x 2mm, 8-pin, dual flat no-lead (DFN) package and are layout compatible with each using a reduced-component matching network.

Skyworks launches mid- and high-power WiFi PAs for 802.11n access points, routers and gateways

Skyworks has also launched mid- and high-power 2.4–2.5GHz power amplifiers (PAs) for 802.11n multiple in/multiple out (MIMO) access points, routers and gateways.

The small-form-factor solutions enable multiple transmit channels on printed circuit boards (PCBs), offering configuration space savings, says the firm. The mid-power PA also offers two operating points in a single-device, providing maximum flexibility when developing platforms meeting varying performance requirements.

The 20-pin, 6mm x 6mm SKY65152-11 and the 16-pin, 3mm x 3mm SKY65152-11 are microwave monolithic integrated circuit (MMIC) PAs with output power, linearity and efficiency suitable for wireless local-area network (WLAN) applications. The high linearity, low EVM and high efficiency also suit use in the transmit chain of WLAN access points and modems.



Skyworks' new SKY65152-11 and SKY65165-11 power amplifiers.

The devices are fabricated using Skyworks' hetero-junction bipolar transistor (HBT) indium gallium phosphide (InGaP) process, allowing single supply operation while maintaining high efficiency and good linearity.

The small-form-factor solutions enable multiple transmit channels on printed circuit boards, offering configuration space savings

The SKY65152-11 is a fully matched PA, incorporating a directional power coupler for accurate power detection, mounted in a multi-chip module (MCM) package. The SKY65165-11 is internally matched at the RF input, includes integrated power detector, biasing and is mounted in a quad flat no-lead (QFN) surface-mounted technology (SMT) package.

"These devices highlight Skyworks' growing suite of WiFi solutions designed to address the expanding opportunities in high-performance gateways, access points, smart phones, media, and emerging mobile Internet access platforms," says senior VP of sales and marketing Liam K. Griffin.

Volume production is scheduled to begin in fourth-quarter 2010. The SKY65152-11 is priced at $1.58 each and the SKY65165-11 at $1.15 each in quantities of 10,000.

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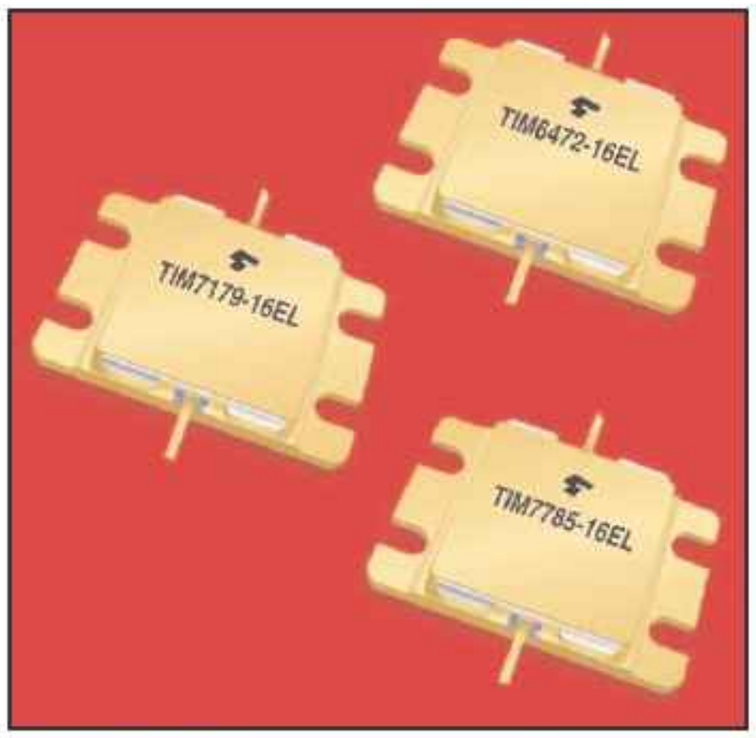
Toshiba expands C-band GaAs FET lineup with PAs optimized for both high gain and power-added efficiency

At the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA, USA (25–27 May), Toshiba America Electronic Components Inc (TAEC) and its parent firm Toshiba Corp of Japan announced the expansion of its gallium arsenide field-effect transistor (GaAs FET) lineup with the availability of samples of a new EL series of C-band devices targeted at microwave radios and solid-state power amplifiers (SSPAs).

"Toshiba's new EL series offers the highest level of performance of our three series of C-band GaAs FETs, with both high power-added efficiency and high gain [complementing the UL series with medium power-added efficiency and gain and the SL series with standard performance for this wavelength]," says Homayoun Ghani, business development manager, Microwave, Logic, and Small-Signal Devices, in TAEC's Discrete business unit.

The first three EL series devices are 16W GaAs FETs targeted at three different C-band frequency ranges.

The TIM6472-16EL operates at 6.4–7.2GHz, with typical output power at 1dB gain compression point (P1dB) of 42.5dBm and power gain at 1dB gain compression point (G1dB) of 11.0dB, and power-added efficiency (PAE) of 37%. It offers increases in gain of 4.0dB and 1.5dB compared to the similarly rated 16W devices in the SL and UL series (TIM6472-16SL and TIM6472-16UL), respectively.



The TIM7179-16EL operates at 7.1–7.9GHz, with typical P1dB of 42.5dBm, G1dB of 10.5 dB and PAE of 37%. It offers increases in gain of 4.0dB and 2.0dB compared to the similarly rated 16W devices in the SL and UL series (TIM7179-16SL and TIM7179-16UL), respectively.

The TIM7785-16EL operates at 7.7–8.5GHz, with typical P1dB of 42.5dBm, G1dB of 10.0dB and PAE of 36%. It offers increases in gain of 4.5dB and 1.5dB compared to the similarly rated 16W devices in the SL and UL series (TIM7785-16SL and TIM7785-16UL), respectively.

"With these high-gain FETs and a newly developed 4W monolithic microwave integrated circuit (MMIC), also introduced during this exhibition, we offer a two-chip solution for microwave radio design," Ghani says. "It eliminates the requirement for a mid-stage 4W discrete FET typically used in existing three-chip solutions, improves design flexibility, and saves board space and cost by reducing part count."

● With a broad bandwidth of 5.65–8.50GHz, high gain of 27dB throughout this operating range and 50 ohm internal matching, the TMD0608-4 4W GaAs MMIC (for sample availability third-quarter 2010) is suitable for use as a pre-amplifier in C-band satellite and terrestrial communications. Housed in a hermetically sealed package, the TMD0608-4 has typical P1dB of 35.5dBm, G1dB of 27dB.

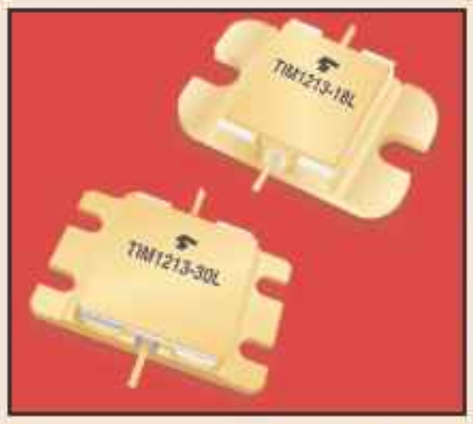
"Use of a broad band, internally matched amplifier can reduce the varieties of board design for different C-band requirements, save board space by minimizing the number of discrete amplification stages, and increase design reliability due to a reduced part count," says Ghani.

www.toshiba.com/taec

Toshiba doubles power of Ku-band GaAs FETs for microwave radio

Toshiba has expanded its Ku-band GaAs FET lineup by making available samples of two higher-output-power devices rated for 18W and 30W.

Operating at 12.7–13.2GHz, the TIM1213-18L and TIM1213-30L are targeted for use in microwave radios for microwave links and satellite communications. Other existing Toshiba GaAs FETs in this frequency range have power output ratings of 2W, 4W, 8W, 10W and 15W.



The new 18W and 30W TIM1213-18L and TIM1213-30L Ku-band GaAs FETs.

The TIM 1213-18L has typical output power at 1dB gain compression point (P1dB) of 42.5dBm, power gain at 1dB gain compression point (G1dB) of 6.0dB and power-added efficiency of 28%. The TIM 1213-30L has typical P1dB output power of 45.0dBm, G1dB power gain of 5.5dB and power-added efficiency of 23%.

"Toshiba is expanding our Ku-band product family with these new devices to enable our customers to design more powerful and linear microwave radios with fewer components," says Homayoun Ghani, business development manager, Microwave, Logic, and Small-Signal Devices, in TAEC's Discrete business unit.

Fujitsu launches first 3G and LTE SAW-less transceiver

Fujitsu Microelectronics America Inc (FMA) of Sunnyvale, CA, USA has made available samples of what is claimed to be the first transceiver supporting 3GPP LTE/WCDMA/EGPRS wireless phones.

Following the launch last September of the MB86L01A (the first commercial multimode 2G/3G SAW-less transceiver), the new MB86L10A transceiver eliminates 3G and LTE TX and RX inter-stage surface acoustic wave (SAW) filters and low-noise amplifiers (LNAs). The single-chip transceiver features backward compatibility with a high-level programming model (API) for radio control using DigRF/MIPI D3G and D4G open-standard digital interfaces, making compatible with a wide range of industry basebands.

Manufactured in 90nm CMOS silicon process technology, the compact module (in a 230-pin, 6.5mm x 9.0mm x 0.9mm LGA package) enables cell-phone makers to reduce component count, board space and total bill of materials, the firm says. The simplified programming model also significantly reduces development time and simplifies integration of the RF in a radio platform. The transceiver, which is optimized for compressed mode operation, features quad-band GSM/EDGE and up to five WCDMA or LTE bands in a single-phone configuration.

The MB86L10A includes eight outputs that directly drive the power amplifier, eliminating the need for TX SAW filters while simultaneously supporting advanced multimode PAs. The receiver provides nine inputs that support LTE, WCDMA and GSM/EDGE. The new RF front-end eliminates the need for LNAs and SAW filters. Five additional ports enable RX diversity in WCDMA and LTE modes. The receiver also incorporates anti-aliasing filters, digital channel filters, digital gain control and high-dynamic-range ADCs.

Fujitsu's MB86L10A transceiver.

The MB86L10A supports GSM (GSM850, EGSM900, DCS1800, PCS1900), WCDMA (bands I, II, III, IV, V, VI, VIII, IX, X and XI) and LTE (FDD bands 1, 3, 4, 6, 7, 8, 9, 10, 11, 13, 17 and TDD band 38 or 40). The transceiver includes dual 3G and 4G DigRF interfaces to the baseband IC to support the latest as well as legacy generations of basebands, SPI and/or GPOs control PAs, switching regulators and antenna switches. A microcontroller in the transceiver simplifies timing and control.

"The Fujitsu MB86L10A LTE multimode transceiver is the first of its kind to eliminate LNAs and 3G/4G TX and RX SAWs, reducing board area, component count and cost," claims Vivek Bhan, senior director of RF Engineering and Product Development for Fujitsu Microelectronics America. "This LTE multimode RF transceiver supports most global band configurations and standard interfaces, and its simple RF API programming reduces radio integration time," he adds. "The result is smaller radios with optimal time to market for handset manufacturers worldwide."

The MB86L10A transceiver is in the pre-production phase and is supporting field trials at a major carrier. The field trial is exercising the new device in 2G, 3G and 4G modes across multiple bands and both DigRF interfaces. "Early feedback on an advanced new standard will help develop a stable product faster, speeding time to market," says Bhan.

www.fujitsu.com/us

IN BRIEF

StratEdge launches leadless, low-profile, hermetic, SMT packages for up to 30GHz

StratEdge of San Diego, CA, USA, which designs, manufactures and provides test & assembly services for semiconductor packages operating up to 50GHz for microwave, millimeter-wave, and high-speed digital devices, introduced the SM family of fully hermetic, low-profile, leadless surface mount (SMT) packages with improved electrical performance, suiting aerospace, avionics, automotive and telecom applications (especially LED, MEMS and optical devices).

The new packages incorporate a metal plug in the base that allows a direct ground path for enhanced electrical performance. Anticipated performance is DC to more than 30GHz. All SM packages meet stringent MIL-STD requirements for hermeticity.

The first package offered has a 5mm x 5mm outer dimension and 28 I/Os. Other configurations planned include packages with 4mm x 4mm, 6mm x 6mm and 8mm x 8mm outer dimensions. Additions to the family will be offered as standard products, with samples and volume production quantities available in Q3/2010.

The SM packages match industry-standard outlines, enabling them to be used as direct replacements for traditional quad flat package designs. They can be used in place of plastic overmolded packages in applications requiring an air cavity (providing improved microwave performance and allowing for ease of rework and repair, suiting prototyping). In addition, air cavities are often necessary for sensors and other devices that need to respond to movement.

www.stratedge.com

Strong demand gives RFMD 51.4% increase in revenue year-on-year

RFMD rebounds after December-quarter dip

For its fiscal fourth-quarter 2009 (ended 3 April 2010), RF Micro Devices Inc of Greensboro, NC, USA has reported revenue of $260.8m, up 4% on fiscal Q3's $250.3m (rebounding from that quarter's dip of 1.8% from the prior quarter) and up 51.4% from the low of $172.3m a year ago.

According to generally accepted accounting practice (GAAP), operating income was $36.6m (up from last quarter's $33.6m) and net income was $26.7m (up from $24.9m). Gross margin was 37.7%, up from last quarter's 36.4% and just 17.3% a year ago.

Full-year fiscal 2009 results were revenues of $978.4m (up 10% on fiscal 2008's $886.5m), operating income of $106.4m and net income of $71m.

The company commented that demand in fiscal Q4/2009 was strong for products from both its cellular products group (CPG) and multi-market products group (MPG) operations. The breakdown of revenues between the two divisions is 80% CPG and 20% MPG.

During the financial year, both groups launched a record number of products: 40 new ones CPG and 350 new/derivative devices at MPG. Asia and 3G devices led CPG sales, while MPG saw a 'broad-based market recovery', led by defense, point-to-point radio, SmartEnergy and cable television (CATV) sectors.

RFMD is already 'fully booked for sequential revenue growth' for the next quarter (fiscal Q1/2011), ending in June. Transceiver revenues (impacted by sales to Nokia) are expected to increase and then 'ramp down' in fiscal Q2/2011 (to end September). For the whole of fiscal 2011, revenues are expected to increase over the year just ended. As an aim for the future, the firm wants to increase gross margin to about 42% and operating margin to about 17%. Capital expenditure (e.g. $35.5m for R&D in fiscal Q4/2010) is not expected to change dramatically from 2–3% of sales in the coming period, and the firm sees no need for extra fab capacity.

CapEx is not expected to change dramatically from 2–3% of sales

The MPG business is rolling out it gallium nitride process with hopes of worldwide deployment in such sectors as cable infrastructure, military communications, private mobilized radio, emergency radio, and military and civil radar applications. A GaN-based broadband transmission product targets CATV operators upgrading their network infrastructure, with increased bandwidth for video/data services and potential energy savings of more than 20%.

Author: Mike Cooke.

RFMD makes available 2010 product selection guide, featuring more than 150 new products

RF Micro Devices has announced the availability of its 2010 Product Selection Guide, providing the latest information on RFMD's broad portfolio of innovative RF components for multiple industries.

RFMD's 2010 Product Selection Guide features over 150 new products in a 52-page, easy-to-use format. In total, it includes specifications for more than 850 products serving more than 20 end-market segments, including point-to-point microwave radio, WiFi, WiMAX, SmartEnergy advanced metering infrastructure (AMI), ZigBee, wireless infrastructure, military and space, broadband transmission, consumer and cellular handsets. The Product Selection Guide allows individuals to cross reference and search products using market application diagrams across multiple end-markets.

www.rfmd.com/selectionguide

RFMD expects positive net cash position in 2010

In a webcast presentation at the Barclays Capital Global Communications, Media & Technology Conference in New York on 26 May, RF Micro Devices Inc's president & CEO Bob Bruggeworth said that, in contrast to its previous guidance, the firm now expects to achieve a positive net cash position by the end of calendar 2010.

Bruggeworth added that RFMD is enjoying favorable demand environment and is continuing to execute on key strategic initiatives (including product leadership, diversification and operational excellence). As a result, he adds, RFMD is comfortable with consensus estimates for its fiscal first-quarter 2011 (ending 3 July 2010) relating to revenue and non-GAAP net income per diluted share.

www.rfmd..com

Highly integrated WiFi front-end module for dual-band applications

RF Micro Devices has launched the feature-rich, dual-band RF5608 WiFi RF front-end module (FEM), which delivers high integration and full final testing to reduce size, simplify development and lower overall cost in high-performance, dual-band applications such as mobile computing and access point WiFi applications.

The RF5608 integrates components for the 2.4–2.5GHz and 4.9–5.85GHz ISM bands, including power amplifiers (PAs), low-noise amplifiers (LNAs), power detector circuitry and a diplexer with full harmonic filtering.

The integrated power detector provides a highly accurate voltage to enable closed-loop power control and help reduce system test time and calibration needs.

The three-stage PAs provide high linear output power of 18dBm at 2.4–2.5GHz and 16dBm at 4.9–5.85GHz. The PAs are also fully tested, including for DC and RF parameters (including EVM).

The RF5608 also features a full, integrated RF matching network to minimize external SMD requirements and an optimized supply voltage to increase compatibility with multiple applications. RFMD says that the highly integrated device enables global customers to lower costs, simplify designs and accelerate time-to-market in high-performance WiFi applications.

The highly integrated device enables global customers to lower costs, simplify designs and accelerate time-to-market

Complete integrated front-end module for handheld WiFi and Bluetooth systems

RF Micro Devices has unveiled a highly integrated new front-end module (FEM) that delivers a complete integrated solution for handset/handheld WiFi 802.11b/g/n and Bluetooth systems.

The RF5755 FEM integrates a 2.5GHz power amplifier (PA), multi-throw switch (SP3T), low-noise amplifier (LNA) and power detector coupler. It also features integrated matching circuitry with output harmonic attenuation, reducing the bill of materials (BOM) and manufacturing costs. The RF5755 is packaged in a small 16-pin QFN package (3mm x 3mm x 0.5mm), minimizing layout area in customer applications.

RFMD says that the highly integrated RF5755 delivers features and benefits including: high linear output power (20dBm), allowing higher efficiency and lower EVM (error vector magnitude) for 11n applications; the ability to switch between WiFi transmit, WiFi receive, or Bluetooth (transmit or receive); reduced need for a high loss/attenuation filter at the FEM output; high IIP3 and gain; simultaneous receive of WiFi and Bluetooth with positive gain in both paths (using the SPST switch after the LNA); and a direct-to-battery connection, eliminating the need for additional DC circuitry. Also, the integrated power detector coupler decreases sensitivity to voltage supply, temperature, and VSWR (voltage standing wave ratio) and improves the accuracy of the closed-loop power control, says the firm.

The RF5755 is fully tested, including EVM and all DC parameters, providing a reduced-size, single-placement solution that minimizes system footprint, reduces costs, and accelerates time-to-market for high linear output power applications, RFMD says.

IN BRIEF

RFMD launches laminate-based VCOs for wireless infrastructure

RFMD has launched a family of laminate-based voltage controlled oscillators (VCOs) for cellular infrastructure and other high-performance wireless transceiver applications.

Using RFMD's expertise in designing and manufacturing low-phase-noise discrete VCOs, its proprietary MicroShield integrated RF shielding technology, and its scale in laminate multi-chip modules (MCMs), the RFVC975x product family offers phase noise performance that meets or exceeds the requirements of 2G, 3G, and 4G (LTE and WiMAX) cellular base-stations.

Compared to the current generation of monolithic VCOs, the RFVC975x family provides improved phase noise and lower current consumption, lowering energy consumption and improving base-station thermal management, says the firm.

The RFVC975x is also 75% smaller than current signal source modules, while providing the same low phase noise performance, satisfying the trend toward smaller base-station sizes for microcells and remote radio heads. As wireless infrastructure migrates to remote radio heads and distributed base stations, system designers are increasingly seeking solutions that push the performance envelope, RFMD says.

RFMD adds that the RFVC975x family provides the flexibility, performance and current consumption of existing VCO modules, with the size advantage of monolithic VCOs.

Samples are available now, with production shipments expected in September.

IN BRIEF

RFMD launches fully tested WiMAX power amplifier

RF Micro Devices has announced the availability of the RF5633 3.3–3.8GHz power amplifier IC.

The RF5633 is optimized for WiMAX systems, but it can be designed into multiple applications including customer premises equipment (CPE), gateways, access points, wireless infrastructure, and WiFi-based wireless high-definition interface (WHDI) for wireless video distribution networks.

The RF5633 integrates a three-stage PA and power detector in a 4mm x 4mm QFN package, minimizing design-in footprint requirements. The IC also works from a standard 5V supply, eliminating the need for additional power supplies and enhancing ease of use for product development. It is also fully DC and RF tested, including error vector magnitude (EVM) at the rated output power, maximizing application yields and accelerating time-to-market, RFMD says. Featuring InGaP HBT technology, the RF5633 is packaged in a leadless chip carrier with a backside ground.

EVM is 2.5% with an output power of 28dBm at 3.4–3.6GHz or 27dBm at 3.6–3.8GHz. The bias of the PA can be controlled to accommodate a 22dB gain step to increase the dynamic range of the system. The RF5633 offers high gain of 34dB and high linear output power, with what is claimed to be best-in-class efficiency. Linearity is maintained over a wide range of temperatures and power outputs, while the external match enables tuning for output power over multiple bands. The RF5633 also features internal input and inter-stage matching, a power-down mode, and power detection.

www.rfmd.com

Zigbee and high-power GaN products showcased at IMS 2010

At the IEEE MTT-S International Microwave Symposium (IMS) in Anaheim, CA (25–27 May), RFMD showcased its portfolio of RF communications components (which serves more than 20 end markets and a diverse global client base), hosting in-booth demonstrations of:

- RFG1M09180, a high-power, high-efficiency GaN Doherty amplifier for 3G/4G cellular base-stations that achieves 180W peak power at 50V operation while maintaining over 70% peak efficiency (a single RFG1M09180 can cover 700–1000MHz frequencies);
- smart energy/advanced metering infrastructure (AMI) Zigbee products developed in collaboration with Ember Corp for the RF6525/EM357 reference design.

In the past fiscal year alone, RFMD has launched more than 350 new and derivative products.

I/Q converters unveiled for wireless backhaul applications

RF Micro Devices has launched a portfolio of 10.0–16.0GHz GaAs pHEMT I/Q converters, the first in a series of new microwave radio front ends for wireless backhaul applications. The RFUV5945A and RFRX5933A are available in a compact 5mm x 5mm QFN package, and the RFMX5986A in a fully molded 4mm x 4mm QFN package.

The firm says that its growing portfolio of microwave radio front ends helps network operators to quickly and cost-effectively upgrade their backhaul networks to meet the increasing requirements of global mobile data uptake. The broadband frequency performance of the new I/Q converters enables a single product to support multiple radio bands, says RFMD. This enables the use of one part across multiple radio systems, simplifying inventory management. Also, each new I/Q converter features I/Q mixer topologies to reduce unwanted sideband filtering and support IF frequencies from DC to 4GHz, helping to simplify the radio design process.

The broadband RFRX5933A targets receive applications and is an integrated 10–16GHz downconverter comprising a low-noise amplifier (LNA), I/Q image rejection mixer and LO buffer amplifier. The noise figure is 2dB while maintaining 13dB conversion gain, 25dBc of image rejection and IIP3 performance of 3dBm. With an input power of –20dBm, the RFRX5933A has a minimum IMD3 performance of –50dBc.

The RFMX5986A 10–16GHz I/Q image rejection mixer integrates an LO buffer amplifier. Offering a conversion loss of 8dB, 25dBc of image rejection and IIP3 performance of 25dBm, it suits designers wishing to deploy a standalone MMIC or discrete LNA, says RFMD.

The RFUV5945A targets transmit applications and is an integrated 10–60GHz upconverter comprising an I/Q image rejection mixer, LPA and LO buffer amplifier. It delivers OIP3 of up to 24dBm and a conversion gain of 13dB.

RFMD claims that its 10–16GHz I/Q converters deliver levels of integration that enable smaller radio board footprints, decreased design time and automated board assembly, and are suited to both current- and next-generation microwave radio applications.

Samples and pre-production quantities are available now. The RFUV5945A is priced at $19.97, the RFRX5933A at $18.75, and the RFMX5986A at $11.35, each in volumes of 10,000.

RFMD launches high-linearity and low-insertion-loss pHEMT switches

RF Micro Devices has made available samples of the RFSW204x family of GaAs pHEMT switches, covering multiple bands in the DC to 25GHz range. Each switch in the family delivers high isolation and low insertion loss, suiting broadband communications, fiber-optics, test & measurement, and military applications, says the firm.

RFSW204x switches deliver broadband performance and are adaptable to multiple frequencies, giving users maximum inventory flexibility across multiple applications, adds RFMD. Also, the switches provide P1dB output powers of 19–27dBm and high IIP3 of up to 47dBm.

The family consists of three switch configurations: single pole double throw (SPDT), single pole triple throw (SP3T) and single pole four throw (SP4T). Each is available in absorptive or reflective versions.

The switches are designed using RFMD's 0.5μm GaAs pHEMT process, offering insertion loss as low as 1dB, high isolation up to 45dB at 20GHz and fast switching speeds of 20ns. RFSW204x switches are available in two packaging options: die-level and RoHS-compliant 3mm x 3mm QFN surface-mount packages.

With die-level switches available from May, the first packaged switches are available in June. Pricing starts at $17.02 in volumes of 1000.

Front-end module launched for ZigBee-based smart energy and ISM applications

RF Micro Devices has launched the RF6525 highly integrated front-end module (FEM), which meets or exceeds the system requirements of ZigBee applications operating in the 2.4–2.5GHz frequency band and supports multiple applications, including smart energy/advanced metering infrastructure (AMI), home area network (HAN), wireless ZigBee home automation, portable battery-powered equipment, and general 2.4GHz ISM-band systems.

Designed in collaboration with Ember Corp to create the RF6525/EM357 reference design, the RF6525 integrates a +20dBm PA with a Tx harmonic output filter in the transmit path, and a low-noise amplifier (LNA) with bypass mode in the receive path. It also includes a low-insertion-loss, high-isolation, double-pole double-throw (DPDT) diversity transfer switch and a two-port 50Ω Rx/Tx integrated balun that simplifies matching and provides balanced input and output signals for both the Tx and Rx paths, says the firm.

The RF6525 is suited to ZigBee systems operating with high-efficiency requirements and a minimum output power of 20dBm. In the receive path, the Rx chain provides 11.5dB of typical gain with only 7mA of current and an excellent noise figure of 2.5dB. The high level of integration and form factor (3.5mm x 3.5mm x 0.5mm) minimize end-customer product footprint and reduce assembly costs and external discrete component count. The complete reference design approach, pairing RFMD's RF6525 FEM with Ember's EM357, shortens customer design time and accelerates time-to-market.

Samples and pre-production quantities of the RF6525 are available now, with volume shipments expected to begin in June. The RF6525 is priced at $1.69 in volumes of 10,000.

IN BRIEF

Digitally controlled variable gain amplifiers launched for wireless infrastructure

At the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA (25–27 May), RF Micro Devices launched a family of high-linearity, 6-bit digitally controlled variable gain amplifiers (DVGAs), expanding its portfolio of infrastructure-grade components targeting the cellular base-station, point-to-point and CATV end-markets.

RFMD says that its new RFDA DVGA family leverages the firm's laminate multi-chip modules to integrate high-linearity amplifiers from multiple technologies with a digital step attenuator (DSA) and an optional serial-to-parallel converter. RFDA DVGA products deliver multi-function features and performance while requiring few external components, so designers of infrastructure transceivers can design radios with smaller size, higher assembly yields and lower cost, says RFMD. The DVGA integration path also supports future market trends toward smaller base-station sizes, microcells, and remote radio heads for new infrastructure deployments.

The RFDA product family offers a selection of components with gain up to 38dB, OIP3 up to 43dBm and a maximum operating frequency up to 4GHz. The family includes wideband and narrowband versions, covering all 2G, 3G and 4G (LTE and WiMAX) standards for base-station frequency bands. The components are suitable for both receiver and transmitter designs and are offered in both parallel and serial interface versions.

www.rfmd.com

RFMD qualifies second GaN process

GaN2 targets CATV broadband transmission and other multi-market applications for higher linearity, higher gain and lower voltage

RF Micro Devices Inc of Greensboro, NC, USA has expanded its portfolio of compound semiconductor technologies by announcing the qualification of its second high-power gallium nitride process technology.

The GaN2 high-electron-mobility transistor (HEMT) process technology achieves 1–2dB higher gain and 6dB greater linearity than the firm's GaN1 process at moderately lower power density. GaN1 was qualified in the June 2009 quarter and delivers much higher power density and voltage breakdown than competing technologies, the firm claims, suiting high-performance devices such as power amplifiers for radar and communications. In contrast, GaN2 targets cable TV (CATV) broadband transmission products and other multi-market applications and is optimized for higher linearity, higher gain and lower-voltage operation.

GaN2 reliability measurements confirm a useful lifetime of over 17 million hours at a channel temperature of 200°C, despite being an early-stage process on RFMD's GaN technology development roadmap. Additional technologies in development include MMIC process modules with complimentary integrated passive component (IPC) technology.

"RFMD's high-performance GaN technology is consistently demonstrating industry-leading levels of reliability, allowing our customers to design GaN products that exceed their stringent system reliability specifications," claims Bob Van Buskirk, president of the firm's Multi-Market Products Group (MPG).

"RFMD's GaN technology also enables advanced RF components and products that operate at significantly lower power consumption levels, helping to satisfy the rapidly increasing end-market requirements for energy saving 'green technologies'."

RFMD presented papers on GaN technology and product development at the Compound Semiconductor Mantech conference in Portland, OR (17–20 May) and at the IEEE MTT-S International Microwave Symposium in Anaheim, CA (25–27 May), including: 'GaN Applications Beyond the PA for RF Systems', 'GaN for High Power, High Bandwidth Applications', 'Defining Application Spaces for High Power GaN' and 'RFMD Takes GaN Mainstream'.

www.rfmd.com/foundry

RFMD launches first 1.2GHz CATV amplifiers, enabling enhanced, bandwidth-driven services

RFMD has launched what it claims is the industry's first 1.2GHz broadband transmission products (available for sampling in industry-standard SOT115J packages), enabling enhanced, bandwidth-driven services for CATV operators and their subscribers.

With bandwidth of 45–1200MHz, the new RFPD2580, RFPP2590, and RFOS601x products provide options for cable operators to upgrade their network infrastructure to 1.2GHz, enhancing their network performance and providing bandwidth for growing broadcast and narrowcast services such as HDTV and emerging 3D HDTV.

The RFPD2580 is a power doubler amplifier that uses RFMD's GaN technology to achieve 22.5dB minimum gain at 1.2GHz and what is claimed to be best-in-class signal output capability. Power consumption is 450mA maximum at $24V_{DC}$.

The RFPP2590 is a hybrid push-pull amplifier module that delivers extremely low distortion (CTB = –60dBc max, CSO = –65dBc max) and consumes just 240mA from a 24V supply. With 23.0dB minimum gain at 1200MHz and 0.8dB gain flatness, the RFPP2590 is a companion part to the RFPD2580, and the two products combine to optimize performance in CATV line extender amplifiers deployed in CATV distribution networks.

The RFOS601x is an optical receiver module designed for use in hybrid fiber coax (HFC) optical nodes (at the edge of the fiber network, converting light into electrical signals for transmission to CATV set-top boxes and home routers). RFMD says that the RFOS601x's low distortion enables 'fiber-deep' networks, in which the optical network is extended closer to the CATV subscriber, supporting higher data rates and addressing the increasing demand for high-bandwidth video and broadband services. The RFOS601x is available with FC/APC (RFOS6012) or SC/APC (RFOS6013) optical connectors.

RFMD claims to be the first firm to introduce GaN technology in CATV hybrids, allowing CATV operators to achieve 3dB higher output power without an increase in current consumption, or a 20% reduction in current consumption without a decrease in output power. The firm adds that its GaN technology also helps carriers expand the utilization of their cable networks to better compete with satellite and fiber-to-the-home (FTTH) networks.

www.rfmd.com

RFMD adds high-power integrated passives to foundry portfolio

RF Micro Devices has added high-power Integrated Passive Component (IPC) technology to its foundry services portfolio and will begin providing the technology to customers in June. The firm says that its IPC technology is complementary to its GaN technology, and other power semiconductor technologies, for the design of multi-chip modules (MCMs).

With IPC technology, customers can design integrated matching networks and other passive functions on RFMD's low-cost gallium arsenide process technology, rather than place them adjacent to amplifiers and other active components. This allows customers to reduce costs and achieve higher levels of integration by leveraging RFMD's scale and cost structure in GaAs and GaN manufacturing, says the firm.

According to RFMD, its IPC technology provides all the passive circuit components necessary to enable matching networks, including MIM capacitors, multi-layer stacked capacitors, thin-film resistors and inductors. Also, three metal interconnect layers are available for complex routing and increased current-handling capability.

"RFMD's leading compound semiconductor scale, built to serve the cellular handset market, allows us to deliver industry-leading cycle time, yields and costs," claims Bob Van Buskirk, president of RFMD's Multi-Market Products Group (MPG). "We enable our foundry customers to take advantage of a compound semiconductor factory capable of shipping over 2 million RF components per day to bring speed, predictability and price advantages difficult to match."

RFMD's GaN Foundry Services business unit currently offers access to two of the firm's GaN process technologies: GaN1 (targeted at high power) and GaN2 (targeted at high linearity).

www.rfmd.com

IN BRIEF

Gain Microwave adds high-power VCO GaN MMIC

Gain Microwave Corp of Ottawa, Canada, which develops GaN monolithic microwave integrated circuits for wireless infrastructure, industrial and aerospace applications, has launched the GMW3051 high-power GaN negative impedance amplifier, designed to be easily integrated with an external resonator for use as a voltage-controlled oscillator (VCO).

Manufactured using a GaN process, the firm says that the GMW3051 delivers good phase-noise performance and high RF output power, combined with the ability to operate in harsh environments (such as high temperature), suiting military, aerospace and industrial applications.

Engineering units and evaluation boards are available now.

www.gainmicrowave.com

RFHIC launches 80W GaN power amplifier for LTE/WCDMA applications

RFHIC Corp of Suwon, South Korea (which makes gallium nitride and gallium arsenide active RF & microwave components and hybrid modules for telecom and broadcast markets) has launched an 80W GaN power amplifier for LTE (long-term evolution) and WCDMA applications.

With internal matched GaN-on-SiC (silicon carbide) transistor as the key building block, the amplifier shows 50dB of gain at 48V. Operating across a frequency range of 2110–2140MHz (30MHz bandwidth), the amplifier demonstrates efficiency of 35% or higher by using a Doherty design and digital pre-distortion (DPD) techniques. A single module includes DC/DC, detector, coupler and isolator functions within a small footprint of 170mm x 175mm x 28mm. RFHIC says that the amplifier is already being deployed with SK Telecom (Korea's largest mobile service provider) at selected sites.

Previous Doherty amplifiers based on silicon LDMOS (laterally diffused metal oxide semiconductor) technology had drawbacks such as limited efficiency and larger size, says RFHIC. Achieving higher efficiency throughout the 30MHz bandwidth and six channels is a challenge for LDMOS, the firm adds. The LDMOS transistor package is larger, prohibiting a smaller power amplifier design. Such issues also counteract the demand from service providers for 'greener' system designs.

RFHIC has been using GaN technology since 2004. With extensive research and design experience, the firm has made advances in areas such as internal matching, heat dissipation, Doherty designs, module optimization, MMIC design and assembly & packaging. Such experience contributed to designing a better-performing GaN power amplifier with lower cost for the telecoms market, the firm claims.

RFHIC says that, for the next version of the product, it is targeting 40% efficiency.

Other products launched recently by RFHIC include 30W WCDMA/LTE amplifiers, 30W cellular/CDMA amplifiers, and 60W cellular/CDMA amplifiers.

www.rfhic.com

Cree demos packaged GaN HEMT RF products

At the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA (25–27 May) Cree of Durham, NC, USA demonstrated packaged GaN HEMT RF products for launch this year, including a SPDT MMIC switch (0.3–3GHz); a 25W MMIC power amplifier (10MHz to 6GHz); a 75W MMIC power amplifier (2.7–3.5GHz); and a 240W transistor (2.9–3.5GHz).

"We have been actively expanding our GaN MMIC and high-power discrete product lines over the last 12 months to include higher-power, higher-efficiency amplifiers," says Jim Milligan, director of RF & Microwave Products.

The CMSA30025S is the first GaN MMIC SPDT switch to operate at 300MHz–3GHz with less than 0.7dB insertion loss, 30dB isolation and less than 20ns switching speed. RF power handling capability is 25W CW at only 0.1dB compression with

Cree's0.3–3GHz SPDT MMIC switch.

an output intercept point higher than 60dBm. As well as having small size and low power consumption, the switch can be incorporated into a circuit with few extra components (unlike PIN diode switches).

The CMPA0060025F is a packaged GaN MMIC power amplifier operating at 10MHz –6GHz with typical saturated output power of more than 25W CW and power gain of 12dB. The distributed amplifier has typical drain efficiencies of 40% and is packaged in a 0.5-inch square footprint.

The CMPA2735075F is the first of a family of radar-centric packaged MMIC power amplifiers, and provides 75W of pulsed RF power (with pulse widths of 300μs typical at 10% duty cycle) with power gain of 20dB over the 2.7–3.5GHz range. The 50Ω (in/out) matched MMIC typically provides 55% power-added efficiency (PAE), and is housed in a 0.5-inch square package.

The CGH35240F is a fully internally matched 50Ω power transistor using Cree's GaN-on-SiC technology for what is claimed to be excellent thermal management and reliability. The packaged 0.70" x 0.95" transistor provides saturated output power of more than 220W with gain of more than 11dB at 2.9–3.5GHz with typical PAE of 60%.

Cree expands GaN MMIC power amplifier range through X-band, launching first commercial GaN low-noise amplifier

Cree has developed five new GaN HEMT MMIC amplifiers that extend its power amplifier frequency range through X-band and include its first GaN low-noise amplifier (LNA) MMIC product. Samples are available as bare die now, with packaged formats following later this year.

Compared to using GaAs, the MMICs can boost system performance in communication systems, homeland defense, electronic warfare and radar from S-band through X-band, says Cree's Jim Milligan.

The CMLA2540001D is claimed to be the first commercially available GaN HEMT low-noise amplifier (LNA) MMIC, operating over the 2.5–4GHz band with small-signal gain of 28dB and input/output return losses of more than 10dB. Operating at 24V, it has a noise figure of better than 2dB over the whole frequency range, with a typical value of 1.7dB. Input/output third-order intercept points are 12 and 38dBm, respectively. While allowing improved linearity and input power handling for radar and other S-band applications, the LNA has a chip size of just 1.7mm x 2.5mm.

The CMPA2060025D MMIC power amplifier outputs about 25W from 2 to 6GHz, improving the performance and extending the frequency coverage of the CMPA2560025D Series of devices down to 2.0GHz. Power gain over the band is 17dB with input/output return losses of better than 7dB. The MMIC shows power-added efficiency (PAE) of typically 35% over the entire frequency range and has dimensions of 3.67mm x 3.61mm. The wideband PA suits homeland defense and electronic warfare applications.

The CMPA2735075D high-power amplifiers output 75W with typical PAE of 60% over an instantaneous bandwidth of 2.7–3.5GHz. Suiting civil and military radar applications that require significant power, gain and efficiency in a small footprint, Cree claims it is one of the smallest MMIC high-power amplifiers available covering this bandwidth, measuring 4.42mm x 5mm. It operates at 28V with 20dB of power gain (typical) and is matched to 50Ω input/output, requiring minimal off-chip bias bypassing.

The CMPA5585025D outputs more than 25W over the 5–8GHz band and suits use in point-to-point radios, satcom, test instrumentation and EMC amplifiers. The MMIC provides 20dB power gain with typical PAE of more than 38% in a footprint of just 17.25mm^2.

The CMPA801B025D MMIC power amplifier covers the 8–11GHz range with typical output of 25W, and — featuring 18dB of power gain with typical PAE of 35% in a small size of 4.78mm x 3.61mm — has applications in satcoms and both civilian and military radar.

www.cree.com

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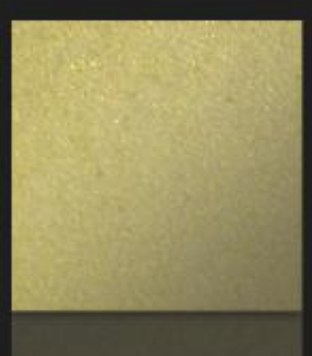

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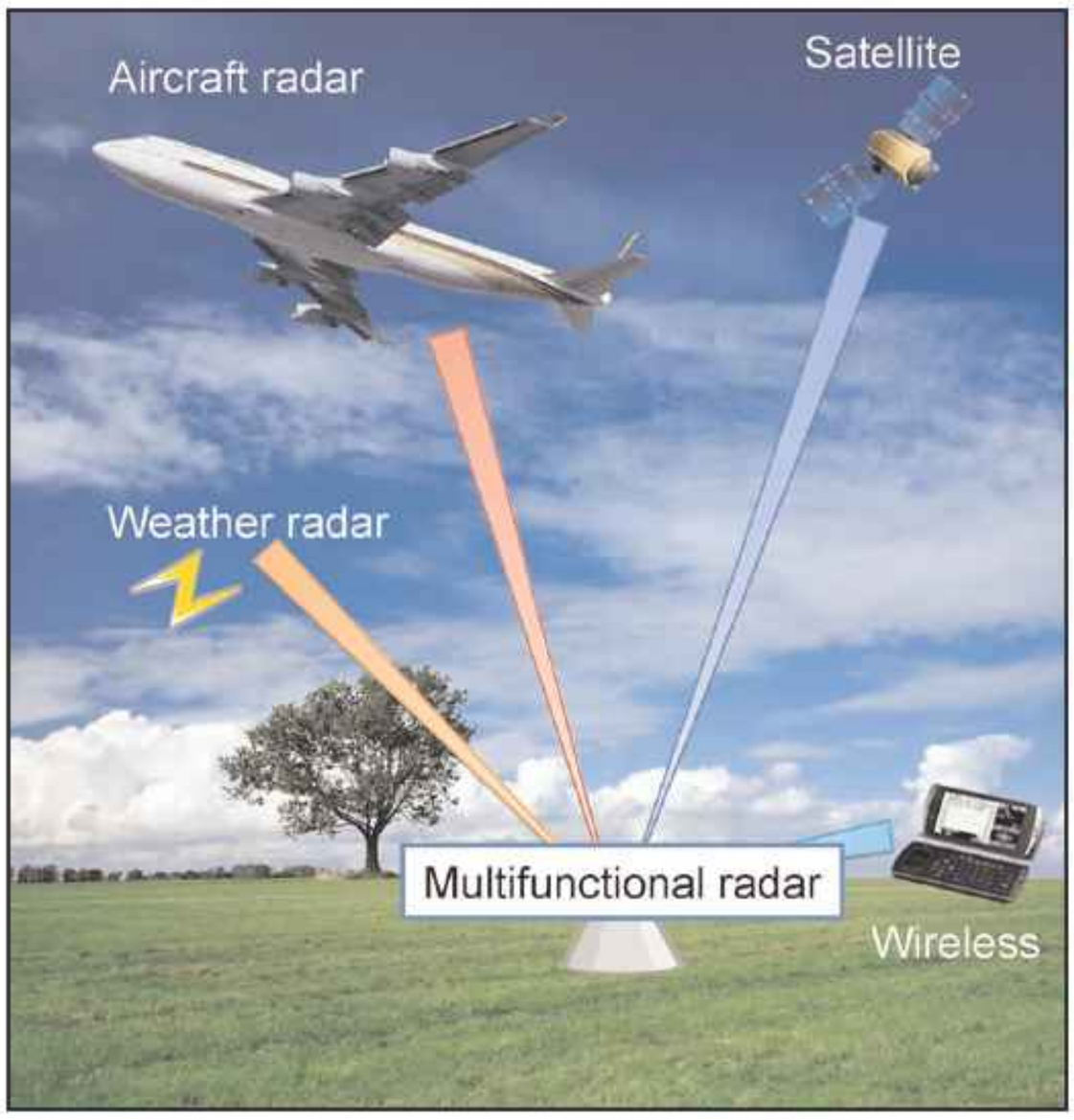
Fujitsu doubles output record to 12.9W for C-Ku band GaN HEMT amplifiers

Smaller, lighter radar and communications equipment promised

At the IEEE MTT International Microwave Symposium (IMS 2010) in Anaheim, CA, USA (23–28 May), Japan's Fujitsu Laboratories Ltd announced the development of an amplifier based on gallium nitride high-electron-mobility transistor (GaN HEMT) technology with record output power of 12.9W when operating in the wide range of the C-band, X-band and Ku-band radio frequency spectrum between 6–18GHz (more than double the output of existing ultra-broadband, high-frequency amplifiers). The amplifier's efficiency is 18% (see Figure 1).

The new technology will make it possible for a single amplifier to operate at multiple frequencies, paving the way for further integration of systems, such as broadband communications systems and radar systems, that use various frequencies. For example, aviation radar typically switches between the C-band (which is relatively unaffected by rain) and the X- and Ku-bands (which offer high-precision detection of solid objects) so, conventionally, separate communications equipment is used for the different frequency ranges.



Concept of C–Ku band multi-functional radar.

Also, previously, to achieve the output needed to cover large spectrums such as the C- to Ku-bands, multiple transistors have been connected in parallel to create an amplification circuit. However, as the circuit is physically longer, line loss increases, making it difficult to extend coverage up to 18GHz.

Key features of Fujitsu Laboratories' high-output ultra-broadband C–Ku spectrum (6–18GHz) GaN HEMT amplifier are therefore:

- band-extending circuit technology devised by Fujitsu Laboratories that compensates line losses at high frequencies, employed in an amplifier for the first time (Figure 2);
- circuit technology (fabricated on the semiconductor chip) that handles the dividing and combining of electrical power across an ultra-wide spectrum (Figure 3).

An amplifier able to cover — on its own — the entire range of the C- to Ku-bands would allow smaller systems that consume less power. Fujitsu says that this has led to interest in multi-functional radar, integrating communications systems and multiple radars into a single device.

Fujitsu Laboratories plans to apply the new single-amplifier technology to a wide range of applications that require high output across wide bandwidths, including wireless communications and radar. It should hence allow the development of smaller, lighter systems capable of covering wide areas. The technology can also be used in instruments for measuring the performance of amplifiers used in broadband communications and radar systems, says the firm.

http://jp.fujitsu.com/labs/en

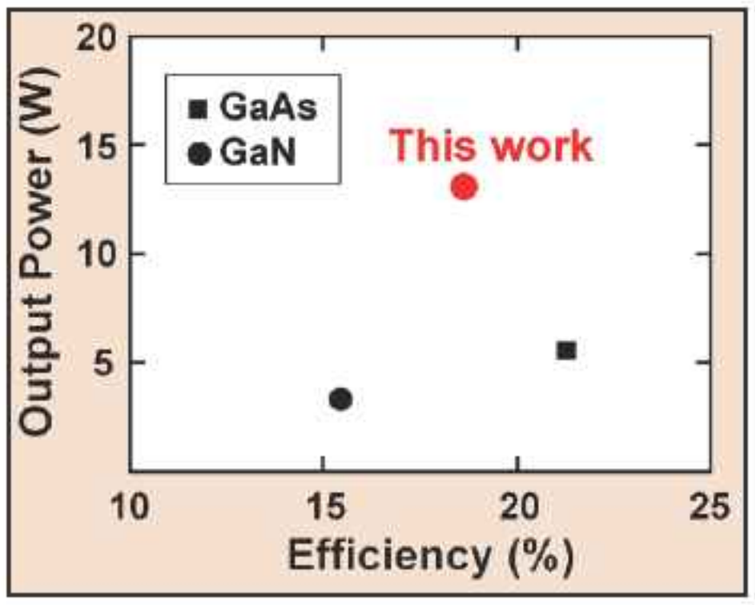


Figure 1: Comparison of C-Ku ultra-broadband amplifier performance.

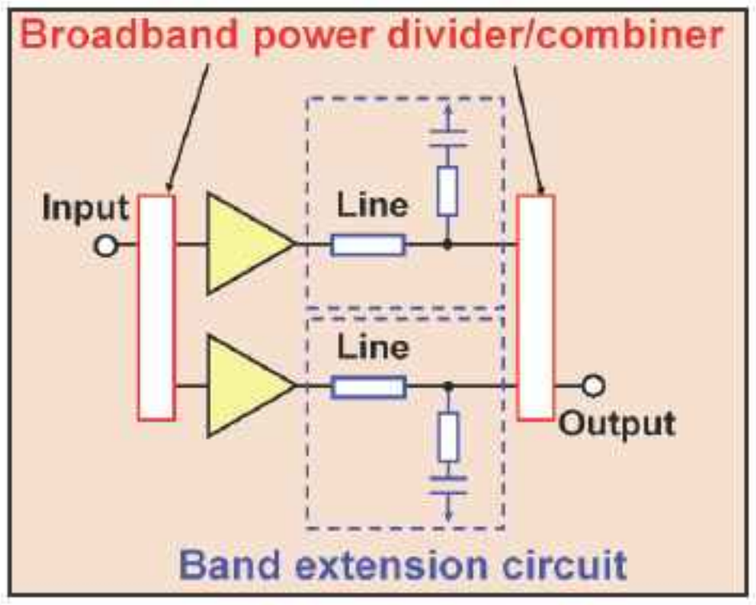


Figure 2: Block diagram for Fujitsu's band extension circuit.

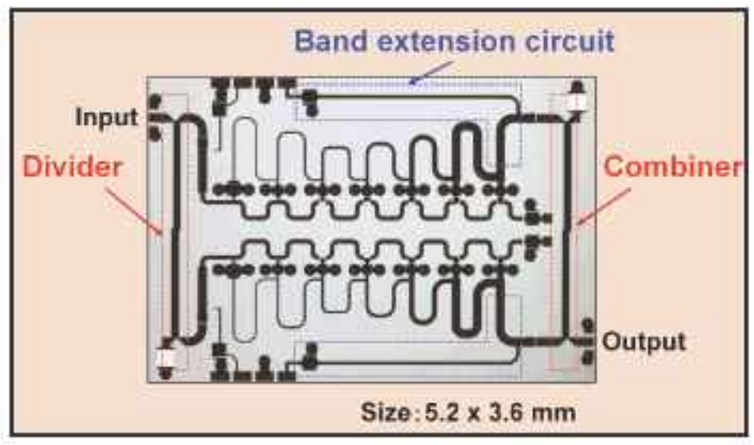


Figure 3: Fujitsu's new C-Ku band amplifier.

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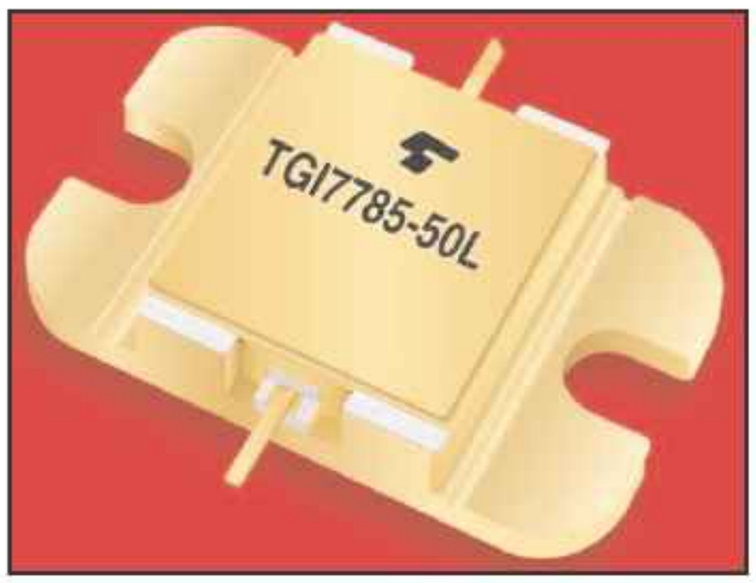
Toshiba adds high-gain 50W GaN HEMT power amplifier for C-band satellite communications

At the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA, USA (25–27 May), Toshiba America Electronic Components Inc (TAEC) announced the addition of a 50W C-band gallium nitride high-electron-mobility transistor (HEMT) to its power amplifier product family.

The TGI7785-50L is another commercial C-band GaN HEMT for satellite communications, joining Toshiba's 120W C-band amplifier launched last year as well as the firm's other Ku-band GaN devices. Operating at 7.7–8.5GHz, the new device's typical RF performance includes output power of 47.0dBm with 40dBm input power, linear gain of 11.0dB and drain current of 5A (at a supply voltage of 24V at 25°C). Toshiba says that the device enables increased output power and helps reduce size and weight in solid-state power amplifiers (SSPA) for satcom applications.



Toshiba's 50W TGI7785-50L.

"Our initial entry into C-band GaN HEMTs was at the high end of the output power range, because microwave system designers have initially used GaAs devices for intermediate-stage amplification to drive higher-output GaN devices," says Homayoun Ghani, business development manager, Microwave, RF and Small-Signal Devices, in TAEC's Discrete business unit. "This 50W GaN HEMT provides additional design flexibility by enabling use of higher-performance GaN at a mid-amplification stage," he explains. "It provides higher linear gain of 11dB compared to our conventional GaAs FETs with similar output power (45W and 60W) [the TIM7785-45SL and TIM7785-60SL, respectively], which have gain of 6dB (typical)."

Toshiba's commercial GaN power amplifiers have been in volume production since 2008, starting with the Ku-band TGI1414-50L, which operates at 14.0–14.5GHz for satcoms. The firm says that GaN technology provides superior device performance such as high gain and efficiency in the satcom and radar markets. Toshiba is exploring new markets for the technology and will continue to develop additional GaN devices with higher output power in the C-, Ku- and other bands.

Samples of the TGI7785-50L are available now, with mass production scheduled for Q3/2010.

www.toshiba.com/taec

Mitsubishi Electric claims first GaN HEMT amplifier exclusively for satellites

Tokyo-based Mitsubishi Electric Corp has developed four models of gallium nitride high-electron mobility transistor (HEMT) for 4GHz-band satellite applications, with high output power ranging from 2W to 100W, making it the first firm to market GaN HEMTs engineered exclusively for these applications, it claims.

As more satellites are meeting the end of their operational lifespan, demand for new microwave communication satellites has been growing recently, says Mitsubishi Electric. While transmitter devices in these communication satellites have traditionally used gallium arsenide (GaAs) amplifiers, GaN HEMT amplifiers offer higher efficiency, as well as high electron velocity and high breakdown fields, helping to make transmitter devices smaller, lighter and more durable.

The range includes the non-internally-impedance-matched 4GHz MGF2633GS, which has an efficiency of 50% and output power of 33dBm (2W). In addition, the internally-impedance-matched 3.7–4.2GHz MGFC43G3742S, MGFC46G3742S and the MGFC50G3742 have efficiencies of 60% and output powers of 43dBm (20W), 46dBm (40W) and 50dBm (100W), respectively (with the MGFC46G3742S and MGFC50G3742 each operating in one of the three separate bands).

In particular, to achieve 100W output with GaAs amplifiers, it is necessary to combine an additional amplifier with an output of approximately 25W in the final stage. The MGFC50G3742S in contrast achieves 100W with a single device while retaining the same size as 25W GaAs amplifiers and offering very high power added efficiency of 60%.

The lower-output 40W, 20W and 2W GaN HEMT amplifiers, which suit use in first- and mid-stage amplification, are smaller, lighter and consume less energy.

Designed for use in satellites (which are usually used for about 10 years), the GaN HEMTs can operate for as long as 1 million hours, given a chip temperature of 175°C and an operation voltage of 45V, and are fit to operate in the severe conditions found in space.

Sample shipments began in March.

www.mitsubishichips.com/Global

Integra samples first 50V GaN-on-Si device

GaN developed for smaller, more efficient broadband power devices

Leveraging a design team and internal wafer fabrication facility with nearly two years of R&D, at the IEEE MTT-S International Microwave Symposium (IMS 2010) in Anaheim, CA (25–27 May) high-power pulsed RF transistor maker Integra Technologies Inc (ITI) of El Segundo, CA, USA launched two new products (available for sampling now) using what it claims is the first high-voltage GaN-on-silicon HEMT process with drain–source breakdowns exceeding 200V. The high breakdown voltage enables the devices to operate at higher voltages than seen on the market currently, translating into higher performance.

Privately owned Integra was founded in 1997 based on record S-band pulsed performance using patented high-frequency bipolar transistor technology (which is still in production). With nearly 100 staff, the firm supplies high-power pulsed transistors to the aviation industry, with a portfolio covering radar bands in the UHF/VHF, L-, S- and C-bands for commercial, military and defense markets. Integra uses technologies including VDMOS, LDMOS, bipolar and now GaN-on-Si, all produced in its all-gold 6" wafer fab (patented technology starts with an all-gold metallization process for all elements of the die fabrication process to ensure high reliability). The firm offers both discrete devices and integrated pallets for the S-band radar market.

Integra says that it has developed GaN technology as a direct result of customer requests for smaller, more efficient power devices with broadband performance.

The new technology allows the firm to penetrate new markets involving CW applications such as electronics warfare (EW) for the defense industry, says founder & president John Titizian. "We have years of RF expertise manufacturing high-power semiconductors and, with our low overhead cost structure, we will continue to dominate in both price and performance," he reckons.

Operating over the instantaneous bandwidth covering 2.7–3.1GHz in the S-band, under 300µs pulse width and 10% duty cycle pulsing conditions the PN IGN2731M25 and PN IGN2731M50 devices typically supply a minimum of 25W and 50W of peak output power, respectively. With breakdown voltage approaching 200V the devices are characterized at 50V operating voltage, providing 50% efficiency and more than 13dB and 12dB of gain, respectively. The single-ended devices are housed in a ceramic flanged package, providing thermal advantages.

www.integratech.com

IN BRIEF

Multi-channel SSPA subsystems added

Accel-RF Corp of San Diego, CA, USA, which produces turn-key RF reliability and performance characterization test systems, has added three new multi-channel solid-state power amplifier (SSPA) subsystems to its product line: an L-band 1–2GHz SSPA Box; an S-band 2.9–3.3GHz SSPA Box with 25W of output power on each channel; and a broadband C/X-band 4–10GHz SSPA Box with 2W of output power per channel across the full frequency band.

The SSPA subsystems can be configured for a bank of 4, 8 or 16 channels. Accel-RF's SSPAs are implemented as stand-alone subsystems or embedded in its RF Automatic Accelerated Reliability Test Systems (AARTS) to characterize RF performance with age and perform gain-compression aging tests. The SSPAs are designed as plug-and-play inter-changeable units to allow flexibility and modularity in the AARTS platform.

"Customers need the capability to compress the RF gain of their devices as a normal part of reliability testing," says president Roland Shaw. "In many new technology devices, such as GaN, RF output power may degrade over time. Driving devices to 2 or 3dB of compression at elevated temperatures allows a significant amount of parametric information to be found," he adds. "These new SSPA models provide our customers with a significant capability to characterize higher-output power devices and MMICs at user-application frequencies of interest."

"Customers have to achieve a balance of RF power, test-frequency, and cost. With these new models we can offer a plug-n-play solution as testing needs move to larger gate-periphery products," concludes Shaw.

www.accelrf.com

Nitronex and Modelithics release enhanced nonlinear GaN device model

Nitronex of Durham, NC, USA, which makes gallium nitride on silicon (GaN-on-Si) RF power transistors, and Modelithics Inc of Tampa, FL, USA, which provides RF and microwave simulation models for use in electronic design automation (EDA), have released the first non-linear model for Nitronex's high-power NPT1012 device.

The model combines heating effects and static and dynamic bias characteristics with large-signal performance to deliver accuracy that is claimed to be unlike other GaN HEMT device models. The collaborative model predicts performance of the NPT1012 in broadband application circuits, specifically targeting the military communications, electronic warfare and radar markets.

Modelithics has worked with Nitronex on multiple projects during the past year as well as for this first external model release. "We have the same goal of enabling more efficient, higher-power, and broader-band GaN PA designs," says Modelithics' president & CEO Larry Dunleavy. The NPT1012 is now available as a free download from Modelithics' website for Agilent Technologies Advanced Design System (ADS) and AWR Microwave Office (MWO) software.

The models will also be included in the next update of Modelithics Select free shareware library (available for ADS and MWO), which is also downloadable.

"We are enthusiastic about the global release of the NPT1012 model as a result of our collaboration with Modelithics for non-linear models of our thermally enhanced power products," says Gary Blackington, Nitronex's VP of worldwide sales & marketing. "The simulated performance predicted by the NPT1012 model, and the accuracy with which it compares to measured results in high-efficiency, high-power and broadband power amplifiers, has been well received by our strategic customer base," he adds.

www.modelithics.com/mvp/NIT

GaN MMIC process design kit released for Agilent's Advanced Design System

Nitronex has released the NRF1 MMIC process design kit (PDK) for Agilent's Advanced Design System (ADS). Its 0.5μm GaN HEMT technology, together with the PDK, provides the active and passive elements needed to enable the development of monolithic power amplifiers operating up to 6GHz.

"We developed the PDK in collaboration with our strategic foundry partners who require high-performance broadband solutions through 6GHz," says VP of engineering Ray Crampton. "The functionality and accuracy offered by the multiple types of scalable active and passive elements included in the process design kit are enabling our strategic foundry partners, as well as Nitronex engineers, to realize the full potential of MMIC products with our NRF1 technology," he adds.

For active elements, the PDK offers fixed and geometrically scalable GaN HEMTs, as well as scalable multi-finger Schottky diodes. For passive elements, epi and TFR resistors, circular and square inductors, as well as circular and rectangular MIM capacitors are available. The PDK also offers a full transmission line library including backside vias.

www.nitronex.com

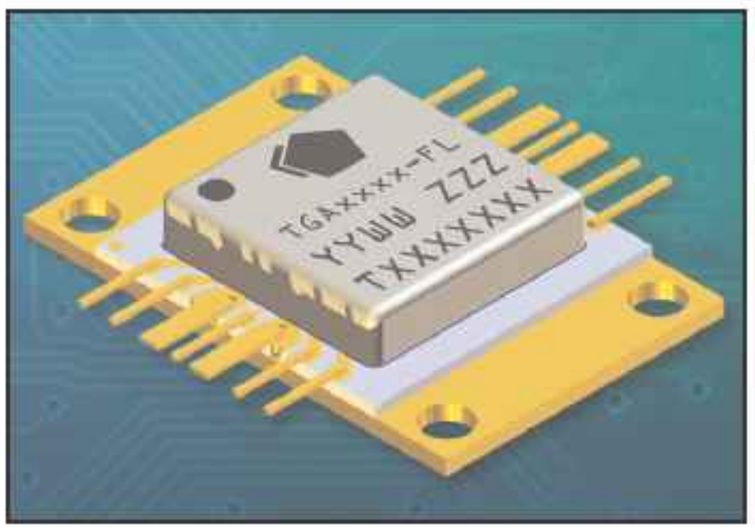
TriQuint wins Air Force Research Laboratories contract for GaN modules to extend range of drone aircraft

RF component maker and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA has been awarded a contract by the US Air Force Research Laboratories (AFRL) to develop new gallium nitride modules that will extend the range and capabilities of unmanned aerial vehicles (UAVs) used for reconnaissance missions over Afghanistan, Iraq and other regions.

The new modules will include 20W and 50W devices. TriQuint says that a challenging aspect of the program includes fitting new 20W amplifiers into the same space now occupied by the fleet's existing 1W devices that limit the range and broadcast power of the aircraft.

"We need to increase the power of one device 20-fold without increasing the size," says TriQuint program manager Doug Cole. "We're using our proven 0.25μm GaN process since it offers excellent power density and ruggedness — key requirements for avionic applications."

Increasing the output power of RF amplifiers will increase operational range and mission effectiveness, allowing new UAVs to serve in areas



TriQuint GaN module.

and under conditions that were impossible for their predecessors, says TriQuint. More efficient GaN devices will also reduce the need for thermal mitigation and extend battery life in each vehicle. As estimated by the AFRL, more efficient amplifiers can extend UAV patrol time from 1 to 3 hours, depending on the aircraft involved, payload and other operational conditions.

TriQuint is developing both the 20W and 50W devices using in-house resources including complete module fabrication. The firm designs and builds both integrated and multi-chip modules (MCMs) at its plant in Richardson, TX, offering assurance that all resources needed for GaN or GaAs programs are available in a single, domestic location.

Cole says that TriQuint was chosen for the UAV amplifier contract based on its detailed plan to meet the AFRL's accelerated development schedule. Other factors included results from TriQuint's Defense Advanced Research Projects Agency (DARPA) Wide Bandgap Semiconductor (WBGS) RF GaN program, in which the firm led Phase II and is currently leading Phase III. TriQuint also leads a DARPA contract for highly advanced MMIC development using GaN technology in the Nitride Electronic NeXt-Generation Technology (NEXT) program.

The UAV program is divided into two main phases: developing appropriate high-power GaN amplifier MMICs; then integrating MMIC amplifiers and other components into single packages to provide 20W and 50W Ku-band power amplifiers. TriQuint is on track to deliver the first amplifier MMIC by August. The first 50W prototype packaged assembly high-power amplifier (HPA) will be delivered in April 2011.

www.triquint.com

BreconRidge ships its first GaN microelectronic modules

Design and manufacturing services provider BreconRidge Corp of Ottawa, Canada, which specializes in RF, microwave and optical technologies, has packaged and shipped over 90 gallium nitride modules to the Canadian Space Agency (CSA) as part of its corporate strategy to extend its core MMIC assembly capabilities in next-generation microelectronic modules (the latest step in its goal to become a key partner with the aerospace and defense industries). Prior milestones include collaborative design and manufacturing contributions to programs involving defense and aerospace radars, radio-astronomy systems and defense communication systems.

"Emerging technologies like GaN require an innovative approach in all aspects of product design and manufacturing," says John Pokinko, VP engineering. "We are aggressively pursuing all opportunities to further our expertise in applying these new technologies in advanced RF and microelectronic solutions," he adds. "Completion of the CSA GaN packaging contract represents a key stepping stone in this strategy."

For next-generation cellular network base-stations and satellite communications systems, compact packaging and stringent linearity requirements are challenging designers to meet heat dissipation and bandwidth allocation objectives. BreconRidge says that GaN-based electronics offers the potential to cost-effectively address such RF challenges.

The National Research Council's Canadian Photonics Fabrication Centre (NRC-CPFC) fabricated the GaN die used in the project at its industrial-grade facility. "Few companies in the electronic manufacturing services sector have the capabilities to assemble and package GaN electronics," comments BreconRidge's president Cyril McKelvie. "Being able to deliver these first modules is a reflection of our desire, skills and capabilities to address the emerging needs of the aerospace and defense sectors."

www.breconridge.com

IN BRIEF

Infineon adds to SiC Schottky diode range

Infineon Technologies AG of Neubiberg, Germany has launched its second generation silicon carbide (SiC) Schottky diodes in the TO-220 FullPAK package, combining the high electrical performance of the second-generation ThinQ! SiC Schottky diodes with the advantages of a fully isolated package, including easier and more reliable mounting, without having to use isolating bushing and foil.

Furthermore, the TO220 FullPAK devices show a similar junction-to-heatsink thermal resistance as the standard non-isolated TO-220 devices. According to Infineon, this is accomplished by using the firm's patented diffusion soldering technique, which strongly reduces the 'chip-to-leadframe' thermal resistance and effectively compensates for the FullPAK's internal isolation layer. Infineon offers the 600V FullPAK portfolio in current ratings from 2A to 6A.

SiC is a revolutionary material for power semiconductors, with physical properties that far outperform Si power devices, says the firm. Key features are a benchmark switching behavior, no reverse recovery, virtually no temperature influence on the switching behavior and a standard operating temperature of –55°C to 175°C.

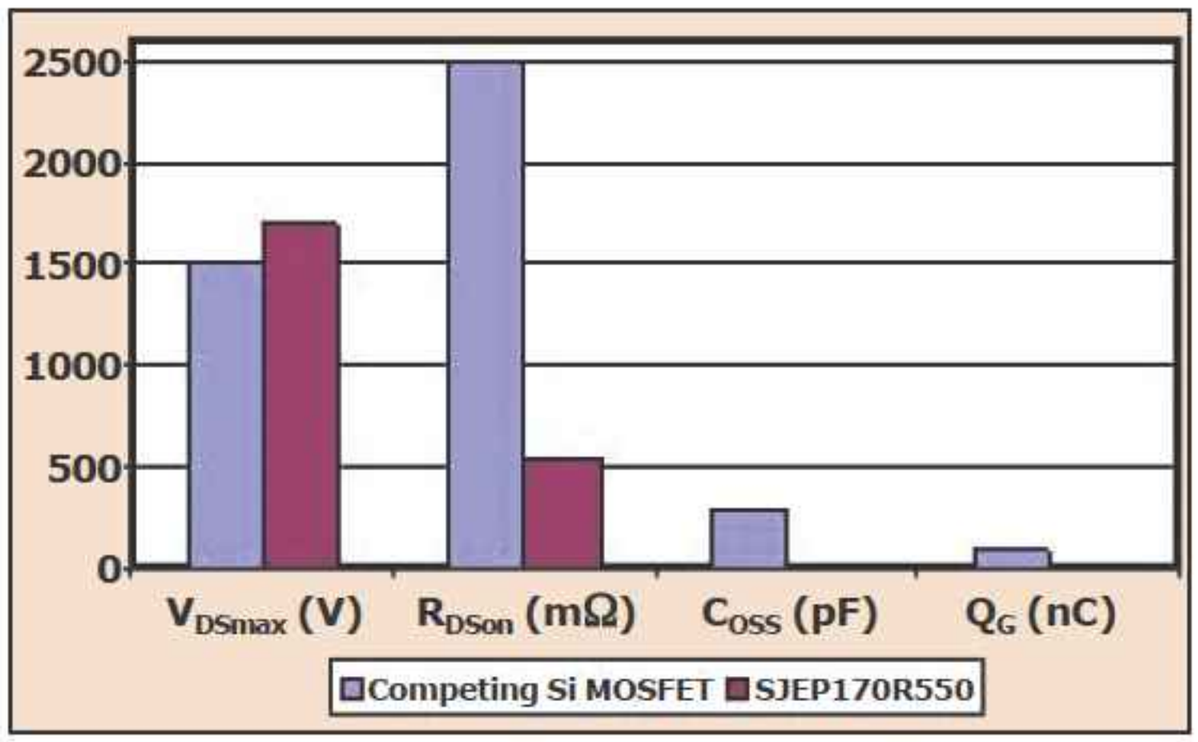
The main application areas for SiC Schottky diodes are active Power Factor Correction (PFC) in Switched Mode Power Supplies (SMPS) and AC/DC and DC/DC power conversion applications such as solar inverters and motor drives. The FullPAK range is suited to use inpower supplies in flat-panel displays and computers.

Infineon's SiC Schottky diodes are offered at 600V and 1200V. The full portfolio is now released for production.

www.infineon.com

SemiSouth launches 1700V & 1200V silicon carbide JFETs

SemiSouth Laboratories Inc of Starkville, MS, USA, which designs and manufactures silicon carbide (SiC) based discrete power devices and electronics, has announced two new additions to its family of SiC junction field-effect transistors, available in bare die form or TO-247 packages.



SemiSouth's normally-off 1700V SiC JFET offers higher blocking voltage, five times lower on-resistance, and ten times lower output capacitance and gate charge than rival silicon MOSFETs for auxiliary power supplies for drives.

The first is a normally-off, 1700V SiC JFET targeted at the auxiliary power supply market for motor drives. Compared with the best silicon MOSFET technology, the new SJEP170R550 offers higher blocking voltage (1700V), five times lower on-resistance (550mΩ), and roughly ten times lower output capacitance (C_{OSS} of 20pF) and gate charge (Q_G of 10nC).

"This new 1700V, normally-off JFET offers the designer additional advantages compared to Si, including higher input voltages, better efficiency, including a significant double-digit efficiency improvement at high input voltages," comments VP of sales & marketing Dan Schwob, citing early interest from customers looking for energy-efficient solutions for auxiliary switched-mode power supplies (SMPS).

The second product (SJDP120R085) is a normally-on version of the 1200V normally-off SiC JFET. "Some customers have asked for a normally-on version of our normally-off SiC JFET products due to their topologies," says Dr Jeff Casady chief technology officer & VP of business development. "This normally-on version is identical to the normally-off version; except that it has 15% lower R_{DSon} [85mΩ], two times higher saturation current, and requires no gate current in the conduction mode."

SemiSouth says that, since releasing its first, normally-off SiC FET in late 2008, it has seen widespread adoption of the power transistor because of its advantages in energy efficiency, reliability and cost relative to other SiC technologies.

SemiSouth says that emerging SiC technology enables energy-efficient operation of power conversion and power management in telecom power supplies, inverters in solar and high-frequency welding, future automotive electric vehicle platforms, and many other products.

Customers have asked for a normally-on version of our normally-off SiC JFET

The firm adds that SiC's promise is its ability to make power supplies and power inverters up to 50–75% more energy efficient, operate at up to 4–8 times higher frequency, and hence run cooler and be physically much smaller. In particular, SiC power JFETs should increase the 'fuel' efficiency of hybrid electric vehicles and help to make them more affordable for consumers.

www.semisouth.com

Acreo and DENSO to co-develop silicon carbide power switches for non-automotive applications

All-epi 1200V, 50A-rated normally-off JFET targets demonstrator circuits in 2011

Microelectronics and optics research institute Acreo AB of Kista, Sweden has signed an agreement with DENSO Corp of Kariya, Aichi prefecture, Japan to develop highly efficient, normally-off power switch technology, developed at DENSO, and to evaluate it in non-automotive applications.

Fabricated using silicon carbide (SiC), the design of the switches is based on the material and processing technology available from both parties. DENSO is a diversified supplier of technology, systems and components with 120,000 staff in 34 countries and annual sales of US$32bn; it has been developing high-quality SiC wafer material, power switches and module technology for more than 10 years. Acreo has just 140 employees but has more than 15 years experience of developing epitaxial growth technologies and device processes for SiC.

The initial device to be designed and fabricated is a power switch with an operating voltage of 1200V and a current rating of 50A. The device of choice is an all-epitaxial normally-off junction field effect transistor (JFET), designed and tested at DENSO for current ratings over 50A and with epitaxial material supplied by Acreo.

For the 50A-rated devices, JFET process technology will be established at Acreo's SiC process line at the ElectrumLab in Kista, and device fabrication will start in autumn 2010. It is planned that packaged JFET devices will be ready for system evaluation demonstrator circuits at the start of 2011. The targeted applications are dc–dc converters, battery chargers, and photovoltaic systems. The technology could be considered for robust high-temperature automotive applications in the future.

The collaboration with DENSO is the result of joint research activities regarding SiC material technology for more than five years. The new agreement includes the transfer of the DENSO JFET technology to Acreo and is supported by the Swedish Governmental Agency for Innovation Systems (VINNOVA) and the Invest in Sweden Agency (ISA), Japan.

Combining both parties' competences and experience in SiC R&D, material technology and power device design and processing should enable the fabrication of high-performance and efficient normally-off SiC-JFET devices, say the firms, adding that the SiC-JFETs should help to revolutionize power electronics and lead to smaller, lighter and more-efficient power systems. Compared to conventional silicon technology, a reduction in size and weight by at least a factor of six is within reach, with no compromise in energy conversion efficiency.

"The agreement takes our cooperation into a new important phase, enabling us to test the new technology in real, demanding applications," says Acreo's CEO Mårten Armgarth. The next generation of power devices are hence directly accessible to Swedish systems firms, he adds.

"It's time to explore the energy-efficient SiC power device potential for non-automotive applications," says Hikaru Sugi, DENSO's senior managing director overseeing its Engineering Research & Development Center.

www.globaldenso.com
www.acreo.se

IN BRIEF

Cree launches Z-Rec 1700V junction barrier Schottkys

Cree Inc of Durham, NC, USA has launched what it claims is the first commercially available Z-Rec 1700V junction barrier Schottky (JBS) diode products. Leveraging SiC's unique advantages over silicon to virtually eliminate diode switching losses, the diodes are targeted at high-voltage power-conversion applications in motor-drive, wind-energy and traction systems.

Initial products in the 1700V series include 10A and 25A JBS diodes in die form, ready for integration into 1700V power modules ranging from 50A to 600A. Cree says that the new 1700V JBS series can increase the efficiency, reliability and longevity of power systems while also reducing the overall system size, weight and cost.

"The 1700V diodes extend our leadership in energy-efficient power systems for data-center and solar-power markets to new markets such as wind-energy, train, tram and electric-vehicle power converters," says Cengiz Balkas, Cree's VP & general manager, Power and RF. "For high-voltage, high-frequency systems, you can't afford not to use SiC."

"ABB has been closely involved with the development of SiC technology for many years," says Francisco Canales, senior principal scientist, ABB Corporate Research. "SiC diodes and switches provide an important step forward in technology that allows the increase of operation frequency, reduced size and weight while providing state-of-the-art efficiency in applications such as motor drives and solar inverters," he adds. "The 1700V devices now being launched by Cree are an important step in the development of this technology."

www.cree.com/power

AXT's GaAs sales drive growth of 4.5% in Q1

Growth of 11–15% expected in Q2

For first-quarter 2010, AXT Inc of Fremont, CA, USA, which makes gallium arsenide, indium phosphide and germanium substrate and raw materials, has reported revenue of $18.6m, up 4.5% on $17.8m last quarter and more than double the $7.7m a year ago (which had halved from Q4/2008 during the severe industry dip in Q1/2009).

Compared to just $5m a year ago, total GaAs substrate revenue was $13.4m, up 6% on $12.6m last quarter. InP substrate revenue was $875,000, up on $513,000 last quarter and almost double the $490,000 a year ago. Although up on $622,000 a year ago, germanium (Ge) substrate revenue has fallen from $1.85m last quarter to $1.64m. Likewise, although almost double the $1.5m a year ago, raw materials sales have fallen slightly from $2.8m last quarter to $2.7m.

"We have continued to experience solid demand for our products across all of our primary markets, driven by significant and extended market trends, such as the rapid expansion of wireless devices and subscribers, the increasing momentum in the adoption of LED technology and the growing interest in solar energy," says CEO Morris Young.

"Further, our own execution has been strong throughout our engineering, manufacturing, sales and administrative functions," continues Young. "We have had tremendous success in continuing to develop our valuable, long-term customer relationships as well as penetrating new customers and new opportunities to drive our growth and diversify our base," he adds.

Compared to –3.1% a year ago, gross margin has recovered further, from 33.9% last quarter to 36.1%.

Operating expenses have risen to $3.9m from last quarter's $3m (which included $500,000 in one-time favorable year-end adjustments for professional fees, China pension funds and China union fees). But this is still down on $5m a year ago (which included $629,000 severance and stock compensation accrual for former CEO Phil Yin and a $507,000 restructuring charge for staff cuts).

Although down slightly from $2.8m last quarter, net income was $2.6m versus a loss of $5.5m a year ago.

"Our efforts to restructure and refocus our organization over the past nine months are resulting in tangible benefits in efficiency, productivity and profitability — creating a solid foundation for our success in quarters to come," comments Young.

For Q2/2010, AXT expects revenue to grow 11–15% to $20.7–21.5m.

www.axt.com

ENAS orders 2nd Altatech liquid-precursor CVD system

Fraunhofer Research Institution for Electronic Nano Systems (ENAS) in Chemnitz, Germany has ordered an AltaCVD system from liquid-vaporization chemical vapor deposition (CVD) equipment maker Altatech Semiconductor S.A. of Montbonnot near Grenoble, France for the deposition onto 200mm wafers of silicon stressor materials, which are used to increase the channel mobility of transistors (enabling higher processing speeds).

This marks Fraunhofer ENAS' second order for a CVD tool from Altatech. The previous system is being used to deposit diffusion barrier and copper layers for copper damascene interconnects and through-silicon-via (TSV) features.

ENAS was scheduled to install the new system in its back-end-of-line (BEOL) cleanroom facility in Chemnitz in second-quarter 2010. Applications support will be provided by Altatech in Berlin.

The AltaCVD uses liquid precursors to create highly uniform thin films. As outlined in the International Technology Roadmap for Semiconductors (ITRS), almost all precursors for advanced wafer processing (e.g. 3D integration) are available only in liquid form, e.g. ruthenium (Ru), hafnium (Hf), copper (Cu), and a ternary alloy of germanium, tin and tellurium (GeTeSn).

"We're developing nanometric thin films to advance the state of semiconductor processing," says professor Stefan E. Schulz, head of BEOL operations at Fraunhofer ENAS. "The use of liquid-phase precursor injection and evaporation is a key enabling technology for this work."

AltaCVD uses direct injection of liquid precursors and a flash-vaporization system in processing wafers up to 300 mm. The modular system can accommodate a range of vaporization and deposition temperatures, enabling choice of the optimal process windows for a specific use, e.g. deposition of materials for high-k gate dielectrics, metal gate electrodes, capacitors and 3D integration. For thermal CVD or RF-enhanced deposition steps, a low-frequency plasma enables tuning of the thin film's mechanical, electrical and optical properties.

"Through our partnerships with Fraunhofer ENAS and other leading research centers, we are continuing to develop liquid-precursor deposition processes for high-k/metal gates, through-silicon-vias, memory and capacitor applications," says president Jean-Luc Delcarri. "We're also working with IDMs and foundries to bring liquid-precursor deposition to their high-volume 300mm fabs," he adds. "And we've begun applying our CVD technology to create advanced thin films for solar cells, high-brightness LEDs and other microelectronics markets."

www.altatech-sc.com

AkzoNobel doubling TMG production

AkzoNobel of Amersfoort, The Netherlands says its High Purity Metalorganics (HPMO) business (part of its Functional Chemicals business unit), which produces In-, Ga-, Al and Zn-based metalorganic precursors for LED and solar cell manufacturing, is doubling the capacity of its trimethyl gallium (TMG) plant in LaPorte, TX, USA.

The expansion is being driven by market growth for LED backlight units in computer screens and TVs, as well as for LED in general lighting.

"This capacity expansion shows AkzoNobel's commitment to the attractive and high-growth LED and solar industry", says Bob Margevich, managing director of Functional Chemicals. "This business also supports our efforts in sustainability, by focusing on applications that drive energy efficiency and lower energy usage."

www.akzonobel.com/hpmo

SMI sells CVD system for oxides & nitrides

Structured Materials Industries Inc (SMI) of Piscataway, NJ, USA has sold a NanoH+ CVD tool (capable of depositing films on 100mm substrates) which is designed to alternate between oxide and nitrides with minimal cross contamination. The load-locked tool features operation through 1200°C.

The system offers rapid turnaround from sample to sample and material to material. "SMI has had a surge of NanoH and NanoH+ CVD tool sales, as we have focused on providing customized solutions for researcher flexibility, upgradeability, value pricing, experimental results, customer achievements, and other benefits," says president Dr Gary S. Tompa. SMI's line of NanoH CVD span several sizes, multiple material systems, plasma enhancement options etc, including the option to operate in both CVD and ALD modes.

www.structuredmaterials.com

IN BRIEF

Riber wins order for multi-wafer production reactor

Riber S.A. of Bezons, France, which manufactures MBE systems as well as evaporation sources and effusion cells, has received an order for an MBE6000 multi-wafer production machine from an unnamed major manufacturer of pHEMT structures.

Riber says that the customer will use the system to increase its production capacity by more than 1500 6-inch pHEMT structures per month, with an up time of more than a year of continuous 7 days x 24 hours operations before maintenance.

The order adds to Riber's backlog, which totals €11.7m (up 92% on a year ago).

www.riber.com

Veeco's LED & Solar orders rise seven-fold year-on-year as backlog reaches $0.5bn

Q2 revenue to rise 35–47% sequentially

For first-quarter 2010, epitaxial deposition, process, and metrology equipment maker Veeco Instruments Inc of Plainview NY, USA has reported record revenue of $163m, up 12% on $146m last quarter and 160% on $62.8m a year ago.

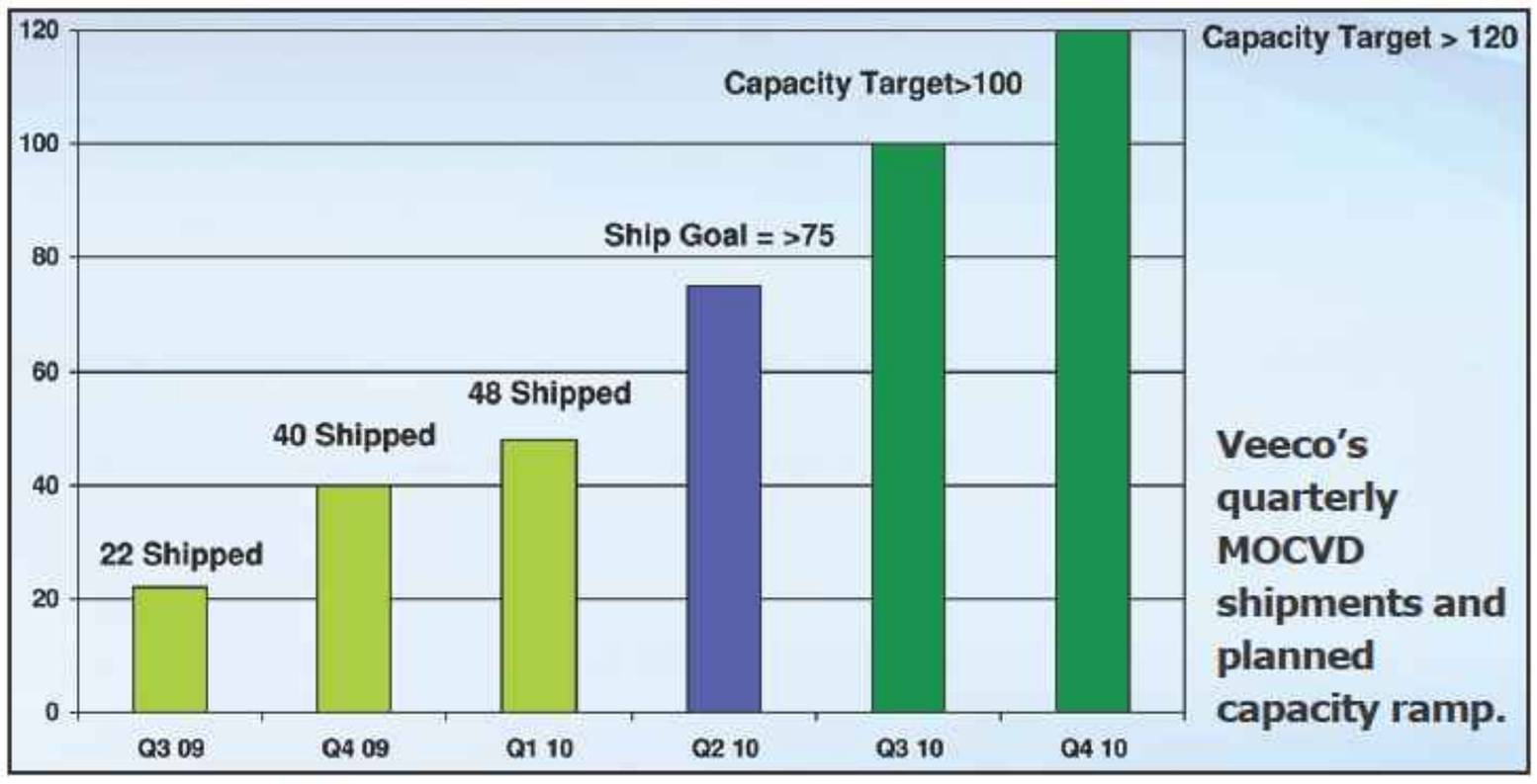
Of this, LED & Solar revenues were a record $111.5m (76% of total revenue). This is up 14% on last quarter's $98m and more than five times the $22.2m a year ago. Meanwhile, Data Storage process equipment revenue was $23.2m, up on last quarter's $21m and $16.9m a year ago. Metrology revenue was $28.4m, up on last quarter's $27.2m and $23.7m a year ago.

Earnings before interest, income taxes and amortization (EBITA) for LED & Solar was $29.8m, up from $27m last quarter and a loss of $3.7m a year ago. Overall EBITA was a record $32.8m (20% of sales), up from $25.1m last quarter and a loss of $9.7m a year ago.

During the quarter, Veeco generated $42m in cash from operations, boosting the cash balance further, from $148.6m to $194m.

"We are executing well, with revenues and profitability increasing sequentially in all three Veeco businesses," notes CEO John R. Peeler.

Orders were a record $268m (up 2% on $262.2m last quarter and five times $53m a year ago). This included a record $211.7m for LED & Solar (79% of total bookings).



Veeco's quarterly MOCVD shipments and planned capacity ramp.

Driven by accelerating orders for TurboDisc MOCVD systems, this is up 20% on last quarter's $177m and more than seven times $28.5m a year ago. "We continued to see strong MOCVD demand as an expanding LED customer list ramps production for laptop and TV backlighting, as well as for general illumination," says Peeler. Data Storage and Metrology orders were $26m and $30m respectively, each much better than a year ago but down sequentially. During the quarter, total order backlog rose from $402m to a new record of $502m.

"We continue to see strong momentum in our LED business," Peeler comments. "Our TurboDisc K465i MOCVD system [launched in January] has hit the market at the right time, offering high productivity and best-in-class yields. As a result, Veeco has been gaining share and winning business at many of the world's top LED manufacturers," he adds.

"Second quarter business patterns remain extremely strong, with multi-tool system orders being quoted at a large number of customers... Several key Asian customers [including LED makers China's Sanan, Genesis Photonics of Taiwan and Seoul Optodevice of Korea] have already booked sizeable orders in April," Peeler says.

"We continue to increase our MOCVD manufacturing capacity, with a goal to ship more than 75 systems this quarter," notes Peeler. "We are currently planning to further build capacity to ship more than 100 and 120 systems in the third and fourth quarters, respectively."

For second-quarter 2010, Veeco expects revenue to rise 35–47% to $220–240m.

Veeco co-sponsors MBE Innovator Award; nominations sought

Veeco will once again co-sponsor the MBE Innovator Award this year in conjunction with the North American Molecular Beam Epitaxy (NAMBE) organization.

Initiated in 2003, the award (consisting of a $3000 honorarium and plaque) recognizes individuals whose innovations have significantly advanced MBE technology. It will be presented at the NAMBE conference at the Beaver Run Resort & Conference Center in Breckenridge, CO in September.

Nominations for the award are open to universities, government organizations and commercial companies worldwide. Nominees must show or have shown innovation in advancing MBE technology. NAMBE Advisory Committee officials will select a winner from the submitted nominations, with the respective recipient receiving the award at the conference banquet.

Submission deadline is 16 July.

www.veeco.com/2010nambe_awards

Epistar qualifies Veeco's K465i GaN system as it ramps LED capacity

Epitaxial deposition, process, and metrology equipment maker Veeco Instruments Inc of Plainview, NY, USA says that Taiwan's Epistar Corp of Hsinchu Science-based Industrial Park has recently qualified its TurboDisc K465i gallium nitride MOCVD system for high-volume production of its high-brightness LEDs.

"Ramping to production quickly and maintaining high throughput is critical to our success. Veeco enabled us to qualify the K465i rapidly and it provides the automation required to produce highly uniform LEDs with minimal downtime," comments Epistar's president Dr M.J. Jou. "The K465i provides Epistar the ease-of-use and system availability to meet our growing production requirements," he adds.

"We currently expect to ship a significant number of tools to Epistar this year," says Bill Miller, senior VP & general manager of Veeco's MOCVD operations. "This is an important milestone for Veeco as we continue to build our Taiwan installed base."

With what is reckoned to be superior wavelength uniformity and run-to-run repeatability, Veeco says that the production-proven K465i extends its capital efficiency (the number of good wafers per day for each capital dollar) for high-volume LED makers. The K465i provides ease-of-tuning for fast process optimization on wafer sizes up to 8 inches and fast tool recovery time after maintenance, the firm adds.

www.epistar.com.tw
www.veeco.com

Sanan orders multiple Veeco MOCVD reactors for new HB-LED fab

Veeco has received an order for multiple K465i and E475 Turbo Disc MOCVD reactors from Xiamen-based Sanan Optoelectronics Co Ltd (China's largest full-color LED maker) for its new high-brightness LED fab in Wuhu, Anhui Province.

"Our new location in Wuhu will be China's — and perhaps the world's — largest manufacturing and research center for LED wafers and chips," reckons Sanan's CEO Simon Lin. "Given the increased demand for LEDs in such applications as general illumination, TV backlight and outdoor displays, we intend to ramp our production quickly with Veeco as our chosen partner."

"We are gratified that we can continue our long-standing relationship with Sanan as their preferred MOCVD supplier for their new world-class LED production facility," says Bill Miller, senior VP & general manager of Veeco's MOCVD Operations. "The China market will drive significant advancement of the LED industry and Veeco, as the market-leading equipment provider in China, is well positioned to benefit from this growth," he adds.

Sanan plans to invest RMB12bn (US$1.7bn) in the Wuhu LED fab, involving purchasing 200 MOCVD systems over the next 3–4 years.

Veeco says that the K465i provides ease-of-tuning for fast process optimization on wafer sizes up to 8 inches and fast tool recovery time after maintenance. The TurboDisc E475 As/P MOCVD system is engineered for high-volume production of red, orange and yellow HB-LEDs.

Sanan plans to invest $1.7bn in the Wuhu LED fab, involving purchasing 200 MOCVD systems

www.sanan-e.com/en/index.aspx

IN BRIEF

Nippon Sanso tool boosts SemiLEDs' UV LED capacity

High-brightness LED chip maker SemiLEDs Corp of Boise, ID, USA (which has chip fabrication facilities in Hsinchu Science Park, Taiwan) is increasing its production capacity of UV LED chips with the addition of a new SR 4000 MOCVD reactor from Taiyo Nippon Sanso Corp.

"The addition of a new UV LED reactor will allow SemiLEDs to continue to build on the momentum of the rapidly growing UV LED market," says president & chief operating officer Dr Chuong Tran. "The new reactor will enable us to further improve the support and service we provide to a growing list of companies dedicated to the UV market through our broad portfolio of UV LEDs," he adds.

"The SR 4000 provides superior and stable performance with a high throughput while achieving the highest crystal quality and uniformity," claims Kuroda san of Taiyo Nippon Sanso.

SemiLEDs' proprietary blue (white), green and UV 'metal vertical photon' (Mvp) LED chip design features a vertical LED structure on a patented copper alloy base that provides what is claimed to be the best thermal resistance on the market (0.4°C/W) as well as electrical and optical advantages such as greater luminous efficacy and longer lumen maintenance.

UV LEDs have had a growing impact on market segments including conformal coating, curing, printing, medical, security and forensics and biotechnology, says SemiLEDs, and are greatly enhancing current applications and providing solutions that are poised to revolutionize the UV LED market, the firm reckons.

www.semileds.com
www.tn-sanso.co.jp/en

Aixtron grows 31% in Q1; orders up fivefold year-on-year — 2010 revenue guidance raised by €50m to €650–700m

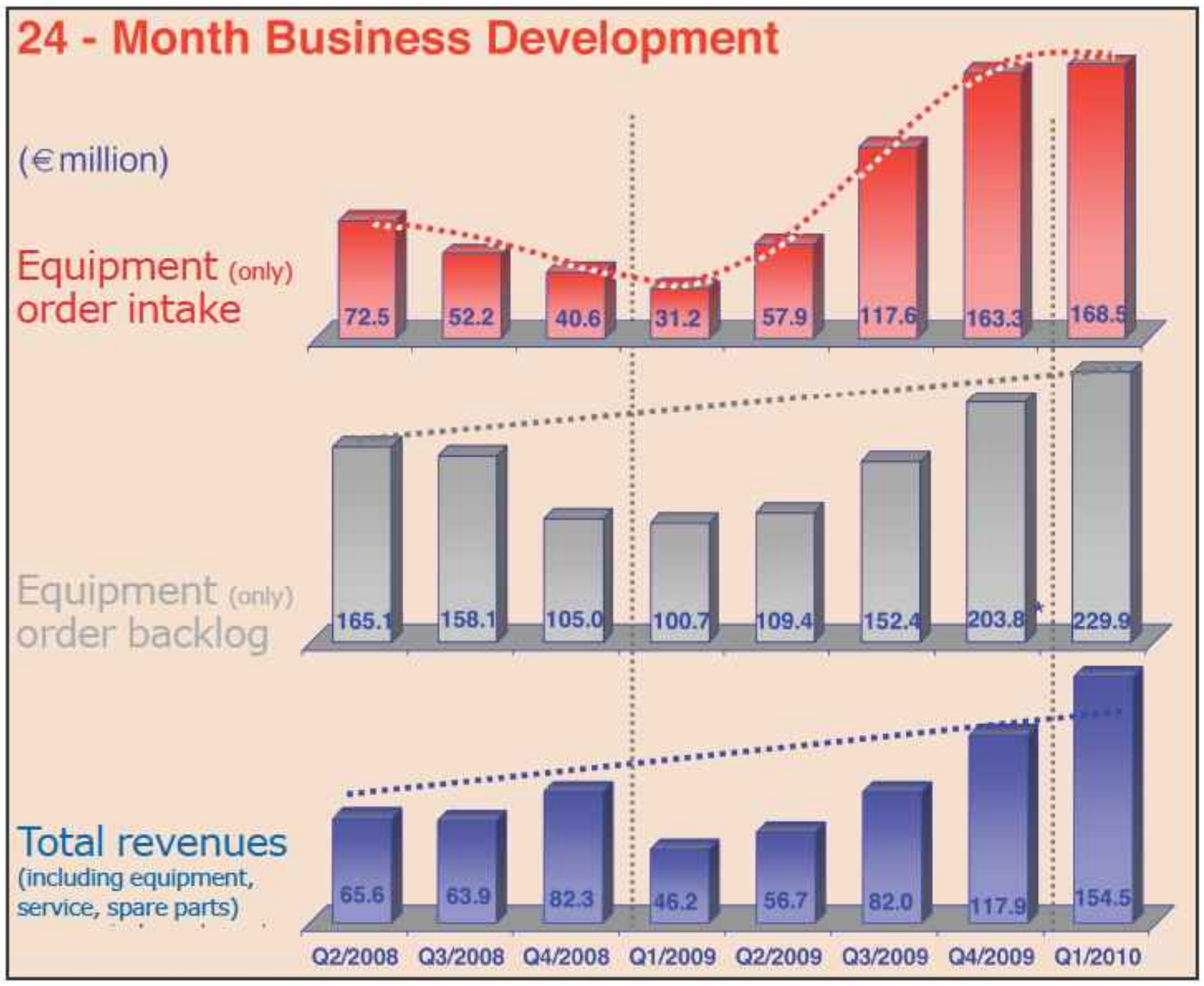
Deposition equipment maker Aixtron of Aachen-Herzogenrath, Germany says that continuing healthy demand, beneficial volume effects, and a stronger US dollar have all contributed to the firm's positive performance in first-quarter 2010. The steadily increasing growth (for a fourth sequential quarter) is underlined by record revenue of €154.5m, up 31% on last quarter's €117.9m and 234% on €46.2m in Q1/2009 (which was the trough of the last investment cycle and the height of the global recession).

Of total revenue, 92% (€141.4m) came from compound semiconductor deposition equipment, 7% from spare parts & services, and just 1% (€1.6m) from Silicon deposition equipment. Of equipment revenue, 93% is for LED manufacturing, 3% for telecom/datacom components, and 3% for display-related products (with no significant revenues from consumer/optoelectronic or solar equipment). By geographic region, 94% of revenue came from Asia, and just 4% from the USA and 2% from Europe.

Gross margin has risen from 45% a year ago and 47% last quarter to 50%. Due to the higher volume and the underlying leverage effect, earnings before interest and taxes (EBIT) operating profit increased from just €7.6m a year ago and €33.7m last quarter to €46.4m, representing the third sequential quarter of rising EBIT performance.

Free cash flow has improved from €10.4m a year ago and €30.1m last quarter to €67.8m. Cash & cash equivalents (including cash deposits) rose to €371.6m. Even after excluding net proceeds of €157.6m raised through last October's capital increase, this is still well up on €81.6m a year ago.

Order visibility remains healthy, with a fourth sequential quarter of rising equipment order intake, to €168.5m (up 3% on €163.3m last quarter and more than five times the €31.2m a year ago). Of this, €164.5m is for compound semiconductors (including organics) and just €3.9m for silicon.



Aixtron's equipment order intake (top), backlog (middle) and revenue (bottom) in the last 24 months, showing more than five-fold order growth since Q1/09.

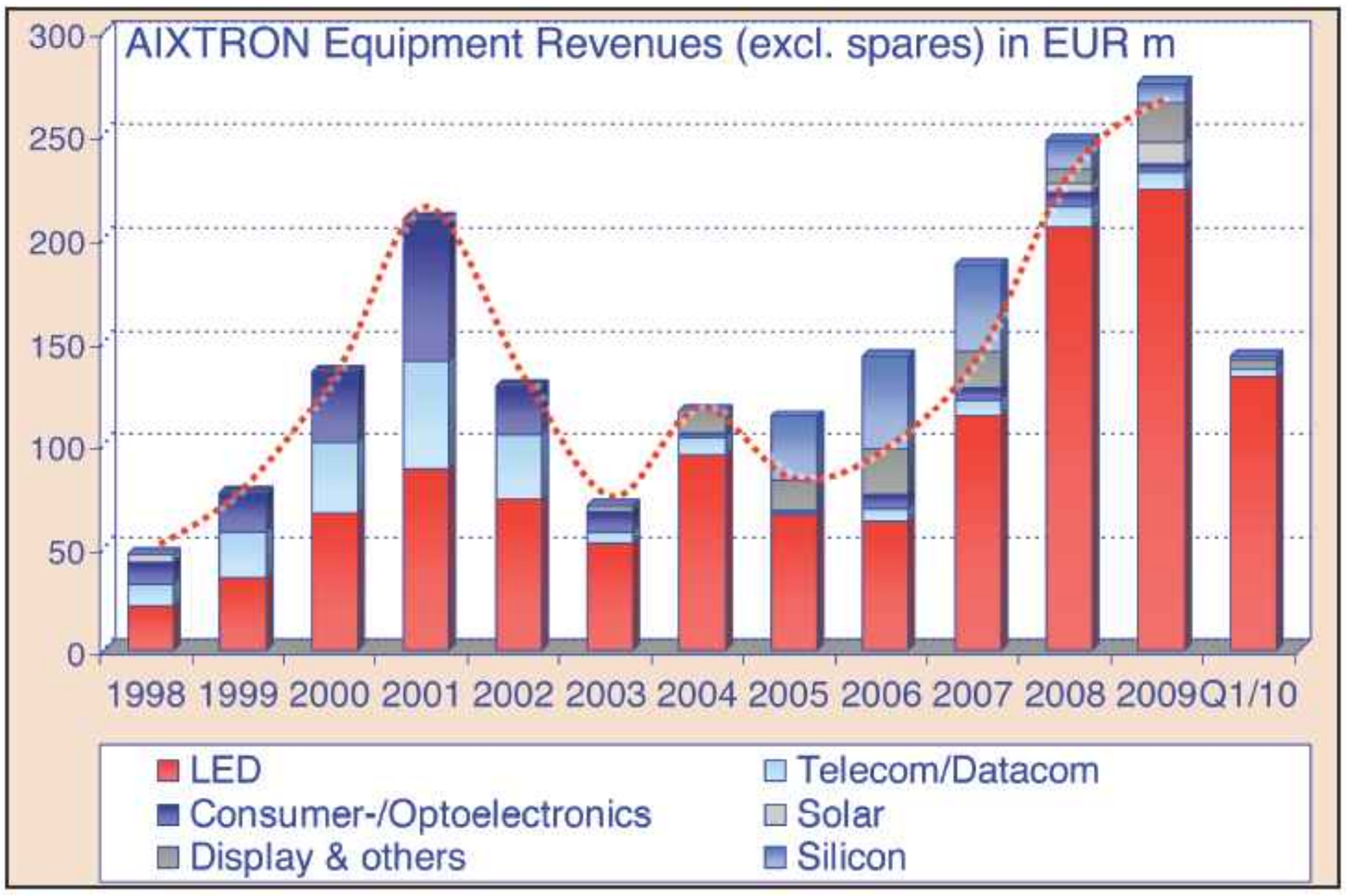
Equipment order backlog at the end of March was €229.9m, up 13% on €203.8m at end-December 2009 and more than double the €100.7m a year ago. Almost all backlog will be converted into revenue by the end of this year.

"These Q1 figures build on what was already an excellent foundation for a record performance year in 2010," says president & CEO Paul Hyland. "Consistent performance over the last 12 months has clearly demonstrated that our flexible business model and our product development strategy enables us to not only meet huge rises in demand but also to increasingly drive our profitability through operational leverage," he adds.

"Following the product launch in February, and the very encouraging market response to our latest-generation IC 2 platform system with our Generation 5 Planetary and CRIUS II reactor technologies on board, we are increasingly confident that the timely market-led decisions we have made previously, on technology development and product launch timing, exactly match the current market dynamics," says Hyland. Expecting €240–290m more of new shippable equipment orders by Q3/2010 (joining the €229.9m backlog) plus €25m of additional spares & service revenues in Q2–Q4/2010, Aixtron's executive board has raised its full-year 2010 guidance from €600–650m in revenue and EBIT margin of 25% (given on 10 March) to €650–700m in revenue.

To meet rising demand, Aixtron is boosting its manufacturing capacity. The firm can already ship more than 120 systems per quarter and is targeting 150 systems per quarter by the end of 2010.

"We continue to see strong system demand, principally from customers delivering LED backlighting appli-



Increasing dominance of LEDs as proportion of Aixtron's equipment revenue.

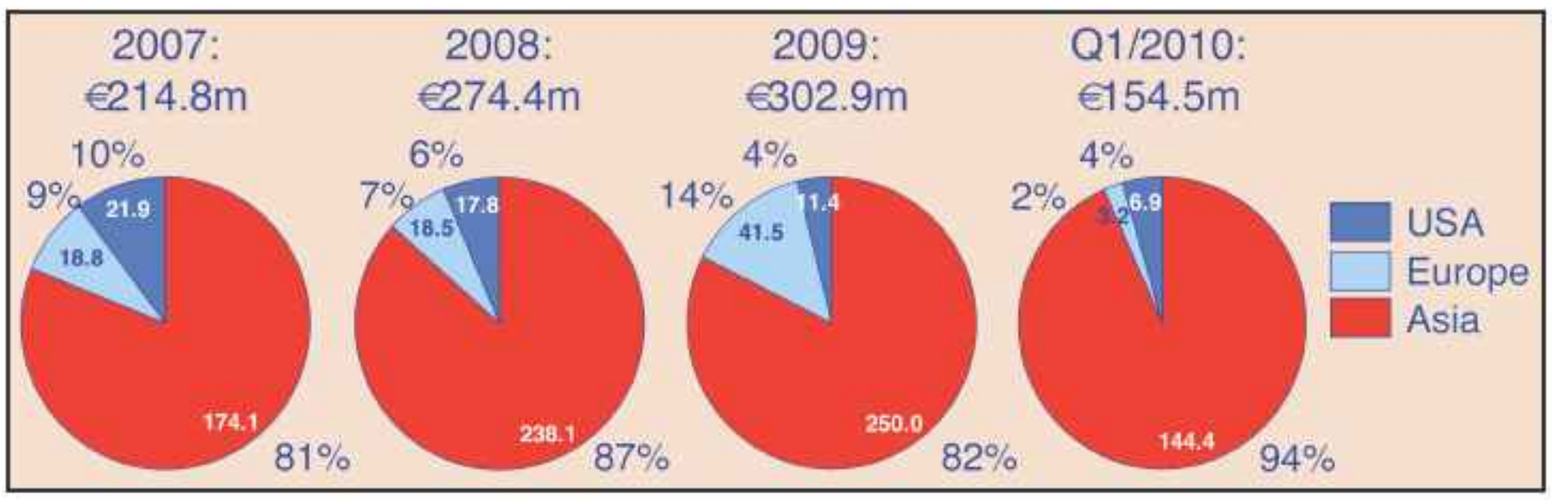
cations but also from customers addressing lighting applications," Hyland says.

Hyland stresses that LED lighting does not yet constitute the sustainable volume that Aixtron is looking for, but adds that it has been a very promising development over the last few quarters. "There are customers out there who are beginning to prepare and invest, in anticipation of an addressable lighting market, and credit must go to those governments who are proactively encouraging this development through regulatory and subsidy initiatives," he adds.

"Some further patience will still be required, but it is a very positive and tangible development and one that played a prominent part in our recent decision to invest more than €40m in a new R&D center [being built near Aixtron's premises in Herzogenrath-Kohlscheid, Aachen County] and to substantially increase our R&D team," Hyland continues. On 14 April, Aixtron held a groundbreaking ceremony for its new R&D center, which will be able to accommodate up to 350 engineers (with the first occupying their new offices by Q4/2010). Aixtron's global staffing has already increased from 621 at end-March 2009 to 731 by end-March 2010.

"We intend to have a new, groundbreaking, high-volume product available when those sustainable volume signals for solid-state lighting are matched by a clearly defined set of performance and cost of ownership criteria that will eventually emerge from the work being done by customers now," says Hyland. "Working closely with key customers gives me the confidence to say that we will have the next generation of Aixtron high-volume production systems available for those customers when the LED industry reaches that key tipping point."

www.aixtron.com



Increasing dominance of Asia as a proportion of Aixtron's total revenue.

IN BRIEF

Tyndall to develop GaN capabilities with Aixtron CCS MOCVD tool

Aixtron says that in fourth-quarter 2009 Tyndall National Institute, based in University College Cork (UCC), Ireland, placed an order for a Close Coupled Showerhead MOCVD system, for delivery in first-half 2010 in 3x2"-wafer configuration.

"From our existing Aixtron reactors we are very familiar with the quality of performance and engineering available with their tools," says professor Peter Parbrook, who has been appointed to lead the GaN growth activity at Tyndall National Institute using strategic funding from Science Foundation Ireland. Reasons for choosing the CCS reactor for the GaN program include the flexible reactor configuration, which includes gap adjustment, he adds. "Plus we can work with a range of different substrate sizes to suit our various research projects. Inherently, the tool also has high growth uniformity and we are looking forward to using the ARGUS pyrometric system to give us precision in-situ monitoring and process control," Parbrook says. The growth tool will complement Tyndall's existing expertise in the theory of GaN photonic materials and fabrication of GaN-based devices.

Following installation by the local Aixtron support team, the new system will be used to support work on GaN technologies, including the growth of GaN/(Al, Ga, In)N-based materials for optoelectronic and microelectronic devices with a focus on high-temperature growth of AlGaN structures.

www.tyndall.ie
www.aixtron.com

IN BRIEF

FOREPI JV JiangSu CanYang orders Aixtron GaN HB-LED MOCVD reactors

Deposition equipment maker Aixtron AG of Aachen-Herzogenrath, Germany says that in Q4/2009 it received an order for Planetary Reactor (11x4" wafer) and Close Coupled Showerhead (31x2" wafer) HB-GaN LED MOCVD tools for delivery in Q2–Q4/2010 to China's JiangSu CanYang, an affiliate of Taiwan-based LED chipmaker Formosa Epitaxy Inc (FOREPI).

"We have aggressive plans for our joint venture in Jiang Su province, PR China, with a total of 50 systems to be in place within the next three years," says FOREPI's CEO Dr Frank Chien. "The excellent performance we have received from our existing Planetary and Showerhead systems from Aixtron at FOREPI in Taiwan have translated directly into high-quality product performance, yield, and cost of ownership," he adds.

Specifically, the reactors in this latest order are destined not only for a new facility but also a new application research topic. "As these plans unfold, the new joint venture in China will allow us to be very close to many of our customers, increasing production capacity, and to meet their future needs in new device technology," continues Chien. "Working in partnership with Aixtron's support team, we can bring these tools onstream quickly, ramping up GaN HB-LED epiwafer production in response to strong local market demand."

Aixtron's local support team will commission the new reactors at the new FOREPI purpose-built facility in JiangSu province, China.

www.forepi.com.tw

LDX orders Aixtron reactors for LED backlighting market entry

Aixtron says that in first-quarter 2010 it received an order for two CRIUS production deposition systems in 31x2"-wafer configuration from new customer LDX (LongDeXin), a joint venture by Zhejiang Longfei Industry Co Ltd and China Delixi Holding Group Co Ltd founded last October. Scheduled for delivery in second-quarter 2010, the new reactors will be installed and commissioned by the local Aixtron support team at LDX's new factory in Shanghai, where they will be used for GaN HB-LED production.

"Our company has decided to make a strategic investment to enter the display backlighting business," says LED project manager Lin Loufei. "This project requires rapid in-house LED development and the manufacturing of materials for epiwafer-based high-brightness LEDs," he adds. "We turned to Aixtron because of the company's experience and the technical know-how its support team can bring to our project...We look forward to working with Aixtron to quickly and efficiently bring the new reactors into full production."

China's Zhejiang Longfei Industry specializes in developing and producing healthcare oxygen supply equipment, meters for industry, and fire alarm and linkage control systems. Via its customer network and after-sales service network, its products are also exported to North America, Japan, Turkey, Nigeria, Hong Kong and Taiwan.

Established in 1984 and based in Wenzhou, Delixi Group is one of China's largest private-owned enterprises. Core businesses are the production of high-, medium-, and low-voltage electric apparatus, the transmission and transformation of power distribution, and industrial automatic control electrics. The firm's scope has been further expanded to trading and logistics services, mineral energy resources, environmental protection, renewable resources and private equity investment.

Our company has decided to make a strategic investment to enter the display backlighting business

www.aixtron.com

VPEC increases capacity with order for eight more Aixtron systems

Aixtron says that in Q4/2009 it received its single largest order of its kind for this year, for eight 2600G3 IC MOCVD tools from Taiwan's Visual Photonics Epitaxy Co Ltd (VPEC), to be commissioned at VPEC's facility in Ping-Jen City, Taoyuan, Taiwan during the second and third quarters of 2010.

"We have been using several AIX 2600 mass-production MOCVD reactor systems for some years now," says VPEC VP Neil Chen. "These have contributed greatly to our strong market share for optoelectronic and microwave epiwafers in Taiwan and worldwide... this business has been so successful that we must bring on stream a major new additional capacity," he adds. "Our technical staff is assured of seamless operation of the high-efficiency precision systems in a year's time."

Founded in 1996, VPEC's principal products are HBT and PHEMT epitaxial wafers for wireless communication applications, high-brightness LED epiwafers and chips for various industrial and commercial applications, and Zn-diffusion-ready PIN epiwafers for optical fiber communication applications.

www.vpec.com.tw

Taiwan LED maker orders JVS' QC3 diffractometer for China JV CanYang

X-ray metrology tool maker Jordan Valley Semiconductors Ltd (JVS) of Migdal Ha'emek, Israel has received multiple orders for its new QC3 diffractometer system from leading LED makers in Asia, including China's JiangSu CanYang Optoelectronics Ltd, an affiliate of Taiwan-based LED chipmaker Formosa Epitaxy Inc (FOREPI).

"The purchase of the QC3 system by a market leader such as CanYang is a testament to Jordan Valley's successful acquisition of Bede in 2008 and leveraging of its technology," says CEO Isaac Mazor. "We vastly improved the speed and effectiveness of this metrology tool, while reducing its price, in order to offer an unparalleled cost/performance solution to the rapidly expanding HB-LED manufacturing market."

QC3 is designed and optimized to provide best cost/performance quality control systems for high-brightness LED (HB-LED) manufacturing, says JVS. It has been configured to provide symmetric and asymmetric measurements for all common semiconductor wafers, such as GaAs, InP, Si, and GaN (thick buffers).

QC3 includes fast reciprocal-space mapping in less than 1 minute and a 300mm-wafer stage with custom wafer-size settings for multiple wafers, as well as full robot automation systems offered for comprehensive factory automation. Its hardware is based on JVS' 300mm fully automated tool range.

Recently introduced to the market, QC3 is now available in volume orders, with a delivery schedule of 90 days ARO. QC3 is manufactured by Jordan Valley Semiconductors UK Ltd, which was formed from JVS' acquisition of Bede Scientific Instruments Ltd.

www.jvsemi.com

JVS acquires VUV metrology firm Metrosol

In late March, JVS acquired Metrosol Inc of Austin, TX, USA, a manufacturer of short-wavelength optical metrology solutions including a vacuum ultraviolet (VUV) tool.

"The acquired VUV technology will strengthen Jordan Valley's position as a key metrology solutions provider for the sub-45nm semiconductors processes while expanding its capabilities to new markets such as the emerging patterned HDD market," says JVS' CEO Isaac Mazor.

Founded in 2002, Metrosol makes thin-film measurement systems for next-generation semiconductor manufacturing, such as process monitoring and excursion suppression for high-k gate structures and multilayer dielectric stacks. Its SHORTY ES (Enhanced Spectrum) Series short-wavelength optical metrology tools are the only commercially available systems able to collect optical reflectance data down to 120nm, it is claimed. The shorter wavelengths enable greater sensitivity on thickness, composition, and optical property measurements on the complex films and stacks necessary to achieve desired device performance.

VUV technology is the most sensitive non-destructive optical metrology available for ultra-thin FEOL layers, such as high-k dielectric and metal gates, and hence complements JVS' x-ray-based metrology solutions.

JVS claims that it offers the semiconductor industry the most comprehensive array of tools, based on advanced XRR, XRF, HRXRD, WAXRD and SAXS technologies, for both product or blanket wafers. For the compound semiconductor industry, JVS offers HRXRD tools for HB-LED manufacturing.

www.metrosol.com

IN BRIEF

Plasma-Therm rates highly in VLSI customer satisfaction survey

Plasma process equipment maker Plasma-Therm LLC of St Petersburg, FL, USA has been awarded overall third place in The Best 2010 Small Suppliers of Wafer Processing Equipment category of VLSIresearch's annual customer satisfaction survey of semiconductor equipment users.

The global survey asked chipmakers to rate their equipment suppliers in terms of: product performance, process support, cost of ownership and uptime. Plasma-Therm rated highest in technical leadership and commitment by its equipment users.

"The Customer Satisfaction Survey that is used to determine the THE BEST goes directly to our customers and provides us with first-hand feedback of their satisfaction level with our systems," says CEO Abdul Lateef. "THE BEST award is tangible proof that our direct attention on focused customer support and top-line customer service is paying off."

Plasma-Therm's latest VLSI award is its 12th for being one of The Best equipment suppliers (following 1998 and 2000, then 2001 – 2009 under the Unaxis and Oerlikon brands).

"The Customer Satisfaction Survey has been measuring the industry's opinion of chip making equipment quality and service for 22 years," says VLSIresearch's president Risto Puhakka. "Being voted one of THE BEST in the industry, Plasma-Therm has set its standards for exceeding customer satisfaction remarkably high early on in its re-emergence as an independent company."

www.vlsiresearch.com

Penn State selects Plasma-Therm multi-module ICP etch tool for Nanofabrication Research Lab

Plasma-Therm LLC of St Petersburg, FL, USA says that Pennsylvania State University has chosen to add a Versalock ICP etch system to its Nanofabrication Research Lab.

The system is configured with two chambers and will be used for basic and applied research in fields such as nanotechnology, material science, electronics and photonics.

"With an installed base of more than 160 systems, the Versalock tool has proven its reliability in settings ranging from R&D to high-volume production," says executive VP of sales & marketing Ed Ostan. "Plasma-Therm's long involvement with leading research facilities like Penn State's Material Research Institute and Nanofabrication Laboratory provides an opportunity to participate in science and technology at a fundamental level," he adds.

As a member of the National Nanotechnology Infrastructure Network (NNIN), Penn State provides technical expertise in materials and chemical technologies at the molecular scale with strengths that include surface chemistry, self-assembly and the fabrication and processing of complex oxide materials.

"This new equipment will significantly contribute to advances in cutting-edge process technologies that address challenges ranging from energy to medicine," comments Nanofabrication Research Lab director of operations William Mansfield.

www.PlasmaTherm.com

University of Waterloo orders multiple OIPT systems

UK-based etch and deposition equipment maker Oxford Instruments Plasma Technology (OIPT) recently received a multi-system order from the University of Waterloo, Ontario, Canada. The order consists of OIPT's System100 ICP & System133 PECVD, and a FlexAL PECVD/ALD Cluster tool, with multi-wafer batch capability and the potential for providing a number of process applications.

The equipment will be housed in the university's cleanroom at the Mike and Ophelia Lazaridis Quantum-Nano Centre, a new building now under construction. Due for completion in 2011, the facility will be shared between the Institute for Quantum Computing and the Waterloo Institute of Nanotechnology.

OIPT says that its tools offer powerful stand alone and clusterable process modules, enabling a wide range of applications. The university will use its new systems for multiple process techniques, including: Bosch, cryo silicon etch, compound semiconductor, metal etch, and PECVD. In addition, one of the tools will be clustered to offer ALD process capability, to deposit Al_2O_3 conformal coating.

OIPT's System133 PECVD tool.

www.oxford-instruments.com

OIPT launches new plasma etch and deposition systems

Oxford Instruments Plasma Technology has launched the PlasmaPro NGP80 system, an open-loading tool offering versatile plasma etch and deposition solutions on one platform with a small footprint that is easy to site and use, with no compromise on process quality, and with multiple process technology configurations.

OIPT's PlasmaPro NGP80 is suited to R&D or small-scale production, and can process from the smallest wafer pieces to 200mm wafers. The open-load design allows fast wafer loading and unloading, suiting research, prototyping and low-volume production. Other features include: the latest-generation BUS control system (increasing data retrieval and delivering faster and more repeatable matching), and easy access to key components for improved servicing and maintenance.

Multiple configurations (RIE, PECVD, ICP & RIE/PE) enable applications including III-V etch, silicon Bosch and cryo-etch processes, diamond-like carbon (DLC) deposition, SiO_2 and quartz etch, hard mask deposition, and etch for high-brightness LED production.

OIPT says Birmingham University's Nanoscale Physics Research Laboratory has been trialing the NGP80 for more than a year, using the tool for R&D of photo-resists for next-generation lithography as well as the fabrication of high-aspect-ratio silicon-based field emitters.

"The PlasmaPro NGP80 has significantly enhanced our etching capabilities," says Dr Alex Robinson, who heads research at the laboratory. "The new software is very simple to learn, but allows considerable flexibility to build complex processes," he adds. "Excellent repeatability, together with comprehensive parameter logging, have enabled a rapid transfer of previously developed fabrication steps to the new machine, consolidating work previously done on several different etchers, whilst the flexibility and ease of use have allowed us to develop our research in new directions."

The equipment was purchased through the AM1 project 'Creating and Characterising Next Generation of Advanced Materials', part of an investment in research infrastructure funded by Advantage West Midlands and the European Regional Development Fund (ERDF) under the wider Birmingham Science City initiative that has united Birmingham and Warwick universities in a new Science City Research Alliance to advance innovation in the region.

"NGP80 has been developed to allow faster throughput and greater repeatability at a reduced cost," says OIPT's sales director Mark Vosloo.

www.oxford-instruments.com

IN BRIEF

SemiProbe appoints reps: WESI for Taiwan & China; Inseto for UK, Ireland & Scandinavia

SemiProbe of Winooski, VT, USA has appointed Inseto of Andover, UK as distributor for the UK, Ireland and Scandinavia.

SemiProbe supplies manual, semiautomatic and fully automatic probing and test & inspection equipment for microelectronics, photovoltaics, optoelectronics, MEMS, biotechnology, chemistry, microfluidics and nano applications (from R&D to production).

Founded in 1987, Inseto provides manufacturing equipment, assembly materials and consumable products for electronic production, including semiconductor, micro & nanoelectronic assembly, as well as products for general industrial manufacturing. "SemiProbe is a recognized global supplier of semiconductor wafer and die probing and inspection systems," says managing director Tony Brown. "This line compliments our existing backend product lines."

SemiProbe has also appointed WESI Technologies of Hsinchu, Taiwan and Shanghai, China (which provides manufacturing equipment and consumables for semiconductor and solar markets) as sales rep for China and Taiwan.

"We selected WESI Technology for their established position in the key Taiwan and China markets, their professional personnel, key customer relationships and offices strategically located in the region's semiconductor capitals," says Don Feuerstein, SemiProbe's VP sales & marketing. "Our line compliments WESI Technologies' existing back-end product lines."

www.inseto.co.uk
www.wesitechnology.com
www.semiprobe.com

Applied launches turnkey MES software to speed packaging ramp-up

Applied Materials Inc of Santa Clara, CA, USA has launched its Applied SmartFactory MES (manufacturing execution system) software, an out-of-the-box, factory automation solution for tracking and streamlining the flow of materials throughout a manufacturing facility that, deployable in less than 60 days, can help to accelerate the production ramp of emerging technologies in the solar, LED and chip packaging industries.

Designed to improve product quality, boost productivity and cut operational costs, SmartFactory is also claimed to be the first MES available with integrated advanced process control (APC) capability, enabling users to achieve higher and more consistent factory output.

"The SmartFactory system is designed to help factory operations in rapidly growing industries achieve the high yields and economies of scale that can lower manufacturing cost — key to the widespread adoption of these important new technologies," says Charlie Pappis, VP & general manager of Applied Global Services. "Customers can realize the benefits of Applied's proven manufacturing automation technology with a ready-to-use solution that can be expanded as their businesses and industries grow without disrupting ongoing production," he adds.

Based on Applied's FAB300 MES technology, the SmartFactory system features pre-built, technology-specific scenarios to monitor every machine and all work-in-progress material movements, manage production sequencing, create an audit trail, and deliver instructions to shop floor workers via a consistent, task-focused graphical user interface. An optional APC module uses Applied E3 technology to interface directly with production equipment, enabling real-time, run-to-run (R2R) process tuning and fault detection and classification (FDC) to increase process capability and reduce unplanned down-time.

Applied's common framework approach allows SmartFactory to be expanded with plug-in components from the firm's portfolio of factory automation software, which has been proven in over 500 manufacturing facilities worldwide. Statistical process control, equipment performance tracking, advanced dispatching and RFID wireless management capabilities can be added rapidly to further raise manufacturing efficiency.

www.appliedmaterials.com/products/smartfactory_2.html

France's CNRS orders Obducat nanoimprint lithography system

Obducat AB of Malmö, Sweden, which supplies systems based on nano-imprint lithography (NIL) and electron-beam lithography, says that it has received an order for an NIL tool from France's Centre National de la Recherche Scientific (CNRS) in Grenoble.

The Eitre system will be installed in the Plateforme Technologique Amont (PTA) cleanroom inside CNRS' MINATEC campus (claimed to be Europe's largest innovation centre for micro- and nanotechnology).

Obducat says that the flexible and easy-to-use system will be used in the PTA to offer equipment for research in nanoelectronics, magnetism, spintronic and photonics at MINATEC.

"The renowned research community at MINATEC will now have access to our NIL technology," says Obducat's CEO Lars Tilly.

www.obducat.com
www.minatec.com

Kyma launches AlN-on-silicon and GaN-on-silicon templates

Kyma Technologies Inc of Raleigh, NC, USA, which provides crystalline gallium nitride and aluminum nitride materials and related products and services, has launched two new nitride template product lines.

Kyma says that its 2″-, 3″- and 4″-diameter AlN-on-silicon templates are crack-free and low-bow and consist of a thin (up to 200nm) layer of crystalline AlN deposited on a Si(111) substrate. The highly oriented sub-grain structure and smoothness (<1nm RMS) of the crystalline AlN layer provides an excellent epi-ready nucleation surface for the deposition of GaN-based device layers, claims the firm.

Kyma says that its 2″-, 3″- and 4″-diameter GaN-on-silicon templates are crack-free and low-bow and consist of a thin (up to 500nm), smooth (<1nm RMS) layer of GaN deposited on top of a Kyma AlN-on-Si(111) template. The GaN surface is epi-ready for epitaxial growth of additional GaN and GaN-based device layers such as LEDs, field-effect transistors (FETs), and Schottky diodes.

"Customers have been asking us to develop GaN and AlN template products based on Si substrates," says technical sales engineer Tamara Stephenson, who adds that the firm is beginning to accept orders for the new products.

"The market pull for Kyma's template products is strong, especially for these GaN- and AlN-on-Si templates," says Dr Ed Preble, chief operating officer & VP business development. "Important goals for us are to continuously improve and augment our growing portfolio of advanced crystalline III-N substrates according to the expanding needs of the market."

Kyma aims to offer larger-diameter templates and to also increase the GaN thickness

In the future, Kyma aims to offer larger-diameter templates and to increase the GaN thickness further in order to provide lower defect densities and higher thermal conductivity.

www.kymatech.com

Ostendo and TDI launch semi-polar GaN wafers for LEDs and lasers

Technologies and Devices International Inc (TDI), part of the UK's Oxford Instruments Group, has announced the availability of a semi-polar ($1\bar{1}22$) GaN layer on sapphire substrate wafers using its proprietary hydride vapor phase epitaxy (HVPE) technology with the proprietary design of Ostendo Technologies Inc of Carlsbad, CA, USA, which develops solid-state lighting (SSL) based display technologies and products for commercial and consumer markets.

The joint development provides high-brightness light-emitting diode (HB-LED) and laser diode developers with the opportunity to increase optical efficiency significantly compared with structures grown on c-plane GaN substrates, the firms claim.

TDI's new semi-polar GaN wafer.

www.oxford-instruments.com
www.ostendo.com

Sharp to start mass producing blue LEDs in second plant, boosting capacity to 5bn chips

Japan's Sharp Corp is to start mass producing blue LED chips in Fukuyama City, Hiroshima Prefecture by the end of 2010. Capital investment in the plant is about ¥15bn (about $164m).

The firm cites the growth in demand for LED backlights for LCD TVs and LED lighting fixtures driving the rapid increase in demand for blue LED chips.

Just this January, Sharp began blue LED chip production at its Mihara Plant in Mihara City, Hiroshima Prefecture. But to meet demand in the mid to long term, Sharp has since decided to also start production at the Fukuyama Plant and to expand materials procurement. This will boost Sharp's total annual production capacity of blue LED chips to about 5 billion units in fiscal 2011.

Sharp says that its blue LED chip production business in Fukuyama has been adopted as a project under the 'Fiscal 2009 subsidy scheme for promoting the location of low-carbon industry and creating employment' run by the Japanese Ministry of Economy, Trade and Industry.

www.sharp-world.com

IN BRIEF

Nichia settles Jiawei lawsuit in US

Japanese LED maker Nichia Corp has resolved its differences with the defendants of a lawsuit that it had filed last November in the US District Court for the Eastern District of Texas against China's Shenzhen Jiawei Industries Co Ltd, Hong Kong's Jiawei Technology (HK) Ltd and Canada's Jiawei North America Inc.

Nichia claimed that certain white LED-application products marketed by the firms contained white LEDs purchased from MLS Electronics Co Ltd of Zhongshan, China that infringed three of its patents covering white LEDs (US Patents. 5,998,925, 7,026,756 and 7,531,960) as well as a patent covering LED chips (US Patent 6,870,191). In the lawsuit, Nichia sought damages and an injunction against further infringement.

Now, under the settlement, Jiawei has agreed to pay part of Nichia's legal fees and to also enter into a business arrangement.

Nichia comments that it will continue to seek to protect its patents and other intellectual property rights and takes actions against infringers in any country where appropriate and necessary.

www.nichia.co.jp/en

Future Lighting Solutions adds royalty-free eligibility mark to Lumileds-based light engines

Future Lighting Solutions has announced an expanded relationship with Royal Philips Electronics under which the firms will offer a broad range of LED lighting component solutions and services to assist OEM customers and integrators in developing finished solid-state lighting (SSL) products.

A notable aspect of the new arrangement is the opportunity for customers to leverage certain specifically marked LED light engines within Future's simpleLED program against Philips' LED-based licensing program to help qualify their licensed luminaires for a 0% royalty payment (potentially eliminating a 3–5% royalty). These specially marked LED light engines, using Philips Lumileds LUXEON LEDs, will incorporate a readily identifiable clover-shaped symbol belonging to Philips.

The arrangement — furthering Future's 10-year exclusive LED distribution relationship with Philips Lumileds — is designed to simplify LED luminaire development and accelerate time to market.

As previously announced, the arrangement enables LED lighting customers to acquire Philips' LED light engine modules, driver modules and lighting controls, as well as to leverage Future's SSL development tools and engineering resources in tandem with Philips' products to accelerate time-to-market.

"This new collaboration between Future Lighting Solutions and Philips, including the opportunity for licensees of Philips' LED-based license program to utilize the clover-marked light engines, advances our mission of accelerating the adoption of solid-state lighting," says Gerry Duggan, executive VP of Future Lighting Solutions' parent company Future Electronics. "Our enhanced portfolio offering comprised of Philips light engines modules, drivers and controls will also assist our customers in accelerating time to market."

The announcements also complement Future's simpleLED light engine program. Eliminating months of sourcing, design and engineering work, the program offers pre-assembled light engines in 12 off-the-shelf form factors with a choice of LED count, color temperature, board layout and more than 600 customization options, says the firm.

Future exhibited light engines as well as the new Philips CLOVER mark at Lightfair International 2010 in Las Vegas, NV, USA (12–14 May).

www.futurelightingsolutions.com

Seoul Semiconductor launches new Acriche and Z-Power LEDs

At Lightfair International 2010 in Las Vegas, NV, USA (12–15 May), South Korean LED maker Seoul Semiconductor launched several new products.

The new Acriche A6 (1W) and A7 (4W) series cool-white LEDs are much smaller than existing Acriche lamps and — with luminous efficacy of 90ml/W — can be used in a variety of general lighting fixtures, including streetlights. For example, the A7, at 8mm x 8mm, offers space-saving versatility over existing 18mm x 12mm Acriche products.

Seoul Semiconductor claims that Acriche is the first mass-production AC-driven LED and that, because it does not require a converter, it is less expensive to manufacture end-products and lasts longer than other LED light sources whose lifetime may be limited by a power converter.

Also launched were three next-generation products in Acriche's Z-Power LED series:

- Z5 offers a high color rendering index (CRI) of 90 and a compact ceramic design;
- Z6 delivers full color options for general lighting applications as well as decorative and architectural lighting uses; and
- Z7 is a high-efficiency LED product containing four individually addressable high-power die.

"The global market for LEDs now exceeds $5bn annually, and continues to increase at a rapid pace," says North American marketing director Doug Hardman.

"Lightfair is a good opportunity for Seoul Semiconductor to actively demonstrate its new technologies to the major lighting companies and the media of the world, following 'Light + Building' held in Frankfurt in April," says senior VP S.M. Lee.

Seoul Semiconductor began producing an Acriche lamp with luminous efficacy of 100lm/W in Q1/2010, and has developed a 150lm/W lamp for production in late 2010.

www.acriche.com

Excelpoint to represent Seoul Semiconductor in Asia, including China and India

Seoul Semiconductor has signed a sales agreement with Singapore-based Excelpoint Technology Ltd, a total-solutions provider of components, engineering designs and supply chain services to electronics manufacturers. Excelpoint will represent Seoul Semiconductor's products, including its ultra-small high-efficiency LED products and Acriche (the first AC-driven LED). With subsidiaries in 20 countries including Malaysia, Thailand, Vietnam, China, Korea, the Philippines and Austria, Excelpoint has been given the right to represent Seoul Semiconductor in Asian countries including China and India, and is expected to be a major factor in Seoul Semiconductor increasing its presence in the Asian market.

"The ecosystem based on LED lighting was one of the major considerations that led to confidence in the agreement with Excelpoint," says Seoul Semiconductor's VP of sales & marketing Yi Sang Min, who is "impressed by the competitive advantage, strong business foundation, specialist lighting design and environmentally friendly systems of Excelpoint".

Excelpoint's chairman & group CEO Albert Phuay believes that Seoul Semiconductor's technical capabilities and strong market position as well as its array of products including the Acriche AC LED work well with Excelpoint's blueprint for the solid-state lighting business.

www.excelpoint.com

IN BRIEF

DOE issues Round 7 Core Technology Research and Product Development SSL funding opportunities

The US Department of Energy (DOE) has issued two Funding Opportunity Announcements (FOAs) seeking applications for projects to advance research, development, and market adoption of solid-state lighting (SSL). This seventh round of funding is directed toward two existing DOE SSL R program areas for Core Technology Research and Product Development:

- Core technology projects focus on applied research for technology development, with particular emphasis on meeting efficiency, performance, and cost targets. Selected projects will fill technology gaps or provide enabling knowledge or data.
- Product development projects focus on using the knowledge gained from basic or applied research to develop or improve commercially viable materials, devices, or systems. Selected projects will develop targeted market applications with fully defined price, efficacy, and other performance parameters necessary for success of the proposed product.

Potential applicants should note changes to the funding opportunity eligibility requirements. Under the new requirements, all types of domestic entities — including federal research centers and national laboratories — are eligible to apply. The DOE will no longer issue the SSL Research Call for DOE/Federal Laboratories. Another key change to the eligibility requirements allows foreign companies to apply as part of a project team.

www.ssl.energy.gov

IN BRIEF

Jiangsu Canyang aims to be top-5 LED chipmaker

China's Jiangsu Canyang Corp, an affiliate of Taiwan-based LED chipmaker Formosa Epitaxy (FOREPI), aims to become a global top-five LED chipmaker in 3-5 years, according to a report in Digitimes.

Jiangsu Canyang is scheduled to start production in July and plans to install 25 MOCVD reactors in 2010 and 25 more in 2011.

Monthly capacity is targeted to be 80 million LEDs by the end of 2010 and 125 million in Q1/2011, says FOREPI's chairman Chien Fen-Ren.

Chien comments that FOREPI is optimistic about China's LED lighting market and, in order to be close to its customers, it decided to establish an LED manufacturing joint venture with its downstream customers.

FOREPI is the largest shareholder in Jiangsu Canyang, with a 40% stake. Taiwan-based LCD TV maker Amtran Technology and Korea-based LCD panel maker LG Display (LGD) each has a 15% stake, while Taiwan-based LED packaging house Unity Opto Technology has about 10%.

Jiangsu Canyang has initial paid-in capital of US$60m, and this should rise to US$120m in second-half 2010, says Chien.

Chien expects the current shortage of LEDs to continue until the end of 2010, as chipmakers have been able to meet less than half of the orders. Demand for LEDs — excluding double ordering — is double the LED chipmaking sector's total capacity currently, he adds.

Jiangsu Canyang's capacity is already fully booked by clients, and the firm expects to make a profit in 2010 on revenue of NT$400–500m (US$12.7–15.9m), Chien says.

www.forepi.com.tw
www.digitimes.com

Epistar expands by taking 48% stake in Huga

GaAs foundry WIN to also take stake

Taiwan's biggest LED chipmaker Epistar Inc plans to form a strategic alliance with its second biggest LED chipmaker Huga Optotech Inc by becoming its largest shareholder, according to Taiwan-based publication Digitimes. For January–April 2010, Epistar's revenues totaled NT$5.68bn (up 89% on a year ago) while Huga's were NT$1.41bn (up 21%).

In late May, Epistar's board of directors approved a plan to issue 78 million new shares in exchange for 184.08 million Huga shares (i.e. one Epistar share for 2.36 Huga shares). Also, on 17 May Huga said that it was issuing 100 million new shares at NT$30 per unit to raise additional paid-in capital, and Epistar is now to subscribe to 44.79 million of the shares (a cash payment of up to NT$1.5bn), according to a filing with the Taiwan Stock Exchange. As a result, Epistar will acquire a total 47.88% stake in Huga for NT$8.6bn (US$268m). The deal is scheduled to close on 19 July.

WIN Semiconductors Corp of Tao Yuan Shien, Taiwan, which is the world's largest pure-play gallium arsenide foundry, is also said to be planning to join the strategic cooperation by taking up new shares being issued by Huga, according to Digitimes (WIN's chairman Dennis Chen already serves as chairman of Huga).

The consolidation is driven by Epistar's aim to boost capacity and efficiency amid booming demand after the rapid adoption of LED backlighting for LCD TVs (by Samsung and other consumer electronics firms), which has been straining LED chip supply.

While Epistar and Huga will maintain their existing operations, they will share resources including joint procurement and development of products for market segmentation, Epistar's chairman Biing-jye Lee is reported as saying in a press conference. Lee said that the alliance is designed to boost the competitiveness of both firms in the global market, according to another report in the Taiwan Economic News.

In 2006, Epistar acquired rival Taiwanese LED chipmakers United Epitaxy Co Ltd and South Epitaxy Corp. Most recently, to gain access to further capacity, in October 2009 Epistar spent NT$722m to acquire a 19.3% stake in Tekcore Co Ltd, which has 28 MOCVD reactors according to investment consultancy Primasia, and this April Epistar paid Formosa Plastics Group NT$839.5m to acquire a 40.75% stake in Na Ya Photonics Inc, which has seven MOCVD reactors.

Epistar, Nan Ya, Tekcore and Huga have a capacity of over 230 reactors. This is expected to rise to 296 by the end of 2010

Collectively, Epistar, Nan Ya, Tekcore and Huga (which has 40 reactors) have a capacity of over 230 reactors. This is expected to rise to 296 by the end of 2010, forming a strategic group that will become a top-two player in the blue LED segment worldwide, Lee reckons. Compared to international rivals, Korean LED makers have been expanding capacity rapidly, with Samsung and LG Innotek planning to have a total of 300 MOCVD reactors by the end of 2010, notes Primasia.

www.primasia.com
www.epistar.com.tw
www.hugaopto.com.tw
www.digitimes.com
http://news.cens.com

Tekcore to raise $47m to grow from 28 to 46 MOCVD reactors by end 2010

Chipmaker to expand from 45,000 to 80,000 2" epiwafers per month

The board of directors of Taiwan-based LED chipmaker Tekcore has decided to issue 50 million new shares worth NT$1.5bn (US$47.4m) to raise funds for equipment purchases, reports Digitimes.

Tekcore's two shareholders, Epistar and Everlight Electronics, are expected to increase their stakes in the firm (from 19.3% and 9.9% currently, respectively) and to take seats on the board.

Tekcore says that it will continue to expand its LED production capacity and start building a new plant in June, for completion by the end of 2010, adding that the new plant will start contributing to revenue in 2011.

With the shortage of high-brightness (HB) LED chips on the market, Tekcore's LED production has been running at full utilization. The firm hence plans to increase its number of MOCVD reactors from 28 now to 38 at the end of June, 43 by the end of September, and 46 by the end of 2010. Correspondingly, its monthly capacity of 2" GaN epiwafers (blue, green) will rise from 45,000 units now to 80,000 at the end of the year, while 3" GaAs epiwafers (red, yellow) will remain at 8000 units, says president Jonathan Lu.

Regarding the recent price hikes amid the shortage of sapphire substrates, Tekcore notes that the shortage is mainly for 2" epiwafers, but it will focus more on 4" epiwafers (which should reach 50% of the firm's total production in 2010).

Tekcore notes that the shortage is mainly for 2" epiwafers, but it will focus more on 4" epiwafers (which should reach 50% of the firm's total production in 2010)

Tekcore says that there is no shortage of sapphire substrates for 4" epiwafers, as not too many LED chipmakers are producing on 4" (a segment that has a higher technological threshold). The firm says it will sign long-term cooperation agreements with its suppliers for this segment.

Tekcore says that backlighting products should account for at least 40% of its total revenues in 2010, mainly for TVs. Lighting products will account for 25%, plus 15% from the handset segment, 10% from the billboard segment, and 5% each from the decorative light (e.g. Christmas lights) and automobile segments, the firm adds.

Due to the shortage of LEDs, average selling process (ASPs) are expected to remain stable in second-half 2010, and Tekcore expects its revenue to reach over NT$600m in the second quarter, over NT$700m in Q3, and almost NT$800m in Q4. Revenue for full-year 2010 should reach NT$2.6bn, up 110% on 2009, Tekcore reckons.

www.tekcore.com.tw
www.digitimes.com

LED prices likely to rise 5-10%, say Taiwanese chipmakers

Demand for high-end LEDs driven by upgrading of TV backlighting

LED backlight products may see their prices increase by 5–10% as both upstream LED chip and epitaxial wafer prices will soon rise due to strong market demand, reports Digitimes according to sources from LED packaging houses.

Some Taiwanese LED chipmakers have noted that, for rush orders, prices may rise by as much as 10%. For example, citing the rising cost of sapphire substrates as a reason, Genesis Photonics Inc of Southern Taiwan Science-Base Industrial Park (TNSIP) raised pricing of its green LED epiwafers in May, while Huga Optotech Inc plans to raise prices by 5–10%. Tekcore Co Ltd and Formosa Epitaxy Inc (FOREPI) are also increasing their prices, while Epistar Corp is considering the possibility of an increase, but has yet to make a decision, the sources note.

The LED-backlit LCD TV market is growing rapidly, with some vendors expecting LED models to account for 20–25% of the total LCD TV market in 2010.

Some market observers are less optimistic, estimating a 15% market share for LED-backlit models in 2010. They have also warned of the possibility of oversupply of LEDs after chipmakers ramp up their new capacities in third-quarter 2010, reports Digitimes.

However, LED chipmakers say that an oversupply may curb price increases and help to ease sapphire substrate shortages.

The chipmakers also say that average selling prices (ASPs) of entry-level to mid-range LEDs may drop as manufacturers are mostly increasing their high-end LED production to meet clients' needs to upgrade the specifications of their LED-backlit TVs.

www.digitimes.com

Philips unveils first LED replacement for 60W light bulb

At May's Lightfair International 2010 tradeshow in Las Vegas, Royal Philips Electronics unveiled its 12W EnduraLED light bulb, which is claimed to be the first LED replacement for a 60W light bulb (the most commonly used incandescent bulb), delivering up to 80% energy savings and lasting 25 times longer.

The development of an LED equivalent to the 60W has been recognized by organizations including the US Department of Energy (DoE), which created the L-prize competition to spur development. Philips' entry was the first (and to date the only) submission for the L-Prize, which was used as the basis for the 12W EnduraLED. Exceeding the Energy Star specifications for a 60W bulb, the EnduraLED uses only 12W of power while delivering what is claimed to be an industry benchmark of 806 lumens.

Every year more than 425 million 60W incandescent light bulbs are sold in the USA (about 50% of the domestic incandescent light bulb market). Philips reckons that its LED replacement could save 32.6 terawatt-hours of electricity in one year, enough to power the lights of 16.7 million US households (14.4% of the households in the US), as well as eliminating the generation of 5.3 million metric tons of carbon emissions annually.

Philips says that the new lamp uses an innovative design and remote phosphor technology to deliver the same soft white light and shape that consumers are familiar with in an incandescent. The EnduraLED works with standard dimmers, simplifying use and providing an effective, low-energy solution for home lighting. For business users, particularly those in the hospitality sector, the new lamp can provide instant plug-in savings, through extended life and reduced energy and maintenance costs, compared with traditional bulbs, says Philips.

Expanding on the EnduraLED family of replacement lighting solutions, the new lamp has a rated life of 25,000 hours, compared with about 1000 hours for a standard 60W incandescent bulb. So, over the course of the LED's life, replacing a 60W standard bulb could save $120 per lamp. The new EnduraLED lamp will be available in the US in fourth-quarter 2010, well ahead of US legislation requiring the use of more energy-efficient lighting from 2012.

"We have been able to show people around the world that LED lighting can deliver energy efficiency and the warm-white light people desire for their homes, without compromise to quality," claims Philips Lighting's CEO Rudy Provoost.

To accelerate the EnduraLED's development and introduction to the market, Philips researchers in The Netherlands created a new remote phosphorous technology and light distribution design; LUXEON LEDs were integrated from Philips Lumileds of San Jose, CA; and electronics for the bulb were built at Philips Color Kinetics in Burlington, MA and Philips Lighting Electronics in Rosemont, IL. The bulbs were then sent to the Philips Quality Assurance team in Shanghai to be rigorously tested, ensuring that they meet quality and safety standards.

www.philips.com

Lumileds provides analysis of LED array lifetime performance

LED maker Philips Lumileds of San Jose, CA, USA has published a new white paper 'Evaluating the Lifetime Behavior of LED Systems' that gives a methodology for evaluating how arrays of LEDs behave over time and how LED luminaire manufacturers can make business decisions such as warranty commitments. Lumileds says that the paper goes beyond simple lumen maintenance data (which describes how a single LED behaves) and addresses the more common lighting system which uses multiple LEDs in a wide variety of use conditions.

An LED luminaire's usable life is determined by a manufacturer's determination of expected lumen maintenance and by the actual usable life of the many components included in the system, says Lumileds. Each component must be analyzed independently to provide an accurate assessment.

Lumileds has collected and analyzed over 700 million hours of LUXEON LED reliability test data. Using statistical analysis and models that have long been used and proven in the automotive and electronics industries, the white paper describes how a luminaire maker can define the 'lifetime' of the LEDs in a system and understand how to scale from the behavior of one LED to many LEDs. Lumileds says that this is an essential process for anyone developing product warranties, and results in a clear understanding of the 'lifetime' of the LEDs.

"Luminaire manufacturers no longer have to rely on the lumen maintenance behavior of a single LED as a proxy for the lifetime," says Rudi Hechfellner, director of applications. "With these new methods, companies can now balance business objectives with engineering realities to provide products and warranties that the market wants and can have confidence in."

The paper covers the following:

- the 'failure' modes of power LEDs, and their impacts on luminaire reliability;
- long-term LED performance testing: the foundation of reliability data;
- how reliability models are derived;
- what the models tell lighting manufacturers about LED behavior over time; and
- predicting LED array 'lifetime'.

www.philipslumileds.com

Lumileds 2700K and 3000K Rebel LEDs shrink white binning space and improve efficacy stability

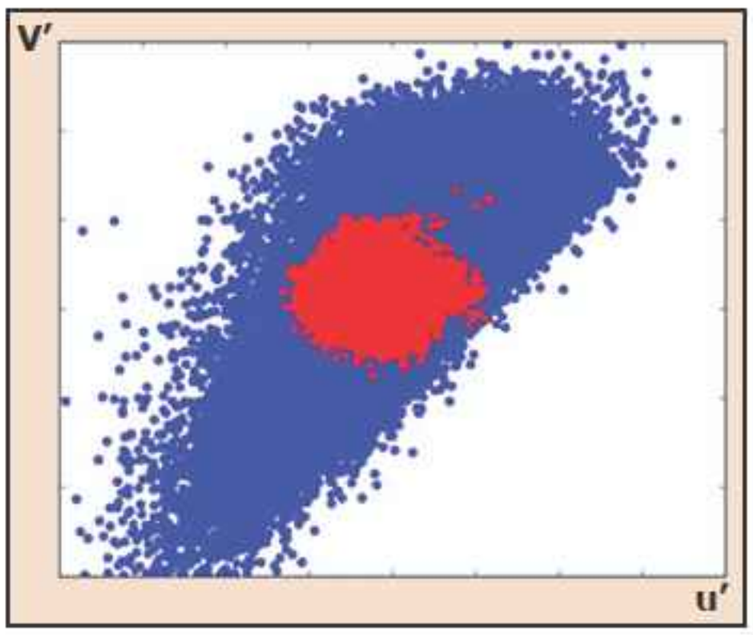
LED maker Philips Lumileds of San Jose, CA, USA has expanded its portfolio for indoor illumination applications in hotels, shops, restaurants, and homes by launching two new LUXEON Rebel LEDs that use the firm's latest thin-film flip chip (TFFC) and proprietary Lumiramic phosphor technologies for correlated color temperatures (CCTs) of 2700K and 3000K.

At the high operating temperatures found in applications like recessed lamps, the new emitters set what are claimed to be efficacy benchmarks: 76lm/w typical for the LXM8-PW27 and 81lm/W typical (and up to 95lm/W at 350mA and 3000K CCT) for the LXM8-PW30. In addition, they provide consistent efficacy across the typical operating temperature range.

Also, the implementation of Lumiramic phosphor technology allows what is claimed to be the industry's smallest and most consistent white binning space (shrinking white color distribution by a factor of four, advancing the firm's drive to free users from white color binning), as well as providing superior color uniformity and raising the standard for quality of light.

For a decade, white binning has complicated luminaire design, says Lumileds. But, with more than 80% of the new emitter's production falling within a 3 MacAdam ellipse area in the ANSI bin space, luminaire design is simplified, unit-to-unit consistency is realised, and the supply chain is more certain and reliable, claims the firm.

"We continue to lead the LED industry transition from semiconductor manufacturer to lighting industry partner," says Steve Barlow, executive VP of sales & marketing. The lighting industry wants an end to binning,



Red indicates u′,v′ reduced color distribution of LUXEON Rebel LEDs using Lumiramic phosphor technology. Blue is a standard distribution of white LEDs.

confidence in application performance, and a certain and dependable supply chain, he adds. "These are elements that we will continue to address with innovation and solutions that improve application performance."

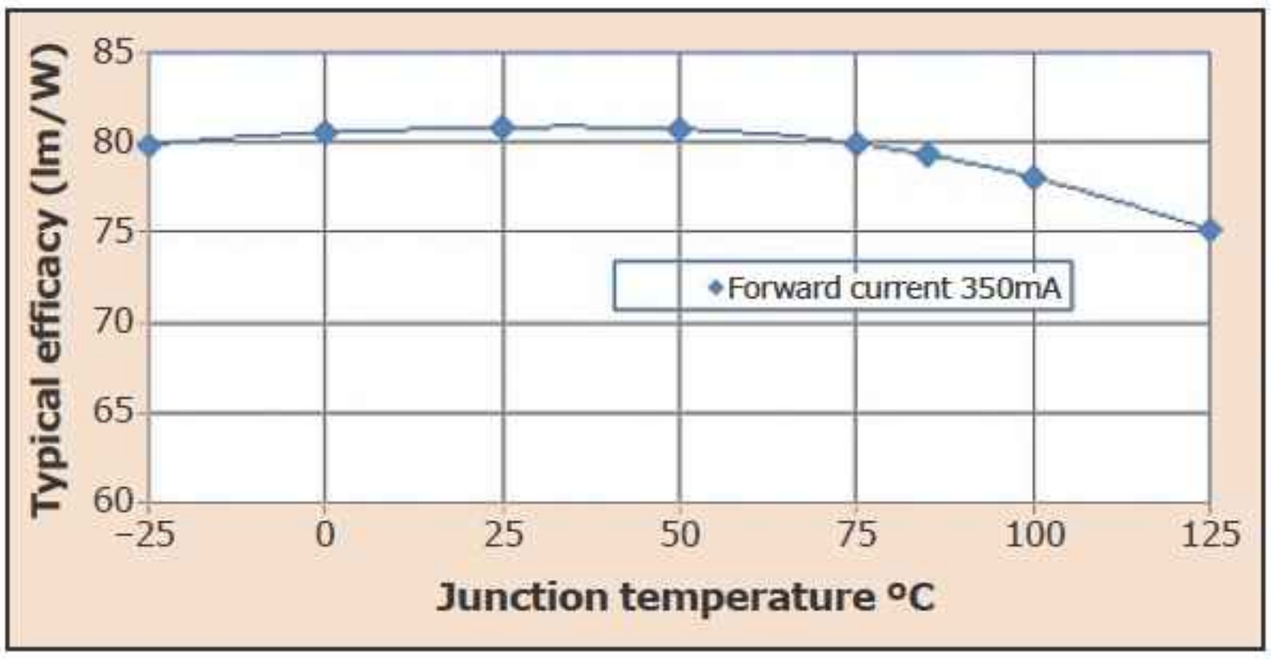
Stable efficacy at virtually all temperatures and superior efficacy at actual operating conditions are features of the new LUXEON Rebel emitters. While LEDs are typically tested at 25°C, in applications like down-lights and retrofit lamps the internal temperature can be much higher (up to 80–100°C). While most LEDs would have significant light output and efficacy losses at these temperatures, the new LUXEON Rebel emitters maintain more than 90% of their light and more than 95% of their datasheet efficacy, even at junction temperature of 85°C, it is reckoned.

Also, through the application of Lumiramic phosphor plates, the color rendering index is also improved and is now being specified with a CRI of 85 (typical) and 80 (minimum) for both the 2700K and 3000K CCT emitters. Illumination of retail goods, food products and skin tones are all very good at this level, it is claimed.

Most LEDs display inconsistent color off the center viewing axis because the blue photons pass through varying thicknesses of phosphor before exiting the LED and therefore have different color qualities. This is particularly problematic in linear or wall wash applications that are prevalent in the hospitality industry. To provide dependable, consistent color and tint at a wide range of viewing angles, Lumileds has therefore also implemented what is claimed to be a unique process in conjunction with its Lumiramic phosphor that allows decreased variance in color over angle. This not only contributes to overall color quality, it delivers consistent, repeatable results, claims Lumileds, so that lighting designers can confidently design for the most demanding applications. The new LUXEON Rebels are the only power LEDs with specified color over angle performance, the firm adds.

The new 2700K and 3000K CCT LUXEON Rebel emitters are available in evaluation and prototyping quantities directly from distributor Future Lighting Solutions' regional marketing centers. High-volume production quantities will be available in August.

www.philipslumileds.com



Stable efficacy at virtually all temperatures and efficacy at actual operating conditions of new LUXEON Rebel emitters.

Durham becomes third city in North Carolina and Bremen the first German city to join LED City initiative

Following Raleigh and Chapel Hill, the City of Durham has become the third city in North Carolina to join the LED City initiative, an international community of government and industry parties initiated by Durham-based LED chip, lamp and lighting fixture maker Cree Inc in December 2006 to evaluate, deploy and promote LED lighting across municipal infrastructure, with the aim of saving energy, protecting the environment, reducing maintenance costs, and providing better light quality for improved visibility and safety.

LED lighting was selected as part of the city's overall effort to reduce greenhouse gas emissions. "We identified several City projects where we could incorporate LED lighting technologies into the building upgrades, and we felt these parking garages were a perfect fit," says Joel Reitzer, director of the city's Department of General Services. "Using LED lighting is not only going to save us in operating costs, but it's also going to prevent greenhouse gas emissions from power generation, getting us closer to meeting our 50% reduction goal by 2030."

"Durham has been Cree's home for more than 20 years, and we're thrilled our hometown is joining municipalities around the world in achieving significant energy and maintenance cost savings through the use of energy-efficient LED lighting," says Cree LED Lighting's president Neal Hunter, who co-founded Cree in 1987 as a spin-off from North Carolina State University.

Durham is currently retrofitting three City-owned parking garages by this fall with 573 new LED lighting fixtures incorporating Cree products worth nearly $1m.

The Corcoran Parking Garage Repairs Project (which began last September and should be completed this June) is using 2005 bond funds to address deferred maintenance repairs as well as upgrades that include an LED lighting retrofit involving changing about 200 metal halide fixtures with LED fixtures that will use one-fifth of the energy and have a lifespan of 100,000 hours. The repairs budget of $2.5m includes about $160,000 allocated for the LED fixtures.

Street in Bremen before (left) and after (right) replacing compact fluorescent lights with LED fixtures.

A second project (with a budget of $8.8m from 2005 bond funds and installment sales) involves the renovation of Centre Garage and includes about $259,000 for buying and installing 373 new LED lighting fixtures to retrofit all original metal halide fixtures. Due to be completed this June, the project stems from a public/private partnership agreement between the City of Durham and Craig Davis Properties.

Thirdly, the Church Street Parking Garage Lighting LED Upgrade Project is being implemented as part of the Energy-Efficiency Conservation Block Grant (EECBG), which was submitted by the Durham City-County Sustainability Office and uses funds provided by the federal government as part of the American Recovery and Reinvestment Act (ARRA). The $508,000 project includes the design (currently ongoing) and installation (to be completed this fall) of an LED lighting system that improves lighting while reducing energy costs.

In addition, at the end of April, Bremen became the first German city to join the LED City program. As the second largest city in Northern Germany, Bremen has systematically introduced energy-saving technologies during the past four years and has significantly reduced energy consumption in public lighting.

Recently, Bremen started a pilot project to explore the opportunities and examine the benefits of LED lighting. The Indal LED streetlights, featuring Cree XLamp LEDs, light up a busy stretch of road in the city center. The test is aimed to allow Bremen to gather experience of the operation, energy-saving benefits and operating costs of switching to LED lighting.

"On our test road we replaced the existing compact fluorescent lights with LED fixtures," says Holger Janssen, division manager at swb Beleuchtung GmbH. "Although we can expect savings of 34% from current LED technology, in this project we are really interested in the color and quality of the LED lights and look forward to the feedback from citizens."

"With the LED City program we provide cities and municipalities with a platform where they can share insights and learn from each other's experience, so that they don't all have to start from scratch when looking for ways to save energy and protect the environment," says Deb Lovig, Cree's LED programs manager.

Durham and Bremen join existing LED City program members Raleigh and Chapel Hill, NC; Ann Arbor, MI; Austin and Fairview, TX; Anchorage and Valdez, AK; Indian Wells, CA; Danville, VI; and Boston, MA (all in the USA); Toronto and Welland in Canada; Tianjin and Huizhou in China; Gwangju in South Korea; and Torraca and Apecchio in Italy.

www.ledcity.org

LED University program gains universities of Central Florida, Shady Grove and Western Ontario

LED chip, lamp and lighting fixture maker Cree Inc of Durham, NC, USA says that the University of Central Florida (UCF), the Universities at Shady Grove (USG), and Canada's University of Western Ontario have joined its LED University program.

Launched in April 2008, the LED University initiative is an international community of universities working to evaluate, deploy and promote the adoption of energy-efficient LEDs across their campus infrastructures (in areas such as offices, student housing, parking garages, walkways and streets). The aim is to save energy, protect the environment, reduce maintenance costs, and provide better light quality for improved visibility and safety.

By installing LED lighting in its student union, UCF estimates that it can save at least $10,000 annually in energy and maintenance costs in its Key West Ballroom simply by replacing recessed downlights and troffers with Cree LR6 LED downlights and LR24 LED troffers. The new LED fixtures consume about 85% less energy than the old fixtures, cutting energy consumption from more than 10,000W to less than 1500W. The traditional T8 fluorescent light fixtures in the student government offices were also replaced with 17 LED fixtures.

"When you consider the Key West ballroom lights are on for 16–18 hours each day, the payback is less than two years," says Rick Falco, the associate director of UCF's Student Union. "The LED lighting also has better light quality — it's easier on the eyes and it's dimmable, which gives us greater flexibility for the wide range of events held in the ballroom," he adds.

"I commend the UCF Student Government Association for taking the lead in bringing LED lighting to the student union, showing the impact students can have in driving green initiatives on their campuses," comments Cree's LED programs manager Deb Lovig. "In addition to becoming a greener campus, UCF can reap the benefits of energy and maintenance savings for years to come."

LED lighting in parking garage at the Universities at Shady Grove.

The Universities at Shady Grove recently opened its first LED-lit parking garage, featuring more than 200 LED fixtures in the new 193,000ft^2 structure. "We were so pleased with the results of this initial LED lighting deployment we have subsequently changed the lighting in Parking Lot #2 on the south side of campus—where 23 LED fixtures replaced 31 high-pressure sodium and metal halide fixtures," says Karen Mitchell, director of USG's administration and finance.

LED retrofits are showing strong returns on investments, ranging from a few months to an average of just four years

Located on the north side of USG's campus, the garage features LED lighting applications throughout all decks, including in the elevator lobbies, stairwells, the pedestrian walkway and the outside driveway. USG anticipates savings of 189,000kW-hrs per year by using LEDs as opposed to traditional lighting sources. The garage also includes daylight sensors to reduce power requirements and light pollution. Additionally, a stairwell canopy is equipped with LED lights powered by a solar panel.

As the first university in Canada to join the LED University program, the University of Western Ontario's initial LED lighting installations, combined with planned installations throughout 2010, are predicted to save Western more than $750,000 in energy and maintenance savings over ten years.

"We've adopted LED lighting in many key areas around campus and have experienced improved light levels and a reduction in energy consumption," says Roy Langille, associate vice-president, Physical Plant and Capital Planning Services (PPD) at Western. "Maintenance savings are another driving force behind these installations, and most of the LED retrofits are showing strong returns on investments, ranging from a few months to an average of just four years," he adds.

Tim Munro, consultant at LED Lighting Gallery, suggests that the lighting has an added benefit of safety: "By measuring light levels before and after, and using proven LED fixtures, we are able to deliver higher quality light — making areas feel safer for students, faculty and visitors — while also saving money for the university." With more than 100 LED lighting installations to date, Western is already seeing more than 70–90% energy savings.

UCF, USG and Western Ontario join Cree LED University's inaugural participant North Carolina State University as well as University of California at Santa Barbara, the University of Arkansas, Marquette University, the University of Notre Dame, University of California, Davis, the University of Miami, the University of Alaska at Anchorage, Arizona State University, Madison Area Technical College, Joliet Junior College, Alfred University and Milwaukee Area Technical College in the USA, as well as Tianjin Polytechnic University in China.

hwww.leduniversity.org

Cree LED luminaire reaches 100lm/W for indoor lighting

Cree Inc has announced a new LED-based troffer that delivers more than 100 lumens per Watt fixture efficacy, which is claimed to be the first indoor fixture known to deliver this level of performance.

Shown at Lightfair 2010 in Las Vegas, the LR24HE is 30% more efficient than the best 2ft x 2ft fluorescent troffers and 15% more efficient than the best 2ft x 4ft fluorescent troffers, claims Cree.

Designed to last at least 50,000 hours, the LR24HE uses the firm's TrueWhite technology to deliver 3200 lumens at 3500K with a 90 CRI (color rendering index).

"By using the LR24HE, which is the most efficient product for general illumination, lighting designers and architects now have the freedom to reintroduce accent and decorative lighting and still meet energy codes or achieve LEED points," says Gary Trott, VP market development, LED Lighting.

The LR24HE is planned for commercial availability in late summer, and will offer Cree's new five-year warranty.

Cree also says that it will reduce the price of its LR24 LED troffer by 15% to reduce upfront cost, as it aims to accelerate the adoption of LED lighting.

www.CreeLEDLighting.com

Higher drive current for Cree's MX-6 lighting-class PLCC LED boosts output by 160%

Cree has announced a higher maximum forward drive current for its XLamp MX-6 LED.

The MX-6's PLCC package is optimized for indoor lighting where enhanced light uniformity and LED-to-LED color consistency is key. At 1A of current, MX-6 LEDs provide up to 300 lumens in cool white (6500K) and 245 lumens in warm white (3000K).

At May's Lightfair 2010 event, io Lighting LLC of Buffalo Grove, IL (the LED-based subsidiary of Cooper Lighting Inc) relaunched its Raye fixture, which is now based on MX-6 LEDs. "The MX-6 LED has dramatically reduced the power consumption for this cove and wall slot fixture, giving us superior luminaire efficacy," says io's founder & general manager Ann Reo. Raye is now a retrofit option for existing fluorescent cove lighting applications since it delivers the same luminous intensity at 25% less power, she adds.

"By qualifying our XLamp MX-6 LEDs at higher drive currents we are giving customers additional design flexibility," says Paul Thieken, Cree's director of marketing, LED Components.

www.iolighting.com

Cree launches directional lamps based on TrueWhite technology

At May's Lightfair 2010 event, Cree launched new directional LED lamps (based on its TrueWhite technology), designed to address one of the largest segments of the directional lamp market.

In response to customer requests, Cree launched a high-performance BR30 retrofit lamp, the LBR-30 (for availability later this summer) to replace incandescent lamps in tracks, commercial and residential recessed downlights. The new lamp delivers 600lm with flood or wide flood distributions, while only consuming 11W.

Cree has also boosted its LRP-38 LED lamp's performance. A narrow beam spotlight with tens of thousands of units installed in offices, retail, grocery stores and museums across North America, the LRP-38 delivers high color quality. The enhanced LRP-38 has been given a 20% boost in performance, and a 30% boost in overall efficacy, enabling replacement of 75W incandescent lamps while consuming 85% less energy. Lumen output is up from 500lm to 600lm, while input power is cut from 12W to 11W.

Cree also showed its new LRP38-1000L, which delivers 1000lm of directional light while consuming only 16W. Availability of the new PAR lamp, in both spot and flood distributions, is expected this fall.

"We continue to extend the availability of Cree TrueWhite Technology into a wider variety of directional lamps," says Mike Fallon, VP sales, LED Lighting. "Since our lamps are designed to last 50,000 hours in open fixtures, end users can reap additional savings by minimized relamping and maintenance."

Cree launches 84lm/W 6-inch LED downlight, doubling CFL efficiency

Cree has launched the TrueWhite-based LR6-DR1000 high-output 6" downlight, yielding 70% more light than the original LR6 and with a 20º shield angle for lighting designs requiring greater brightness control.

Using just 12.5W of input power to deliver 1000lm, fixture efficacy is 84lm/W while consuming half the energy of a typical CFL downlight for the same output. Cree also now offers the LR6-DR650 deep-recess 650lm downlight.

"By broadening our downlight family, we can now address higher ceiling applications, as well as the specific aesthetic and electrical needs of most commercial spaces," says VP of market development Gary Trott.

Record, above-target performance at Cree driven by buoyant lighting market

LED chip, lamp and lighting fixture maker Cree Inc of Durham, NC, USA is celebrating record revenue and net income for its fiscal third-quarter 2010 (ended 28 March). Revenue of $234.1m represents a 78% increase over the $131.1m reported at the same time last year. The generally accepted accounting principles'(GAAP) net income of $44.6m was ten times better than the $4m recorded for fiscal Q3/2009.

"We achieved record revenue and net income again in Q3 due to a combination of strong LED demand and solid execution with our factory ramp," says chairman & CEO Chuck Swoboda. The firm exceeded its revenue targets on the back of strong LED growth, primarily of its XLamp products. In the last quarter, more than half the LED products were for general lighting.

In terms of margins, the company saw much improvement in execution. The backlog going into fiscal Q4 is larger than at the end of the last quarter, despite some movement from a 12-week lead-time to an 8-week target.

Revenue for LED production rose 78% year-on-year to $211.8m, while power and RF products rose 83% to $22.27m. Government contracts contributed $3m to power and RF revenue, but just $0.5m to LED revenue.

The 'very good' execution in the quarter was due to good ramp-up of capacity, and profitability was enhanced due to the cost-leverage enabled by increased volume/scale of production and good yields. Capital expenditure was about $66m in support of recent capacity expansion.

Looking forward to fiscal Q4/2010 (ending 27 June), Cree expects revenue of $255–265m, with net income of $46–49m. These represent year-on-year increases of 72–79% in revenue and about a five-fold improvement in net income.

The company also gave a 'preliminary estimate' for next year's capital expenditure of $250–300m.

In fiscal first-half 2011 (i.e. later this calendar year), Cree plans to begin LED chip/wafer and power device production on its first 150mm line, ramping up in fiscal 2012. In addition, a new back-end facility in China is due to begin work. Pilot production is also due to begin shortly in Cree's new module and lighting solutions businesses.

www.cree.com

Author: Mike Cooke.

Cree sets new 5-year warranty standard for LED fixtures

Cree is extending the warranty on its entire family of fixture products to five years.

"We have almost 20,000 hours of real-world data on products from our early installations nearly 3 years ago, and the performance is rock solid," says Ty Mitchell, VP & general manager, LED Lighting. "Lengthening the warranty lets our customers know that Cree stands behind the long-term performance and reliability of our fixtures."

Cree's fixture portfolio includes the CR6, LR4 and LR6 recessed downlights and the LR24 architectural troffer, all of which are installed in restaurants, offices and commercial spaces across the USA. All recessed downlights are ENERGY STAR qualified for commercial and residential use.

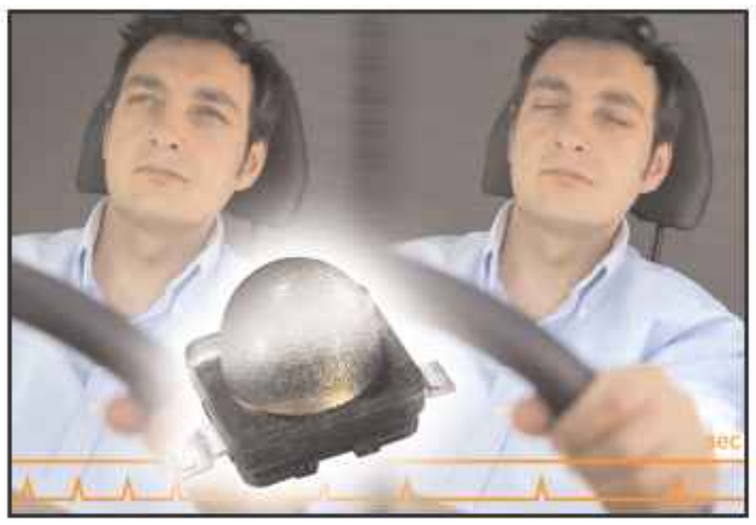
Integrated lens for Osram Opto's IR DRAGON LED boosts radiant intensity by 3.5x

Osram Opto Semiconductors GmbH of Regensburg, Germany has launched the DRAGON SFH 4236 infrared (IR) LED, which has an integrated lens that concentrates the emitted infrared light within a viewing angle of ±20°.

This boosts typical radiant intensity to 650mW/sr at a DC current of 1A, more than three times that of its standard IR DRAGON SFH 4232. The IR DRAGON family consists of the standard version SFH 4232, the stack version SFH 4235 with twice the total radiant flux, and now the new SFH 4236 with integrated lens.

The integrated lens also eliminates the need for a complex, expensive external lens assembly (which previously have been necessary to achieve a narrow beam angle).

"The total height of the new SFH 4236 is about 35% smaller compared to conventional DRAGON solutions with an external lens," points out Harry Feltges, marketing manager Infrared Devices.



Drowsy driver monitoring systems can benefit from the IR DRAGON SFH 4236's high radiant intensity and small dimensions.

With the same small footprint as other IR DRAGON devices (enabling use as a drop-in replacement in existing designs), the new SFH 4236 IR DRAGON is designed for applications with limited board space that require narrow radiation characteristics, says Osram Opto. The SFH 4236 also shows the same electrical parameters as the standard IR DRAGON and is suitable for reflow soldering.

IR DRAGON LEDs emit at a wavelength of 850nm, which is the best compromise between maximum spectral sensitivity for CCD and CMOS cameras and suppressed visibility for the human eye, says Osram Opto. Suitable applications are camera-based vision systems for the industrial and security sector, as well as applications in the automotive sector such as driver and passenger monitoring systems for cars and trucks and blind-spot detection systems.

www.osram-os.com

Osram makes management changes in North American LED business as it creates Solid State Lighting segment at Sylvania

Osram GmbH of Munich, Germany says that it is reinforcing its aim to take a stronger market position in solid-state lighting and LEDs by making a double change in its North American management.

Tom Shottes has assumed responsibility as senior vice president at Osram Sylvania of Danvers, MA, USA for its new Professional Solid State Lighting and Light Management System groups. He will be succeeded as CEO of Osram Opto Semiconductors Inc in Santa Clara, CA by Don Klase. Osram says that the changes emphasize the growing importance of semiconductor lighting technologies for the firm.

In his newly created role, Shottes will be responsible for the development, marketing and sale of professional solid-state lighting (SSL) solutions across North America.

"Shottes is the ideal choice to lead Osram Sylvania's professional SSL business," believes Osram Sylvania president & CEO Rick Leaman.

Shottes (left) and Klase (right).

"Tom's many years of experience in LEDs and deep understanding of the lighting business are a powerful combination," he adds.

Osram says that the changes emphasize the growing importance of semiconductor lighting technologies for the firm

Shottes started his career with Osram Opto Semiconductors in 1998 where, among other positions, he worked in the area of LEDs for automotive lighting. Before becoming president of Osram Opto Semiconductors Inc, he was VP of sales & marketing. Shottes holds a degree in Business Administration from Massachusetts College of Liberal Arts.

Klase has worked in the semiconductor industry for 26 years and has held management positions of increasing responsibility in sales & marketing at Osram Opto Semiconductors Inc. In 1997, he joined Siemens Microelectronics and later transitioned to Osram Opto Semiconductors in 2004. Klase most recently held the post of VP of sales at the Osram subsidiary. He holds degrees from The Pennsylvania State University (electrical engineering technology) and Linfield College (management).

www.sylvania.com

Osram inaugurates its first LED chip fab in Asia

Osram Opto's new chip fab in Penang, Malaysia.

After breaking ground on construction in July 2007, Osram Opto Semiconductors GmbH of Regensburg, Germany has held a formal inauguration ceremony in Penang, Malaysia for its first LED chip fabrication plant in Asia.

The ceremony was attended by CEO Dr Ruediger Mueller, parent firm Osram GmbH's CEO Martin Goetzeler, Penang's Chief Minister Y.A.B. Tuan Lim Guan Eng, and Malaysia's Minister of International Trade and Industry Y.B. Dato' Sri Mustapa Mohamed. Installation work was completed and the test phase concluded at the fab last December, enabling the start of production.

In addition to cost, Mueller highlights the talented and experienced workforce as being in Penang's favor when it came to choosing the site for the new facility. "It was also the long-term partnership with the Malaysian authorities that made it the top choice: after all, we have operated in Penang for over 30 years," he adds. The Malaysian facility in Penang's Bayan Lepas Free Industrial Zone already hosts LED chip packaging, employing about 2600 of Osram Opto Semiconductors' total worldwide workforce of 4400 (as of end-September 2009).

Covering 35,000m^2 and creating about 250 new jobs, the new plant is Osram Opto's second LED chip fab (after Regensburg, which was expanded in 2008), making it the first LED maker with high-volume chip production facilities in both Europe and Asia. It also doubles the firm's chip production capacity. It will produce indium gallium nitride (InGaN) blue, green and white LED chips on 4-inch wafers. Osram says that the new production capacity enables it to respond flexibly to the demand for LEDs at competitive prices, as the market has begun to pick up again steeply.

Analysts forecast a threefold rise in the market for LEDs and organic LEDs (OLEDs) to almost €13bn by 2012. Osram says that these technologies offer small size, long lifetime and high energy efficiency, opening up new applications and markets. Already, 17% of Osram's total revenue comes from solid-state lighting. "In connection with classic technologies, our LED portfolio of products, systems and solutions will raise energy-saving potential for lighting up to 60%," says Goetzeler. "The list of LED applications keeps on expanding: architectural lighting, backlight displays, mobile terminal devices, solid-state lighting, automotive lighting and many more to come," he adds. "We already see projectors being lit up by LEDs, advertising boards being replaced by LED display video walls, and cars illuminating the streets with LED headlights."

www.osram-os.com

Luminus and Almeco demo first single-source LED street light

Luminus Devices Inc of Billerica, MA, USA, which designs and makes high-output PhlatLight (Photonic Lattice) LED solid-state light sources for illumination applications, has announced a partnership with Almeco Group, which makes reflectors for street and industrial lighting, to demonstrate the world's first, single-source LED street light, powered by a single CSM-360 PhlatLight LED in combination with Almeco's novel reflector optic. The result is a single-source LED fixture that looks more like an HID-based street light than the typical pixelated LED fixtures that dominate the current landscape, says Luminus.

The CSM-360 LED has luminous efficiency of more than 100lm/W, color temperatures of 3000–6500K, and L70 lumen maintenance of 60,000 hours. With an emitting area 36 times greater than a 1W LED, a single CSM-360 can reduce design complexity, reduce cost, and increase fixture reliability, the firm claims. Instead of using arrays of LEDs and optics, the single-source street fixture requires just a single optic. Additional cost savings can be realized since the CSM-360 is a chip-on-board LED, which does not require an expensive metal core PCB typically used with LED arrays.

Almeco's low-glare Vega LED98 reflector design, incorporating material with what are claimed to be the highest values of reflectivity across the visible wavelength spectrum, can take the light from the CSM-360 and distribute it onto the street in accordance with industry standards. With a reflectivity of greater than 98%, the LED98 aims to optimize overall fixture efficiency.

"We see the single-source street light concept as an indicator of what is possible in accelerating the adoption of LED technology in the marketplace," says Luminus' president & CEO Keith T. S. Ward. "The single-source solution increases overall fixture reliability by drastically reducing the number of points of failure. It is a perfect lamp replacement option with a large-emitting light source, virtually no glare and has a life expectancy of 60,000 hours, reducing the total cost of ownership... Almeco is assisting Luminus' expansion in more outdoor applications with our innovative big-chip LEDs," Ward adds.

"The partnership with Luminus gives us an ideal opportunity to integrate their big-chip LEDs with our reflectors," says Almeco's CEO Onorato Fiorentini. "Our enhanced selective surface for light sources, particularly for LED optics, enables our development team to work closely with Luminus to generate highly efficient, cost-effective street lights for any municipality around the world."

The Luminus/Almeco street light concept fixture was exhibited at LightFair 2010 in Las Vegas, NV, USA (12–14 May).

www.almecogroup.com

Luminus launches brightest surface-mount LED

At Lightfair 2010 in Las Vegas, Luminus Devices Inc of Billerica, MA, USA launched what it claims is the industry's brightest, high-power, surface-mount (SMT) LED. The firm says that its new SBT-90 white PhlatLight LED is suited to entertainment, display, medical and automotive applications that require an LED package that emits directly into air instead of having an integrated dome lens.

"The SBT-90 contains a single 9mm^2 chip, so the optical brightness can't be matched by tiled arrays of traditional 1-Watt LEDs," says Chuck DeMilo, director of global product marketing for lighting. "The ability to deliver more lumens through their optical architectures in a compact and highly integrated form factor becomes a game changer for our customers as new opportunities emerge to apply LEDs to demanding applications," he adds.

The SBT-90 generates more than 1800 lumens (6500K, 70+CRI) from a small 10mm x 11mm package footprint. Using high-thermal-conductivity ceramic packaging, thermal resistance is just 0.64°C/W. The device has a nominal input power of 10W, but can be operated continuously at drive conditions up to 35W. Due to its low-profile window and direct chip-to-air emission, the SBT-90 is optimized for coupling to proximity optics and optical light engines, maximizing optical throughput while maintaining long life and high reliability. Typical applications include entertainment wash lighting, edge-lit displays, projection systems, fiber-coupled medical lighting, and automotive forward lighting.

Available in an SMT package, the SBT-90 integrates with standard SMT manufacturing processes and equipment. PhlatLight LEDs are mercury-free and provide a lifetime of 60,000 hours with lumen maintenance of greater than 70%. The SBT-90 is available for sampling now, with volume shipments beginning in the third quarter of 2010.

www.luminus.com

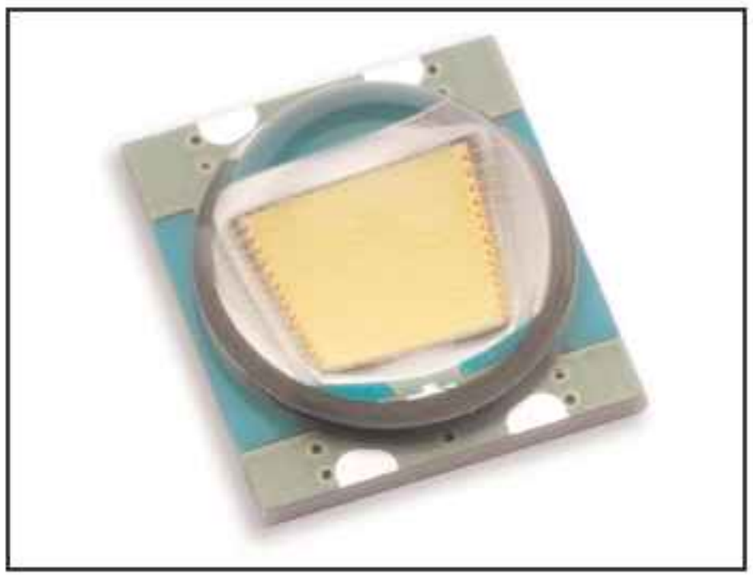
PhlatLight LEDs adopted for lighting

At the Light + Building event in Frankfurt, Germany (11–16 April), Luminus Devices said that its flagship lighting-class LED products — the SST-50 and SST-90 (demonstrated at the show in a retail track lighting fixture) — are the centerpieces of several new indoor and outdoor lighting applications.

"Guth Lighting is leveraging the SST-90 across several fixtures in our product portfolio," says Bob Catone, general manager of Guth Lighting, a Philips Brand Company. "LEDs represent the future of lighting and we believe Luminus LEDs will play an important part in defining that future."

SST-50 and SST-90 LEDs were introduced less than a year ago and have experienced rapid adoption by the lighting user community, says Luminus. The firm's LEDs have been designed into volume lighting applications including retail and residential track lighting, PAR/MR replacement lamps, high-/low-bay commercial and industrial lighting, and outdoor area lighting including roadway and acorn fixtures.

"The emergence of many first-class, world-wide lighting installations using our LED technology provides validation of our basic value proposition," says Chuck DeMilo, Luminus' director of global product marketing for Lighting. "Customers recognize that Luminus' big-chip [PhlatLight] technology allows them to move away from the ubiquitous pixelated look and differentiate their fixture designs with a classical single-source aesthetic," he adds. "By using fewer sources they can reduce fixture cost and complexity, while enabling a solution with fewer points of failure."



Luminus' SST-90 warm-white LED.

The SST-50 and SST-90 are high-lumen-output single-source LEDs, with input power of 5W and 10W, respectively. Both are available in surface-mount packages, have energy efficiencies in excess of 100 lm/W, color temperatures of 3000–6500K, and L70 lumen maintenance of 60,000 hours.

www.luminus.com

Luminus' LEDs power Philips' display light

Luminus says that Philips' Selecon FOCUS LED display light is being powered by a single CBM-380 color-mixing chip-on-board PhlatLight LED, capable of delivering 3500lm, as a practical and cost-effective alternative to LED arrays. The FOCUS LED particularly suits uses such as display lighting for museums and art galleries, because it does not generate ultraviolet (UV) or infrared (IR) light and will protect artwork.

"Selecon's use of the Luminus CBM-380 demonstrates that PhlatLight LED technology brings unique advantages for color quality, tuning and uniformity to demanding entertainment and architectural lighting applications," claims president & CEO Keith T.S. Ward.

"Luminus' big-chip LEDs are ideal for entertainment and architectural lighting applications used inside fixtures in museum lighting and other environments," says Steve Carson, CEO of Philips Entertainment. "Our design teams utilize PhlatLight LEDs because costly lamp replacement isn't needed and the color rendering is superior in both daylight and conventional lighting environments."

www.seleconlight.com

IN BRIEF

Avnet Electronics to distribute Luminus' LEDs in Asia

Luminus Devices Inc of Billerica, MA, USA has agreed a partnership for Avnet Electronics Marketing Asia of Beijing, China (part of Phoenix-based global technology distributor Avnet Inc) to distribute its PhlatLight (Photonic Lattice) LEDs to customers in Asia. Avnet already represents Luminus in the Americas, while subsidiary EBV Elektronik distributes its products throughout Europe, the Middle East and Africa.

Avnet Electronics Marketing Asia will provide comprehensive distribution services, design-chain services and supply-chain optimization solutions to help Luminus' customers accelerate product development for general illumination and specialty lighting applications.

"The demand for our PhlatLight LEDs in Asia is growing exponentially," says Luminus' CEO Keith T.S. Ward. "Avnet Electronics Marketing Asia's reach and reputation in that part of the world as a specialist in distributing electronic components are exceptional," he adds.

"LED lighting products — especially high-brightness LEDs — cover electronics, thermal and optical technologies. This broad expertise requirement can be a barrier to entry," says Andy Wong, senior director, Avnet Design Service/Segment Marketing, Avnet Electronics Marketing Asia. "That's where our design unit, Avnet Design Services comes in, offering manufacturers technical support and solutions that lower the barrier and speed time-to-market," he adds. "Our in-depth engineering expertise and broad customer footprint will prove an ideal match with Luminus Devices."

www.em.avnetasia.com

Kaai starts shipping blue laser for display and specialty applications, and gives update on green laser progress

Kaai Inc of Goleta, CA, USA has started shipping its new blue laser diode product for display and specialty applications. The firm launched the product and gave an update on its green laser commercialization at Projection Summit 2010 in Las Vegas, NV (7 June) in the presentation 'The Emergence of Direct Emitting Green and Blue Semiconductor Lasers for Display Applications'.

A subsidiary of Soraa Inc, Kaai was co-founded in 2008 by nitride-based semiconductor laser pioneers Shuji Nakamura, Steven Denbaars and James Speck, who are professors in the Solid State Lighting & Display Center of University of California, Santa Barbara (UCSB) and had previously developed the first non-polar nitride laser in 2007. The vertically integrated firm aims to commercialize green and blue laser diodes — based on patented and proprietary indium gallium nitride (InGaN) technology fabricated on GaN substrates at a facility in Santa Barbara — for consumer, biomedical, defense, and industrial applications.

The new blue laser diode is designed for integration into portable applications such as embedded and companion pico projectors and features 60mW of 445nm single-mode output power in a compact TO-38 package. Kaai says that the laser operates with high efficiency and requires minimal power consumption over a broad temperature range, meeting the demanding requirements of consumer projection displays, defense pointers and illuminators, biomedical instrumentation and therapeutics, as well as industrial imaging applications.

www.kaai.com
www.projectionsummit.com

ODIS receives two more awards from AFRL

Following a $750,000 award in January, ODIS Inc (Opel Defense Integrated Systems) of Shelton, CT, USA, which designs communications transceivers, optoelectric integrated platforms and infrared sensor type products for military and industrial applications, has received two additional AFRL awards for $850,000, making $1.6m so far this year.

The first award is for $100,000 to develop an 'Ultra Low Power RAM', a novel memory cell using ODIS' optoelectronic thyristor within its III-V Planar OptoElectric Technology (POET). Very high density and low storage power may be achieved with the cell represented as the cross-point of an array, says the firm. The memory design enables it to be fully compatible with integrated optoelectronic CHFET/thyristor logic and optical I/O. Fabricated in radiation-hard GaAs, the structure enables both static and dynamic operation.

"Digital signal processing and static memory, currently implemented exclusively in CMOS technology, have now reached scaling limits in chip size and power," says ODIS' chief scientist Dr Geoff Taylor. "The new memory cell uses the thyristor latching function in the vertical direction to achieve super high density and a power-down mode within an inversion channel to achieve ultra-low storage dissipation," he adds. "The commercial opportunity is for memory embedded within processors in next-generation floating point gate arrays."

The second award (Phase II) is for $750,000 to develop 'Optoelectronic Directional Couplers for Switching Fabric'. ODIS says that a switching fabric on a single chip is a device technology that is required to enable the coordination and routing of multiple optical input signals to arbitrary multiple output ports without optoelectronic conversation (essential for optical communication switching hubs and routers). The technology is targeted at future military satellite missions. Like the first award (Phase I), it should greatly reduce power demand and be designed radiation hard.

"ODIS' development of POET as an integrated optoelectronic platform with the capability to realize arrays of in-plane optical switches and the associated optoelectronic routing circuitry will enable it to meet AFRL's satellite communications technology requirements on a single chip or chipset," says Taylor. "Here as well, the OE integration reduces the weight and power of the craft and indicates a pathway to realize the high-speed satellite OE systems of the future," he adds.

"Receipt of these Awards so closely to the last one indicates that ODIS, through the use of the patented POET process, is being viewed as having the potential to produce tremendous cost savings with enhanced capability to the US Air Force and Space Missile Command in future missions," claims president Leon (Lee) Pierhal. "Quite significant is the opportunity to address the high-density memory market for next-generation data processors, which is identified to be a huge market as the chip industry pushes Moore's law beyond the limits of Si CMOS into the optoelectronic world," he adds. "The Phase II technology effort embraces low-cost switch architecture and component capability to address the distribution of fiber-optic signals for LAN, MAN and WAN applications and for the exploding fiber-to-the-home commercial market."

www.opelinc.com/odis.html

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Pranalytica launches 2W QCL system covering 4μm gap

Pranalytica Inc of Santa Monica, CA, USA, which manufactures quantum cascade lasers and laser-based trace gas detection equipment for industrial, environmental, military, and security applications, has launched the Model 1101-40 2W, fully packaged, continuous-wave, room-temperature quantum cascade laser (QCL) system, emitting at a wavelength of 4μm, marking what is claimed to be a breakthrough in directional infrared countermeasure (DIRCM) systems for commercial and military aircraft.

Pranalytica previously announced a 2W version of its Model 1101-46 QCL system operating at 4.6μm. The firm claims that availability of the shorter-wavelength (4μm) mid-infrared QCL system now makes it the only commercial supplier able to provide a complete solution for 3.8–4.8μm-band sources based on semiconductor lasers needed for the protection of aircraft from MANPADS (man-portable air defense systems, or shoulder-fired missiles).

According to the US Department of State, MANPADS have been manufactured in more than 20 countries. Unfortunately, a substantial number of these missile systems have found their way into the hands of insurgents and terrorists and have been used to attack more than 40 civilian aircraft, resulting in more than 400 casualties. According to a recent report by the Federation of American Scientists, possession of MANPADS continues to be a threat in many parts of the world.

For several years, the US Department of Defense has supported a large effort to develop a new generation of laser-based DIRCM systems to dramatically improve the level of protection available to aircraft against heat-seeking missiles. Since 2004, the Department of Homeland Security also conducted extensive analysis, demonstration and testing of technologies to counter the threat to commercial aircraft during take-off and landing from shoulder-fired missiles.

The Homeland Security Counter-MANPADS program is now looking at adapting DIRCM technology systems used on select military aircraft for commercial use. These are expected to provide unprecedented improvement in protection against MANPADS in the event of a terrorist action and potentially save lives and reduce economic disruption caused by a successful attack.

Pranalytica's latest development is a second key component of highly effective, reliable and affordable countermeasures systems for military and commercial aircraft defense applications, said founder, president & CEO Dr. C. Kumar N. Patel at the Conference on Lasers and Electro-Optics (CLEO) in San Jose. "This rapid technological advancement represents a significant leap forward in meeting the needs of our aerospace, defense and homeland security customers and puts Pranalytica in the unique position as the only supplier of mid-wave infrared (MWIR) semiconductor laser-based solutions for affordable countermeasures against MANPADS," he adds. "Customers now have a complete MWIR solution that provides primary, electrically pumped semiconductor lasers operating at room temperature without the need of cryogenic or even water cooling, covering the 3.8–4.8μm spectral band."

Pranalytica has already supplied a 2W versions of its QCL system, operating in the 'red' (longer wavelength) sub-band of the 3.8–4.8μm spectrum, since June 2009 to most tier-one aerospace and defense contractors. However, until now, application engineers have been forced to use laser sources other than primary semiconductor lasers for covering the critical 'blue' region of the spectrum at 3.8–4.2μm for infrared countermeasures.

The new 2W, 4μm version of the room-temperature-operation QCL system maintains the same output beam quality of earlier Pranalytica systems in the 'red' band, and offers much lower cost per watt. The 2W system is a turnkey solution and fully lab tested with several thousand hours of in-house testing time. As before, the laser package is hermetically sealed for reliable operation in adverse environments and the laser output is collimated using an internal lens system. In addition to DIRCM, Pranalytica's 2W QCL systems in the blue and red bands of the 3.8–4.8μm spectrum can be used to enhance other applications such as LIDAR (light detection and ranging) and free-space optical communications.

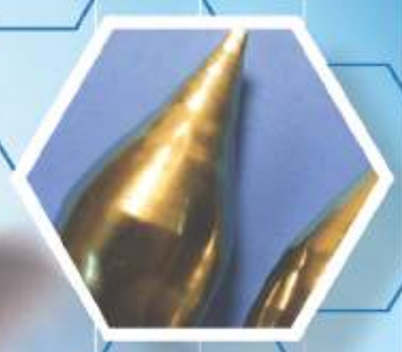
Even though QCL systems were first demonstrated more than 16 years ago at Bell Labs (where Patel led all Physics and Materials Science Research efforts from 1981 to 1993), it is only through Pranalytica's recent offerings that high-power, CW room-temperature turnkey QCLs have become commercially available, the firm claims. The systems are enablers for many critical defense and homeland security applications. Driven by the needs of DARPA-funded contracts to detect chemical warfare agents and explosives and to increase the wall-plug efficiency of QCLs, Pranalytica has gained expertise in high-power QCLs. Reliable high-power operation of the QCL has been enabled through advances in the QCL structure's fundamental design that are patent protected by Pranalytica.

Pranalytica has also developed industrial-grade processing of the lasers, including high-reliability facet coatings and fully integrated hermetic laser packages for high-reliability practical applications. The firm claims that high-power QCLs offer game-changing capabilities for DIRCM systems due to their small size, low weight, low power consumption, high reliability, and potentially lower cost. Unlike just a year ago, application engineers no longer need to be experts in QCL technology to incorporate the lasers into defense and homeland security systems, the firm adds.

www.pranalytica.com

Source Materials

LPE



VPE

Laser

InAs

InSb

VCSEL

MOCVD

PIN

GaAs

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Polycrystal

Solar Cell

InP

HBT

GaSb

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GigOptix reports record revenue of $5.3m in Q1

Growth driven by shift from government contracts to product revenue

For first-quarter 2010, GigOptix Inc of Palo Alto, CA, USA, which designs modulator and laser drivers and transimpedance amplifier (TIA) ICs based on III-V materials as well as polymer electro-optic modulators for fiber-optic communications systems, has reported record revenue of $5.3m. This is at the high end of guidance and up 29% on $4.1m a year ago and up 71% on $3.1m last quarter.

With revenue from government contracts dropping from $1.6m a year ago (39% of total revenue) to just $0.1m (3% of revenue), growth is driven by product revenue of $5.2m (97% of revenue), up 38% on last quarter's $3.7m and 107% on $2.5m a year ago (61% of revenue). "Our government revenues were abated while we resolved our billing issue with the government, which I'm pleased to report is resolved and programs will hopefully be back on track in the second quarter," says chairman & CEO Dr Avi Katz.

The record revenue is a result of efforts to strategically acquire valuable assets within the optical communications industry over the past several years (highlighting growth from the CX product line, acquired with analog and mixed-signal custom ASIC supplier ChipX Inc of Santa Clara, CA last November) and to surround the firm with an experienced management team, according to chief financial officer Ron Shelton.

"We saw increased demand across all our high-speed optical market products including drivers, amplifiers, thin-film polymer on silicon (TFPS) modulators, and analog mixed-signal ASICs," notes Katz. "As our current product portfolio gains traction in the industry, we continue to focus on breakthroughs with our technology pipeline," adds Katz. "The first major event was through our alliance with Sanmina-SCI to manufacture our proprietary TFPS modulators."

During the quarter, GigOptix moved its 40 and 100Gbps TFPS modulators to production and entered into a manufacturing partnership with electronics manufacturing services (EMS) firm Sanmina-SCI Corp of San Jose, CA, USA to produce its high-bandwidth modulators designed for 40 and 100Gbps long-haul optical transponders.

"We recently moved to mass production and shipping of our 40Gbps receiver amplifier ICs to tier 1 telecom OEMs, started shipping volumes of our high-performance 100G DP-QPSK drivers [the industry's first monolithic solution for the next-generation 100G DP-QPSK DWDM market] to a tier 1 telecom OEM, as well as sampling our 40Gbps and 100Gbps MZ-DPSK TFPS modulator to a number of tier 1 customers," says Katz. "All three products offer meaningful advantages over current technology in the marketplace and we have positioned ourselves as an emerging leader in the 40Gbps and 100Gbps area."

We saw increased demand across all our high-speed optical market products including drivers, amplifiers, TFPS modulators, and analog mixed-signal ASICs

Although up from 38% last quarter, non-GAAP gross margin of 52% is down from 60% a year ago. This is due mainly to a drop in higher-margin government billings, and lower margins associated with a ChipX product line, which is being phased out by working with customers to replace the product line with newly designed products. However, GigOptix says that, as it continues to integrate operations, focus on cost-reduction initiatives and increase sales of newer, higher-margin products, gross margin should trend above 50% during 2010.

"We have also successfully managed our expenses following our acquisition of ChipX," says Katz. Total operating expenses have been cut from $7m last quarter to $4.6m. R&D expense was $2.1m, up from $1.5m a year ago (due mainly to increased spending as a result of the ChipX acquisition as well as certain costs being classified as R&D resulting from almost no government billings) but down from $2.3m last quarter. Selling, general and administrative (SG&A) expense has been cut from $3.7m last quarter to $2.1m, due to a $1.2m drop in acquisition-related expenses, a reduction in professional fees (including legal, accounting and auditing services), as well as consolidation of corporate SG&A functions after the ChipX acquisition.

On a non-GAAP basis (excluding the impact of restructuring expenses and other non-cash items) operating loss has been cut from $7.1m last quarter to $0.9m. Though up from $0.9m a year ago, net loss has been cut from $2.8m last quarter to $1.1m.

Nevertheless, during a quarter that involved the acquisition of ChipX, cash and cash equivalents fell from $3.6m to $1.7m. "We have restructured and consolidated our outstanding debt into a new credit facility with Silicon Valley Bank (SVB). This new facility offers better borrowing terms and more flexibility as we continue to grow the company," says Katz.

"We have also strengthened our teams in finance, marketing, operations and sales with talent to support our continuous growth," he adds. During the quarter, GigOptix promoted Julie Tipton to senior VP of operations from VP of marketing and Padraig O'Mathuna to VP of marketing from director of product marketing, and hired Jay De La Barre as VP of global optical sales, ➤

Brian Groft as director of sales Americas, Dan Takise as director of sales Far East, and Jeff Parsons as director of finance & corporate controller.

"GigOptix is launching revolutionary technology into the market at a rapid pace," says Katz. "Three years after inception we continue to demonstrate our ability to monetize the value of our organic and acquired portfolio of intellectual property by increasing customer acceptance," he adds. "As market conditions continue to improve, we believe that we will see continued demand for our innovative product base and technology pipeline in all areas of telecom, datacom and consumer electronics," Katz continues.

During the quarter, GigOptix announced the availability for sampling of its:

- GX3101 universal limiting TIA, which is designed for fiber-optic communication systems such as wireless base-station backhaul, Fiber Channel, Ethernet and SONET transceivers operating at 1-14Gbps over distances of 10m to 80km (designed to simplify logistics by enabling one solution support for a variety of optical reaches, speeds and standards); and
- GX3122 dual-channel linear TIA for use in next-generation 40Gbps DWDM coherent optical receivers (designed to have the required large dynamic range and handle the high AC and DC currents with a consistently low THD).

GigOptix also announced the production release of:

- Flip-chip versions of all members of the low-power HX4 family of parallel 4x10G and 12x10G PMDs for 40 and 100Gbps Ethernet and 120G Infiniband Active Optical Cables (AOC); and
- GX3440, a 45Gbps differential limiting amplifier for use in 40Gbps DPSK and DQPSK telecom receivers and instrumentation applications (developed in cooperation with a major telecom customer).

"We continue to see strong sales and customer activity, and expect that revenues will continue to grow sequentially through the rest of the year," comments Shelton.

Volume production orders of 40G RZ-DQPSK receiver amplifiers start shipping

GigOptix says that its GX3240 high-performance 40G RZ-DQPSK (return-to-zero differential quadrature phase shift keying) receiver amplifier has entered mass production and is shipping in volume to a tier 1 telecom OEM.

Made available as samples last November, the GX3240 is a high-gain, broad-bandwidth and low-power differential amplifier in a compact 3mm x 3mm QFN form-factor package that is capable of directly driving a 40G de-multiplexer. GigOptix says that the product was developed through close collaboration with a tier 1 telecom OEM, consistent with GigOptix's strategy of partnering with industry-leading customers to define and drive commercialization.

"The GX3240 concept is a very challenging design and significantly strengthens GigOptix's existing 40G receiver amplifier portfolio," says chief technology officer Andrea Betti-Berutto. "Paralleling our previously announced 40G DPSK receiver amplifier and 100G DP-QPSK driver developments, we aligned this product's development with a tier 1 customer's requirements... This enabled us to design the right device for the market."

In its most recent report on 40G components, market research firm Ovum forecasted that the 40G RZ-DQPSK market would rise at a compound annual growth rate (CAGR) of 41% from 10,000 units in 2010 to more than 56,500 units in 2015. Two GX3240's are used in each 40G RZ-DQPSK transponder.

IN BRIEF

GigOptix reduces interest costs by consolidating debt

GigOptix Inc of Palo Alto, CA, USA, which designs modulator and laser drivers and trans-impedance amplifier (TIA) ICs based on III-V materials as well as polymer electro-optic modulators, has established a new credit facility with Silicon Valley Bank (SVB) that provides the firm lower interest rates, less restrictive covenants and more flexibility with respect to its borrowing base.

The financing should enable GigOptix to achieve its next stage of growth, says Rick Tu of Silicon Valley Bank (a provider of diversified financial services to emerging growth and established technology companies).

GigOptix has also restructured and consolidated its two other outstanding debt instruments with SVB (representing the firm's entire debt), as follows:

- A $3m line of credit that will increase the amount that GigOptix is entitled to borrow on its net eligible accounts receivables. The initial funding will be used to repay about $1.6m outstanding with Bridge Bank, enabling the firm to terminate its loan and security agreement with them. Under the new line and the reduced interest rate, GigOptix will realize immediate savings in its interest costs of about $40,000 per year.
- A $400,000 term loan to replace its existing $400,000 term loan with Agility Capital. As a result of the refinancing of this debt, GigOptix will immediately reduce its borrowing costs from 14% to 9% (yielding immediate savings in interest costs of 36%).

www.svb.com
www.GigOptix.com

Advanced Photonix restructures debt to boost cash flow by $1.3m through fiscal 2013 and cut interest by $120,000

Advanced Photonix Inc (API) of Ann Arbor, MI, USA, which designs and makes silicon, InP- and GaAs-based photodetectors, subsystems, and terahertz instrumentation, says that on 19 May it entered into a debt conversion agreement with the Michigan Economic Development Corp (MEDC) and Michigan Strategic Fund (MSF).

A total of $562,337 of principal and interest owed by subsidiary Picometrix LLC is to be converted into 1,041,363 shares of Class A common stock of API at a conversion price of $0.54 per share. The balance of the loan ($2.2m) will be amortized over about 4.5 years at an interest rate of 4% (reduced from 7%). Total interest saved over the life of the loan is expected to be about $120,000.

The deal will strengthen API's balance sheet and improve cash flow by more than $1.3m over the next 2.5 years, says chief financial officer Rob Risser. "The conversion by MEDC and the MSF for the accrued interest, and the more favorable terms, will provide us with additional flexibility in our operational activities as we see business begin to rebound," he adds. "We are seeing the start of a rebound, as reflected in our recent announcement [on 14 April] that we added a second shift to meet demand for high-speed optical receivers."

The deal will strengthen API's balance sheet and improve cash flow by more than $1.3m over the next 2.5 years...

The more favorable terms will provide us with additional flexibility in our operational activities as we see business begin to rebound

Separately, April saw the expiry of warrants for the purchase of API Class A common Stock totaling 694,541 shares (related to the 2004 convertible notes from Smithfield Fiduciary LLC and Iroquois Capital LP). The remaining 694,541 warrants associated with these convertible notes will expire in September 2011 if not exercised prior to that date.

www.advancedphotonix.com

Advanced Photonix launches CCRx-compliant compact 100G coherent receiver for DP-QPSK modulation

Advanced Photonix Inc subsidiary Picometrix LLC has made available a compact coherent receiver targeting the emerging 100G optical communications market.

The firm has two configurations for its CR-100A compact coherent receiver (currently sampling to subsystem and equipment makers for system-level testing): one incorporating an internal polarizing beam splitter (PBS) and one without. Incorporating technologies including optical beam splitters, mixers, high-speed photodiode arrays and amplifier arrays in a compact package, the CR-100A receiver will be fully qualified and released for volume production in second-half 2010.

The CR-100A is the first in a planned suite of coherent receivers (CR) targeting next-generation 40G, 100G and beyond line-side telecom networks using the DP-QPSK (dual-polarization quadrature phase shift keying) coherent modulation format.

In addition to 100G, Picometrix's CR platform will serve as the basis for next-generation 40G line-side coherent receivers.

Coherent transmission offers the benefit of being mostly immune to impairments intrinsic to optical fiber plants. This eliminates the need for optical amplification and dispersion compensation, greatly reducing total system cost. Coherent transmission systems also reduce network latency, which is critical for real-time applications such as stock and commodity trading.

The CR-100A supports four 32 Gbaud outputs (128Gb/s), covers both C and L bands, and is compliant with the compact form-factor recently established by the CCRx multi-source agreement (MSA) and the Optical Internetworking Forum (OIF) 100G optical receiver implementation agreement.

"We have been at the forefront of 100G coherent receiver development during the past year through close cooperation with the major OEM customers of optical communication equipment," says Robin Risser, Picometrix's general manager and API's chief financial officer.

"Our initial product shipments this quarter have enabled our customers to develop their 100G systems, and our fully qualified product will support their initial field trial deployments over the next year," he adds. "We have experienced robust customer demand for our CR-100A family of products as they develop their first-generation 100G systems," Risser continues. "We expect the market to enter its growth phase within 18–24 months."

Picometrix exhibited the compact coherent receiver and its full line of receivers at the Optical Fiber Communication event (OFC 2010) in San Diego, CA (23–25 March).

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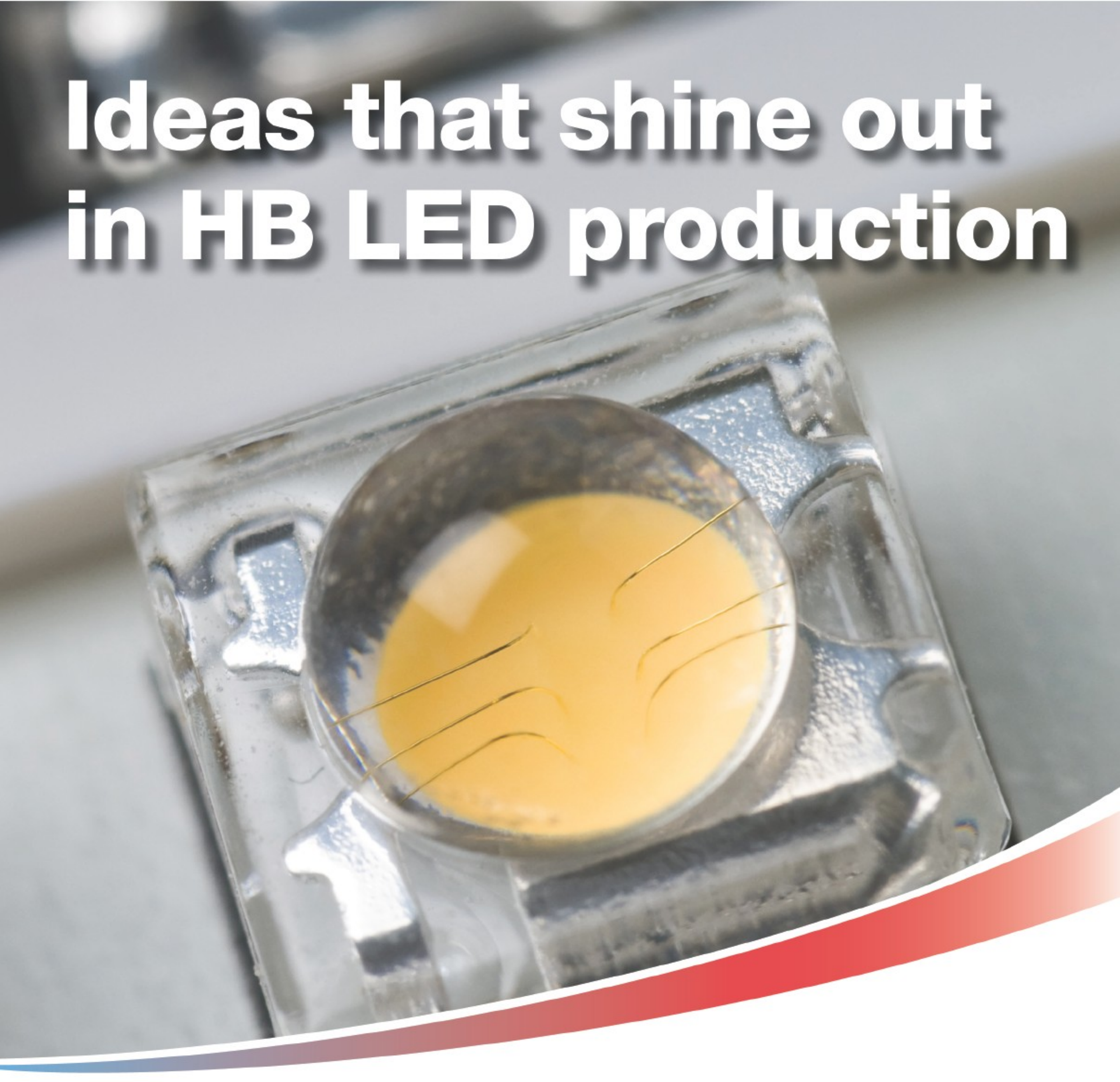

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Infinera accelerates 100G coherent system shipment

Infinera Corp of Sunnyvale, CA, USA says that it is accelerating its product development plans for next-generation optical systems to take advantage of evolving market trends and technological advances in product development. The new program includes plans to ship systems based on 100Gb/s coherent transmission in 2012 to meet the growth in market demand for optical networks providing 8Tb/s of capacity per fiber.

The new 100G systems will be based on Infinera's next-generation indium phosphide-based photonic integrated circuits (PICs), which integrate the functionality of hundreds of optical devices to provide 500Gb/s of optical capacity on a single pair of chips (dubbed 500G PICs). The systems are designed to use coherent detection to deliver an optical system with ultra-long-haul reach, fiber capacity of 8Tb/s, and the disruptive economics of photonic integration. Infinera is also planning to add non-PIC-based coherent capability to its DTN (delay-tolerant networking) system in 2011, to meet the needs of users that require a 40Gb/s solution.

Infinera says that service providers have shown growing interest in 100G as the best step forward from existing 10G networks, driven by continuing growth in mobile, video, and other sources of network traffic, as well as a growing consensus that 100G networks will benefit from more rapid price reductions than the market has seen for 40G technology. "We expect 100G coherent technology to be widely available in the 2013 timeframe at price points that make it very competitive with 40G coherent technology," says Infonetics analyst Andrew Schmitt. "We expect that many service providers will opt to go directly from 10G to 100G at that point, making 100G the predominant long-haul technology of the coming decade," he adds.

Infinera's product development team has been working on both 40G and 100G solutions, including key optical and electrical enabling technologies. Recent engineering milestones, such as its transmission of a 100G signal over 1600km of fiber using coherent modulation technology, has enabled Infinera to accelerate its timetable for a 100G solution. The firm believes that this demonstration shows that an Infinera 100G system, based on its unique 500G PICs, will be able to meet ultra-long-haul-reach requirements while delivering a significant boost in fiber capacity at a better cost-per-bit.

"Infinera's 100G system will reach the market at a time that enables 100G mass adoption," expects CEO Tom Fallon. "Advanced features like digital bandwidth management and Bandwidth Virtualization, which customers expect from Infinera, will continue to deliver valuable benefits in our intelligent networks," he adds. The firm believes that traditional muxponder-based DWDM systems become even more inefficient when carrying a wide range of lower-speed services over 100G wavelengths.

Infinera expects 40G demand to be limited, but believes a 40G solution may be required in the short term for applications needing additional fiber capacity, including terrestrial and submarine deployments. To meet those needs, the firm aims to deliver 40G capability for the DTN next year. It adds that 40G networks will offer all the benefits of its digital intelligence and a seamless transition from existing 10G networks.

Infinera believes that its product development plan, including 40G and 100G networks, provides the industry's best roadmap to accommodate future needs. Strong bandwidth growth creates the pressing challenge of expanding networks while trying to maximize profitability amidst declining prices for telecom services. The new set of products is intended to enable service providers to expand their networks quickly and cost-effectively, while the disruptive economics of 500G PICs help them to generate better business results.

Infinera adds ex-Cisco veteran as vice president of architecture

Infinera says that Michael Frendo has joined as vice president of architecture to lead the development and implementation of long-term architectural direction at the firm.

Frendo joins after a series of senior architectural and engineering roles at companies including Cisco Systems, Juniper Networks, McDATA Corp and Avaya, where he played leading roles in product strategy, direction, and engineering.

At Cisco in the 1990s, Frendo played a significant role in that firm's decision and execution of its strategic focus on Internet Protocol technologies, including IP voice and IP video.

"Infinera has world-class technologies in a variety of areas including photonic integration and system design," comments Frendo. "With the disruptive power of photonic integration technology, Infinera has the opportunity to become a major force in this industry," he believes.

"Michael's vision and skills will be a valuable asset as we grow further and develop and broaden the company's product portfolio," adds CEO Tom Fallon.

www.infinera.com

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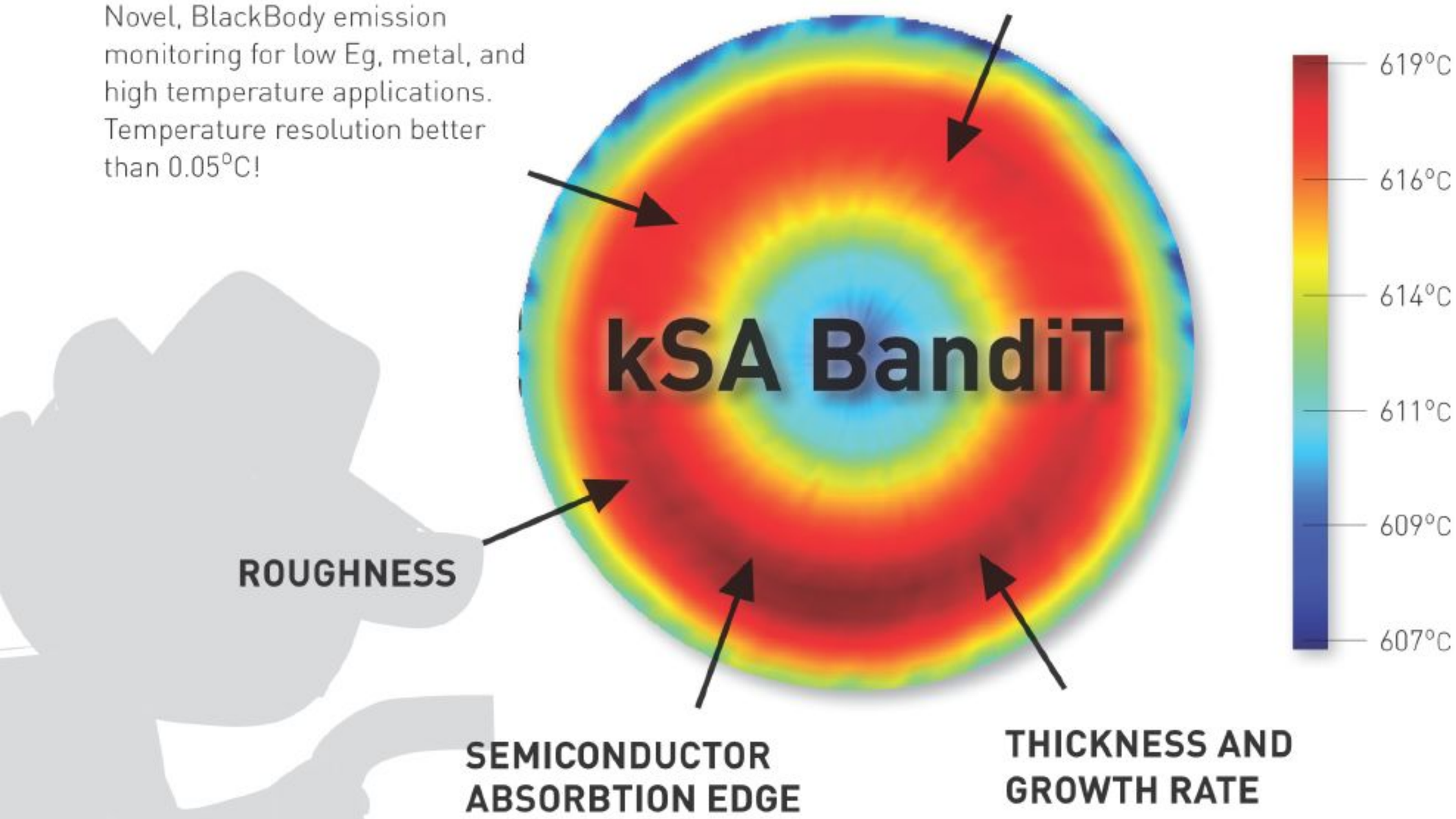

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Opnext to burn cash for next two quarters while expanding

Component supply constraints hit 10G shipments

For its fiscal fourth-quarter 2010 (to end March), optical component and module maker Opnext Inc of Fremont, CA, USA has reported revenue of $76.8m, up on $76.1m last quarter but down 8% on $83.6m a year ago (despite including $14.2m in subsystems from the former StrataLight Communications Inc, acquired on 9 January 2009). This is also down on its guidance of $78–83m, despite seeing demand build throughout the quarter (especially in March). "We had a disappointing fourth quarter," comments president & CEO Gilles Bouchard.

Component supply shortages near the end of the quarter delayed shipments worth several million dollars, contributing to 10G and below revenue for 10Gb/s and below products falling 11% from $55.1m last quarter to $48.9m, due partly to lower shipments of 300-pin tunable products and X2 modules. Nevertheless, this was still up 19% on $41.2m a year ago (due mainly to year-on-year rises in sales of XFP, SFP+, X2 and Xenpak modules).

Due to a drop in sales of subsystems, revenue from 40Gb/s and above products has fallen 45% from $39.7m a year ago to $21.8m. However, this is up 30% on $16.8m last quarter, due to growth in 40Gb/s modules and R&D contract revenues. The resurgence of the 40G market is being driven by major carrier deployments in China, but Opnext is now also seeing deployments in all regions of the world, says Bouchard.

Revenue from industrial & commercial products also grew strongly, up 45% from $5.4m to $6.1m (and more than doubling on $2.8m a year ago).

On a non-GAAP basis, gross margin has risen from 13.5% a year ago and 18.7% last quarter to 20.9%, driven mainly by higher 40Gb/s and above revenue as well as favorable product mix, partially offset by lower average selling prices.

R&D expenses have risen from $16m a year ago and $18m last quarter to $18.4m (above the forecast $16–18m), due mainly to higher material and outsourcing costs related to product development prototype builds. Selling, general and administrative (SG&A) expenses have risen from $11.2m a year ago and $11.7m last quarter to $12.4m, due partly to the resumption of payroll taxes at the beginning of the calendar year and higher costs associated with customer samples.

Consequently, though down from $18.5m a year ago, net loss has risen from $12.7m last quarter to $14.5m. Adjusted EBITDA (earnings before interest, taxes, depreciation and amortization) worsened from –$7.3m last quarter to –$9m.

Cash and cash equivalents has continued to fall, from $146.3m at the end of last quarter to $132.6m, reflecting $2.7m of capital expenditure, $2.5m of capital lease payments, and $8m of cash used in operations (including the final payment of $2.1m for the StrataLight Employee Liquidity Bonus Plan).

The non-GAAP EBITDA breakeven target remains $95m of revenue per quarter. "Getting to that will get us to a better position to get to a positive cash flow position," says Bouchard. However, "for at least the first half of this year we will continue to use cash," he warns.

For fiscal first-quarter 2011 (to end June), Opnext expects total revenue to rise to $80-85m. "While we expect sales of 40G and 100G modules to also show strong growth, we expect 40G subsystems sales to be weak, resulting in lower overall 40G and above revenue relative to the March quarter," says Bouchard. Industrial and commercial revenue should be flat following significant growth in the past two quarters (to back above pre-downturn levels). However, based on customer demand, Opnext expects 10G and below revenue to rebound, although supply constraints are still a challenge industry-wide.

"We have taken actions to improve the availability of parts from our suppliers and to increase our production capacity," notes Bouchard. Starting last year, Opnext launched an initiative to increase the number of second sources for key components. Also, the firm is increasing module production capacity by about 40% in fiscal first-half 2011. Nevertheless, the firm expects the supply chains of both semiconductor and optical components to remain constrained for at least two quarters.

Gross margin should improve slightly in fiscal Q1 due to higher sales volumes and lower average unit costs (helped by off-shoring and outsourcing of activity in Opnext's Japan operations), offsetting the drop in average selling prices. "This year we have several important new products coming out primarily from our Japan operations that will contribute to revenues and margins in the near-term [with margins for 40G and above products tending to be higher than the average margins on 10G and below business]," says Bouchard.

As well as adding 16 new slots and four new customers in 10G, in 40G modules Opnext is now qualified in 52 slots across 25 customers (an increase of seven slots and three customers from last quarter) and in 100G it is in the qualification process for eight slots with five customers (an increase of six slots and four customers). "We have made decision to invest very heavily in the 100G program in the face of the declining sub-system business," notes Bouchard. Most starkly, in the next six months, Opnext expects the proportion of its revenues generated by products less than one year old to be at least five times what it was in 2009. "We have completely renewed the portfolio," stresses Bouchard.

www.opnext.com

Opnext demos single-wavelength, real-time coherent 127G PM-QPSK modem at AT&T

Opnext has demonstrated a single-wavelength, real-time coherent 127G PM-QPSK modem on an AT&T ultra-long-haul (900+km) link between Louisiana and Florida.

The demo also included Opnext's IEEE 802.3ba standards-compliant CFP MSA client optical modules, which are fully interoperable with 100GbE interfaces on IP routers.

Opnext's plug and play technology allows carriers to upgrade their existing line systems to 100Gb/s without having to strand capacity or light new fibers. It eliminates the need for external dispersion compensation, reducing cost, minimizing IP latency and allowing deployment over older installed fiber with poor transmission characteristics.

"Most of the 100G coherent trials announced in the past are not real-time solutions and are only testing the optics; the data is acquired on a digitizing oscilloscope and coherent DSP post-processing is offloaded to a PC," says Andrew Schmitt, directing analyst of Optical at Infonetics Research. "Opnext's trial is different because they are demonstrating a real-time solution implemented in hardware for the toughest part of the 100G coherent transport problem."

"Bandwidth requirements have increased significantly faster than capacity in recent years, and faster transmission speeds will provide carriers with the ability to move more data over essentially the same infrastructure," says Mike Chan, president of Opnext's Subsystems business unit. "The latest consumer and business applications such as HD video-on-demand, user-generated video, video gaming, video teleconferencing and software as a service will continue to drive the need for greater bandwidth," he adds. "Ever faster internet access speeds enabled by 4th generation wireless and fiber-to-the-home (FTTH) technologies push more traffic into carrier backbone networks, where Opnext is in an excellent position to benefit from the next wave of bandwidth investments."

The real-time optical Modulator Demodulator (MODEM) operates at 127Gb/s, with a PM-QPSK modulation format described in the Optical Internetworking Forum framework document on Ultra Long Haul 100Gb/s transmission. The system is designed to carry an industry-leading 20% overhead forward error correction (FEC) required for ultra-long-haul and submarine transmission distance and to carry 100GbE payload transparently mapped into an ITU OTU4 payload. The design is tolerant to filtering, allowing for metro/regional networking with 10 or more cascaded ROADMs at 50GHz channel spacing.

www.opnext.com

Opnext partners with Mobius to develop low-power quad CMOS ADC for 127Gb/s PM-QPSK modulation

Opnext claims that it has solved one of the major challenges of delivering a polarization multiplexed quadrature phase shift keying (PM-QPSK) coherent receiver.

Together with Mobius Semiconductor of Irvine, CA (a privately held firm specializing in high-performance mixed-signal products for next-generation communications and networking standards), the firm has developed a low-power quad CMOS analog-to-digital converter (ADC), designed for a 127Gb/s PM-QPSK modulation scheme.

Opnext verified the digital signal processing (DSP) and forward error correction (FEC) algorithms on its real-time 100G coherent platform (announced on 9 March). Mobius uses DSP-assisted mixed-signal calibration techniques to develop multi-gigasample data converters, making possible integrated transceivers with significantly reduced cost, power and form factor.

Mobius says that its calibration technology is naturally aligned with CMOS scaling. The Opnext–Mobius ADC will be integrated with the DSP and FEC into a single PM-QPSK receiver chip using a standard CMOS process, eliminating numerous high-speed interconnects between the ADC, DSP and the FEC. It also includes continuous digital background self-calibration and synchronization, eliminating the need for external calibration signals. The receiver is hence immune to process, voltage and temperature variations, allowing reliable performance over a broad range of operating conditions. The ADC will use a BGA (ball grid array) package enabling volume SMT manufacturing, consistent with Opnext's current 32Gb/s mux.

"Opnext previously announced the mux and last week it demonstrated its DSP prototype," says Karen Liu, principal analyst at market research firm Ovum. "With this ADC, Opnext will have control of all the critical chips for its MSA [multi-source agreement] transponder: a reliable merchant supply of the transponder is essential for the 100G market to move quickly toward a robust supply chain," she adds. Mobius' CMOS-based technology is portable over different foundries and processes.

Opnext says it continues to employ selective vertical integration on components like the ADC, with the goal of delivering the lowest-cost and highest-performance 100Gb/s Optical Internetworking Forum (OIF) MSA-compliant solution to its OEM partners.

www.mobius-semiconductor.com

Oclaro grows margin for third consecutive quarter

For its fiscal third-quarter 2010 (ended 3 April), optical component, module and subsystem maker Oclaro Inc of San Jose, CA, USA has reported revenue of $101.2m, up 8% on $93.6m last quarter.

Also, this is well over double the $41.2m of predecessor firm Bookham Inc a year ago. However, that was before its merger on 27 April 2009 with Avanex Corp of Fremont, CA to form Oclaro, and before July's acquisition of the high-power laser diode business of Newport Spectra Physics (in exchange for laser and photonics components supplier Newport Corp of Irvine, CA acquiring Oclaro's Advanced Photonics Solutions division's New Focus business).

"Demand remains strong across all our businesses," says president & CEO Alain Couder. Telecom revenue was $87m (up 6% on $82.2m), while advanced photonics solutions revenue was $14.1m (up 24% on $11.4m).

"We continue to gain share in key product areas," adds Couder. There were three 10% or greater customers: Huawei at 13%, Alcatel-Lucent at 10% and Ciena plus the former Nortel MEN division combined at 10% (the three market share leaders in the telecom markets served, says Oclaro). Five other customers each comprised greater than 4% of revenue. These included five of the next six equipment companies in terms of telecom market share.

"We increased revenues and gross margins in the historically slow March quarter," notes Couder. This is evidence of the strength of the underlying demand environment of Oclaro's market share gains and of the gross margin leverage in the firm's operating business model, adds the chief financial officer Jerry Turin. On a non-GAAP basis, gross margin has risen from 26.8% last quarter to 27.7%.

We increased revenues and gross margins in the historically slow March quarter... This is evidence of the strength of the underlying demand environment

Operating income has more than doubled from $1.5m to $3.2m. "The leverage of our operating model is beginning to translate to the bottom line," says Turin. Adjusted EBITDA has risen from $4.3m to $5.8m. Net income has risen from $2.1m to $3.5m (continuing its rise from break-even the quarter before last).

"Our continued operating improvements and revenue growth are driving progress towards realizing our business model targets, which will support opportunities to accelerate innovation and further strengthen our operating machine," comments Couder.

"We expect strong revenue growth for the June quarter, which should enable continued gross margin improvement," he adds.

For its fiscal fourth-quarter 2010 (ending 3 July), Oclaro expects revenues of $111–116m, non-GAAP gross margin of 30–33% (achieving the target of 30%), and adjusted EBITDA of $8.5–12.5m.

Oclaro now expects its next gross margin target of 35% to be achieved by the end of fiscal 2011 (ended next June). "If the strong demand environment continues, this 35% target could conceivably be achieved as early as the upcoming December quarter," says Turin.

At 35% gross margin, Oclaro expects non-GAAP operating income targets to be 10–12%, with the parameters of that range largely a function of the level of investment in R&D

At 35% gross margin, Oclaro expects non-GAAP operating income targets to be 10–12%, with the parameters of that range largely a function of the level of investment in R&D, says Turin. The firm is currently investing in R&D at about 11% of revenue, but its long-term business model is 13%.

www.oclaro.com

Quality Excellence Award received from Huawei

Oclaro is one of only two optical component suppliers to receive the Quality Excellence Award from telecom equipment maker Huawei Technologies Co Ltd of Shenzhen, China. The award was received by SC Lim, VP of Oclaro Asia Operations, at the 2010 Huawei Supplier Quality Conference.

The award was given to Oclaro based on outstanding quality performance for 2009. Oclaro says that its delivery of high-performance, highly reliable products, along with excellent customer service, were the key factors in winning the award.

"Huawei holds its suppliers to the highest quality standards," says Oclaro's chief operating officer Jim Haynes. "Vertical integration of core technologies and a focus on systems and processes provides the control we need to deliver world-class product and service quality," he adds. "With this combination, and the quality of our Shenzhen and various manufacturing facilities, we can meet the needs of our customers around the world."

Just last December, Oclaro also was the only supplier in the Optical category to receive the Excellent Core Partner Award from Huawei at the Huawei 2009 Core Partner Convention.

Oclaro invests in ClariPhy to speed 100Gb/s development

Optical component, module and subsystem maker Oclaro Inc of San Jose, CA, USA has made a $7.5m strategic investment in ClariPhy Communications Inc of Irvine, CA, USA, a privately held fabless semiconductor company developing mixed-signal digital signal processing (MXSP) ICs for 10, 40 and 100Gb/s optical networks in enterprise backbone, enterprise data center and telecom environments.

Oclaro's investment is part of ClariPhy's $24m Series C funding round, which included other new strategic investors (telecom OEMs) as well as all existing venture investors (Norwest Venture Partners, Allegis Capital, Onset Ventures and Pacific General Ventures).

Also, a co-marketing and development agreement plans to leverage ClariPhy's 40nm single-chip products with Oclaro's optical technology. Oclaro says that the alliance is a key milestone in its strategy to build on its position in 40Gb/s regional and metro networks and expand into the 100Gb/s coherent long-haul and ultra-long-haul markets.

According to Oclaro, the surge in new broadband services, such as social networking, video sharing, voice over IP (VoIP) and cloud computing, is creating significant demand for increased bandwidth and improved network performance, with global IP traffic expected to rise at a compound annual growth rate (CAGR) of 40% between 2008 and 2013. This intensive growth is driving the rapid transition from 10Gb/s optical networks to 40Gb/s and beyond. These very high-bit-rate communications require not only advanced optical solutions but also advanced DSP and mixed-signal ICs, combined into modules for deployment by telecoms systems providers. In particular, the move to 100Gb/s requires coherent technology, which is fundamental to extending the reach of high-speed networks.

"We expect an increasing percentage of the transceiver solutions for optical networks to be comprised of DSP and mixed-signal electronics as they evolve towards 40Gb/s and 100Gb/s," says Oclaro's president & CEO Alain Couder. "Through our investment and alliance with ClariPhy, Oclaro believes it will be able to offer its customers best-in-class electronics and optical technology as a complete solution from a single source, whether incorporated directly in our Oclaro solutions, or co-marketed as complementary products."

Oclaro claims a leading market share in 40Gb/s regional and metro networks. In the differential quadrature phase-shift keying (DQPSK) and differential phase-shift keying (DPSK) space for regional and first-generation long-haul markets respectively, Oclaro already offers lithium niobate ($LiNbO_3$) and indium phosphide (InP) component solutions. At the sub-system level, Oclaro says that its vertical-integration model has resulted in disruptive technology, as demonstrated by its fully qualified 40Gb/s DQPSK 300-pin transponder solution for regional and metro applications. From this base, Oclaro now aims to broaden its high-bit-rate portfolio into next-generation long-haul and ultra-long-haul with coherent detection. With standardization of 100Gb/s gaining momentum, Oclaro aims to continue to deliver core optical building blocks, alongside ClariPhy's signal processing engines, as well as providing modules.

"By leveraging the significant 40nm CMOS technology innovation from ClariPhy, Oclaro will focus on optimizing our future optical products to further increase bandwidth, improve network performance, and lower the total cost of ownership for customers," adds Couder.

Oclaro and ClariPhy have a history of collaboration and offer products designed to improve the performance and bandwidth of optical networks. With low power dissipation, Oclaro's TL9000M small-form-factor 300-pin transponder for 10Gb/s networks — launched last year, and incorporating ClariPhy's maximum likelihood sequence estimation (MLSE) IC — established a new benchmark in transmission performance for dispersion-tolerant modules, it is claimed. Oclaro says that its 300-pin transponder portfolio continues to ramp and take market share in the 10Gb/s space. The firm now aims to deliver transceivers such as tunable XFP and XFP which, when combined with ClariPhy's IC, should deliver the industry's highest-density, lowest-power MLSE-based solution, it is reckoned. Oclaro and ClariPhy believe the ongoing combination of their optics and signal processing delivers the performance and integration demanded for such next-generation 10Gb/s modules.

"This alliance brings together industry-leading mixed-signal CMOS technology from ClariPhy with the world-class optical technology from Oclaro," comments ClariPhy's CEO & co-founder Dr Paul Voois. "By working together to deliver innovative solutions to the market, Oclaro and ClariPhy can help customers accelerate deployment of the next generation of high-speed networks."

www.clariphy.com

Oclaro closes $77.2m public offering of common stock

On 12 May, Oclaro closed its public offering of 6,900,000 shares (including 900,000 after exercise of the underwriters' over-allotment option) at $12 per share.

Net proceeds were $77.2m, for intended general corporate purposes, including working capital, and acquiring or investing in complementary businesses, products or technologies.

www.oclaro.com

IN BRIEF

Sumitomo Electric Industries wins Huawei Excellent Quality Award

Tokyo-based optical component, module and subsystem maker Sumitomo Electric Industries Ltd (SEI) says that, at the 2010 Huawei Global Supplier Quality Convention on 23 April, its subsidiary Sumitomo Electric Device Innovations Inc (SEDI) received an 'Excellent Quality Award' for 2009 from Huawei Technologies Co Ltd of Shenzhen, China, which is now the world's biggest telecom equipment provider.

The Excellent Quality Award recognizes suppliers that have demonstrated outstanding results in providing quality products and service to Huawei, says SEI.

Launched in August 2009 by integrating the wireless and optical transmission device business of Eudyna Device Inc and Sumitomo Electric Industries Ltd, SEDI designs and manufactures optical/wireless components and subsystems for telecom, CATV, broadband data communication and wireless transmission.

www.huawei.com
www.sedi.co.jp/e

JDSU grows 15% quarter-to-quarter in Optical Communications
Communications & Commercial Optical Products operating income quadruples

For fiscal Q3/2010 (ended 3 April), JDSU's revenue was $332.9m, down 3% on $343.8m last quarter but up 19% on $279.2m a year ago.

The Americas represented 45% of revenue (down on 50% last quarter), Europe 29% (up from 28%) and Asia-Pacific 26% (up from 22%).

Advanced Optical Technologies revenue was $58.6m (17% of total revenue), up 7% on last quarter's $54.6m and 15% on $51m a year ago. Communications Test & Measurement revenue was $145.7m (44% of total revenue), down 18% on last quarter's $177m (51% of total revenue) but up 14% on $127.7m a year ago.

Communications & Commercial Optical Products (CCOP) revenue was $128.6m (39% of total revenue), up 14% on last quarter's $112m (33% of total revenue) and up 28% on $100.5m a year ago. In particular, Commercial Lasers revenue was $18.7m (up 12% on last quarter's $16.7m and up 63% on $11.5m a year ago), while Optical Communications revenue was $109.9m (up 15% on last quarter's $95.6m and up 23% on $89m a year ago).

"We began the calendar year with the highest quarterly bookings JDSU has reported in the last two years, with each of our businesses achieving a book to bill of greater than 1," says president & CEO Tom Waechter.

On a non-GAAP basis, although up from 41.8% a year ago, gross margin has fallen from 44.6% last quarter to 44.1%.

Although cut from $204.2m a year ago, operating expenses have grown from $125.3m last quarter to $142.5m. Hence, despite improving from a loss of $6.4m a year ago (–2.3% of revenue), operating income is down from last quarter's $28.1m (operating margin of 8.2% of revenue) to $22.1m (6.6%). However, this included $12.6m from CCOP, almost quadruple $3.2m last quarter and an improvement from a loss of $6.4m a year ago.

Net income was $23.2m, down from $26.6m last quarter but an up from a net loss of $5.4m a year ago. Free cash flow was $7.9m, helping to boost total cash and investments from $698m to $713.1m.

"Recovery in our markets, and our innovation and new product offerings, are driving the strength of our customer demand," says Waechter.

For its fiscal Q4/2010 (ending 3 July), JDSU expects revenue to grow 16–23% to $385–410m.

www.jdsu.com

Small-form-factor 40Gb/s DWDM DPSK module ships

Mintera Corp of Acton, MA, USA, which makes high-bit-rate optical transport sub-systems, is claiming the industry's first shipment of a small-form-factor 40Gb/s DWDM DPSK transceiver module. The MI 7000XM Adaptive-DPSK product delivers industry leading optical performance in a standard 3.5" x 4.5" 300-pin package.

"This shipment signals the next phase in 40Gb/s evolution with the first delivery of a new generation of 40Gb/s DWDM modules," says president & CEO Terry Unter. The MI 7000XM is half the size and dissipates half the power of previous-generation DWDM 40Gb/s 300-pin modules.

The patent-pending Adaptive-DPSK technology enables 40Gb/s transport on 50GHz-channel-spaced systems and transmission over agile reconfigurable optical add-drop multiplexer (ROADM) networks without compromising critical ultra-long-haul (ULH) reach. The unit maintains the same industry-standard interfaces as its MI 4000XM predecessor, enabling existing customers to use the MI 7000XM module on line cards designed for the MI 4000XM. Such backward compatibility enables users to bring the latest technology to market rapidly without incurring significant development costs, the firm claims.

www.mintera.com

Emcore losses slashed as revenue grows 14% sequentially

Fiber Optics sector order backlog rises 42%

For its fiscal second-quarter 2010 (to end-March), Emcore Corp of Albuquerque, NM, USA, which makes components and subsystems for the broadband, fiber-optic, and solar power markets, has grown revenue sequentially for a third consecutive quarter, to $48.2m (exceeding guidance of $45–47m). This is up 14% on last quarter's $42.4m and 11% on $43.3m a year ago.

Photovoltaics revenue was $18m (37% of overall revenue, down from 40% last quarter). This is up 21% on $14.9m a year ago and 7% on $16.8m last quarter (due mainly to space solar power products growing 8%).

Fiber Optics revenue was $30.2m (63% of overall revenue, up from 60% last quarter). This is up 6% on $28.4m a year ago and 18% on $25.6m last quarter (including digital fiber-optics product revenue up 25% and broadband product revenue up 14%), due mainly to higher demand for cable TV, parallel optics and telecom products.

Fiber Optics gross margin rose for a third consecutive quarter, to 23.6% (the highest in the last seven quarters). This is up from 16.7% last quarter and –11.7% a year ago, due mainly to higher margins in the broadband and digital product lines as well as lower excess and obsolescence inventory charges.

Photovoltaics gross margin was a record 46.6%, more than double the 22.1% last quarter and a big improvement on –24.7% a year ago. This was due mainly to greater sales of higher-margin space solar power products, improved manufacturing yields and efforts to manage operational costs, favorable adjustments of $0.8m related to the sale of inventory previously reserved for, and a larger-than-expected benefit from a precious metal reclamation process of about $0.4m.

Overall gross margin has improved for a fourth consecutive quarter, from –16.2% a year ago and 18.9% last quarter to 32.1% (the highest since fiscal Q4/2001).

Net loss has been slashed further, from $23.7m a year ago and $13.6m last quarter to just $1.7m, the firm's best bottom-line performance in the last six years.

Photovoltaic generated positive operating cash flow for the fourth consecutive quarter, while Fiber Optics also generated positive cash flow (the segment's third consecutive quarter of sequential improvement in cash flow). Overall operating cash flow was $1.1m, despite increasing inventory levels associated with the increase in customer orders and future demand. Emcore has now generated positive operating cash flow in three of the last four quarters, aggregating $900,000 (compared with cash consumption of $43.5m in the prior four quarters) due to a combination of improved operating performance, a continued focus and improvement on working capital management, and lower spending on capital equipment.

PV generated positive operating cash flow for the fourth consecutive quarter, while Fiber Optics also generated positive cash flow

Net working capital rose $5.9m to $37.9m (the first sequential rise in seven quarters). Over the last four quarters, Emcore has generated $7.6m in cash from working capital driven mainly by the monetization of $10.1m of inventories and the lowering of accounts receivable balances by $4.6m.

During the quarter, cash, cash equivalents, current restricted cash, and available-for sale securities rose by $2.5m to $19m. Nevertheless, Emcore continues to maintain a $14m credit facility with Bank of America and a $25m committed equity line of credit facility with the Commerce Court Small Cap Value Fund Ltd.

During the quarter, order backlog rose 11%, from $61.2m to $68m. In particular, Fiber Optics backlog was up 42% from $18.9m to $26.7m (due to broad-based increases across both customers and products). This outweighed Photovoltaics backlog falling slightly from $42.3m to $41.3m.

President & CEO Dr Hong Hou says that the quarter represents the firm's best operating results in the last several years. "Our businesses are finally getting back on the right track... we expect a continued improvement in the current quarter," he adds. For fiscal third-quarter 2010 (to end-June), Emcore expects revenue to rise 1.7–5.8% to $49–51m, with growth in both the Photovoltaics and Fiber Optics segments.

● On 3 February Emcore said that it had entered into an agreement to sell 60% of its Fiber Optics business to the Tangshan Caofeidian Investment Corp (a Chinese non-operating investment firm administered by Tangshan City's Caofeidian Industry Zone in Hebei Province), creating the Hong Kong-registered joint venture Emcore Fiber Optics Ltd (EFO). Emcore says that it is in the process of securing government approvals and expects to consummate the transaction shortly after receiving such approvals.

www.emcore.com

IQE announces 6" wafer capability for CPV applications

Comparable performance achieved on both Ge and GaAs substrates

Epiwafer foundry and substrate maker IQE plc of Cardiff, UK has developed epitaxial processes for producing high-efficiency, triple-junction concentrator photovoltaic (CPV) solar cells with comparable results on both 6 inch diameter germanium and gallium arsenide substrates.

IQE has been supplying the global chip industry as a pure-play contract manufacturer for more than two decades and is established in GaAs-based epiwafer products for wireless applications including RF components for mobile phone handsets. The group, which has manufacturing sites across Europe (Cardiff, Milton Keynes and Bath in the UK), Asia (Singapore) and the USA (Bethlehem, PA and Somerset, NJ), has been working with key partners during the last two years to develop multi-junction solar technologies for the provision of large-scale renewable energy.

Increased wafer sizes are an essential step in ensuring the provision of high-quality and highly efficient solar power generation at the lowest possible cost, says IQE. Current CPV technology is based on 4"-diameter wafers, but IQE says that its new capability has demonstrated what is claimed to be unsurpassed performance and excellent uniformity across 6" (150mm) diameter wafers. Peak multi-sun device performance is the same for both types of substrate (Ge and GaAs) and approaches the best previously achieved on 4" substrates using the same process, the firm adds.

"Delivering 6" diameter wafers for CPV applications is an important milestone for IQE," says group CEO & president Dr Drew Nelson. "Our experience as the world leading outsource manufacturer of GaAs-based wafers has enabled us to develop the capability to produce multi-junction solar cells on both GaAs and Ge substrates with comparable results, fully scalable from our well-established 4" process in terms of performance, uniformity, and yield," he adds.

"Our 6" CPV wafer products have generated a great deal of interest at both the cell supplier and systems-supplier level, and have demonstrated excellent performance and uniformities on which we will continue to build," Nelson concludes.

www.iqep.com

Spire's large-area cell reaches 41% efficiency at 500x suns

Spire Corp of Bedford, MA, USA, which provides capital equipment and turnkey production lines for manufacturing photovoltaic (PV) cells and modules, says that subsidiary Spire Semiconductor LLC of Hudson, NH has matched the energy conversion efficiency record for a concentrator photovoltaic (CPV) cell. The record efficiency is available on a production-ready cell with a photovoltaic area of 1.0cm^2.

The US Department of Energy's National Renewable Energy Laboratory (NREL) measured efficiency of 41.0% at 500-sun concentration. Spire Semiconductor began working with NREL under an 18-month, $3.7m cost-share subcontract in early 2009. The goal is to develop a 42.5%-efficient triple-junction GaAs 'Triathlon' cell for CPV systems.

"We have experienced continuous improvement in our proprietary cell processing design technology throughout the NREL contract," says chairman & CEO Roger G. Little. "We have nearly four months remaining under the subcontract to surpass this level and achieve the target 42.5% efficiency," he adds. "A more efficient concentrator solar cell will provide a lower-cost and more reliable source of solar generated electricity."

www.spirecorp.com/spire-bandwidth-semiconductor

Contract to develop high-efficiency solar cells for space applications

Spire Semiconductor has been awarded a contract from the US Missile Defense Agency (MDA) to develop high-efficiency, multi-junction cells for space applications.

"This award is timely since it supports our ongoing terrestrial solar cell business," says Spire Semiconductor's general manager Edward D. Gagnon. "Currently, we are developing a 42%-efficient, 500-sun concentrator cell under a US Department of Energy's National Renewable Energy Laboratory contract [awarded in April 2009]. The MDA contract will help to further establish our capabilities and expertise in CPV cell technology for both space and terrestrial solar cell applications," he adds.

"The market opportunities for concentrator solar cells are significant," comments Spire Corp's chairman & CEO Roger G. Little. "This contract supports commercial initiatives at Spire Semiconductor and provides validation of Spire's approach to increasing the efficiency while lowering the cost of concentrator solar cells," Little adds. "We have already generated significant customer interest, and we plan to work closely with the MDA and customers to develop devices that optimally address strategic interests and market needs."

ISE researchers win Fraunhofer Prize for record-efficiency multi-junction solar cells and CPV modules

Drs Andreas Bett and Frank Dimroth — heads of the Department of Materials (Solar Cells and Technologies) and the III-V – Epitaxy and Solar Cells group, respectively, at the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany have received the Fraunhofer Gesellschaft's highest distinction — the €20,000 Joseph von Fraunhofer Prize for 2010 — for achieving record solar cell conversion efficiency of 41.1% last year. Since 1978, the Fraunhofer Gesellschaft has awarded staff annual prizes for outstanding scientific accomplishments that solve applications-based problems.

In ISE's record metamorphic triple-junction cell reported last year, three subcells of gallium indium phosphide (GaInP), gallium indium arsenide (GaInAs) and germanium (Ge) are deposited by MOCVD in a stacked on top of each other. Each absorbs different wavelength ranges of the solar spectrum, boosting energy conversion efficiency. Fresnel lenses at a distance of about 10cm focus incident sunlight onto the 3mm^2 cells, concentrating it by a factor of 500. The technology produces more power per area than conventional flat-plate PV technology, reducing the area of semiconductor needed. "We substitute costly semiconductor material with inexpensive optics," says Bett. The record conversion efficiency of 41.1% is nearly double the efficiency of conventional silicon-based solar cells.

Bett (left) and Dimroth (right).

ISE's multi-junction cell technology has been implemented in concentrator modules that have been commercialized with spin-off firm Concentrix Solar GmbH under the brand name FLATCON. Concentrix now has more than 60 staff and ships modules mainly to the USA and southern Europe, including systems feeding more than 600kW into the grid at a solar park in Spain. Currently, the AC efficiency of a complete 5kW system is 25%.

Due to the concentrating optics, the systems make use of only direct solar radiation and hence must track the sun. However, due to the two-axis tracking mechanism, high power output can be achieved even in the morning and evening hours. Also, since radiation scattered by clouds or water droplets cannot be concentrated, such systems are not particularly suitable in countries like Germany or as roof-top systems, but rather as large commercial power stations in sunny countries having a large fraction of direct radiation, e.g. in southern Europe.

Using ISE's latest metamorphic triple-junction solar cell technology gives systems with 29% efficiency. Using efficient cells also reduces the cost of solar electricity, says Bett. Under favourable conditions, electricity costs of just 10–15 cents per kilowatt are possible for southern Europe. "Systems have the potential to supply southern Europe with low-cost solar electricity in a matter of just a few years," reckons Dimroth.

"Mass production reduces costs," says Dimroth. "In the long-term, we calculate that this technology will be about 20–30% more economical than silicon technology." A team of 50 staff at ISE is hence working to optimize aspects of the system, i.e. from the cell through the measurement technology and process technology up to the modules. An advantage of CPV systems is their modular construction, which allows them to be expanded arbitrarily to kilowatt or even gigawatt size. Also, the capital needs and investment for building automated series production are comparatively low. In addition, the energy consumption for the manufacture and installation of the CPV systems is amortized within a few months. The aim is to demonstrated that the systems can be made in large numbers at low cost and that they can produce energy reliably over a period of 20 years.

www.fraunhofer.de/en/

Fraunhofer ISE's Frank Dimroth receives French science prize

At the Institut de France in Paris on 9 June, Dr Frank Dimroth of the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany received the 'Fondation Louis D' award (the highest-endowed award presented in France for achievements in science), which carries a cash value of €750,000.

The Fondation Louis D was established 10 years ago under the auspices of the Institut de France (a non-profit organization dedicated to the advancement of language, science and the arts), and presents a major science award each year (along with a major award for research in the humanitarian or cultural area).

"High-efficiency concentrator technology — in addition to photovoltaics using crystalline silicon and the classic thin-layer technology — will become established as a third technology for cost-efficient generation of solar electricity in the sunny regions of the world," believes Fraunhofer ISE's director Professor Eicke R. Weber.

OPEL Solar expands North American manufacturing to support US and Canadian local content requirements

OPEL Solar Inc, a subsidiary of OPEL International Inc of Shelton, CT, USA and Toronto, Canada, which makes high-concentration photovoltaic (HCPV) panels and other solar products, says it is qualifying manufacturing companies to build its product line in North America.

US manufacturers are being qualified in nine states across the country. In Canada, it is ready with a number of suppliers in the Toronto area. The firm says that the manufacture of its HCPV panels and tracker products, with the support of local industry in the USA and Canada will ensure expeditious and cost-effective delivery of North American orders.

OPEL Solar says that manufacturing in both Canada and the USA exemplifies its abilities to help customers apply for the solar incentives available that require Ontario or US job content for some portion of a project. For example, with the Ontario feed-in tariff recently implemented, the firm is compliant and ready to start on utility-scale projects with primary suppliers aligned.

"With so many industries declining recently, solar power represents a bright spot with potential for significant growth for many years to come. OPEL Solar has been responsive to our customers and the solar market by being agile and ready for local content requirements that benefit economies," OPEL Solar's chief operating officer Francisco Middleton.

"We at OPEL Solar are very happy to work with local suppliers to provide for in-country manufacturing content," says Ed Linke, director of Mechanical Engineering. "Working with a local company has many advantages, especially for the development and manufacturing of our products," he adds. "We have challenged each supplier on price, quality, and delivery; and they are meeting that challenge."

www.opelinc.com

CEO & president Robert G. Pico steps down

OPEL International has made changes to its management and board of directors following the resignation of CEO, president & board member Robert G. Pico (who remains in a consulting capacity, assisting with several strategic customer accounts and other key matters).

Board member Leon (Lee) M. Pierhal (with OPEL since 2001, and president of OPEL Inc affiliate ODIS Inc), has been appointed OPEL's CEO & president.

OPEL has also made changes to the structure of its board of directors. Lawrence R. Kunkel, who has served several years as a board member and chair of the Audit Committee (and has long-standing connections to the renewable energy and the defense industries), has been appointed chairman of the board. Former chairman Denis Colbourne remains on the board and continues to serve on the Audit and Compensation Committees.

"We wish Bob well. We thank him for all his accomplishments at OPEL and look forward to a continued working relationship with him on strategic projects important to building upon the commercial success OPEL has achieved as the leading innovator in the HCPV industry," said Lawrence R. Kunkel.

OPEL has also expanded Frank Middleton's role as VP of marketing & chief operating officer of OPEL Solar to include being chief operating officer of all OPEL companies.

OPEL opens $7m fundraising round

Due to a rapid increase in its pipeline for solar business, OPEL International plans to raise up to $7m in a brokered 'best efforts' private placement of units of the company at a price of $0.30 per unit.

Each unit consists of one common share and one-half of one common share purchase warrant. Each whole warrant entitles the holder to purchase one additional common share at $0.50 for a period of two years following the closing of the offering.

The purpose of the new funding is to allow OPEL to build inventory and other infrastructure requirements to meet the potential product demand.

OPEL has engaged IBK Capital Corp in Toronto, Ontario as the lead investment bank for the offering. IBK Capital president William F. White has a long-standing relationship with OPEL, having raised about $19m for OPEL in its early funding from December 2005 to December 2007. OPEL's board of directors says that it selected IBK to lead the new round of funding because of its history spanning more than 21 years in the mining, renewable energy, and technology market sectors. IBK will start scheduling meetings with the investment community immediately.

The offering is subject to all necessary regulatory requirements including the approval of the TSX Venture Exchange. All securities issued will be subject to the applicable statutory, exchange and regulatory hold period of four months. The offering is expected to be completed by the end of June.

OPEL sees rise in RFQs for industrial-scale CPV systems

Despite an uneven economic recovery and the lingering effects of the global recession on virtually every industry worldwide, OPEL Solar Inc of Shelton, CT, USA (a subsidiary of OPEL International Inc of Toronto, Canada) is reporting a sharp rise in requests for quotes (RFQs) on industrial-scale solar power systems in both North America and abroad, according to CEO Leon (Lee) M. Pierhal.

"With the worst hopefully behind us, there is no question that both governments and investors alike are reaffirming their interest and commitment to solar power in a big way," says Pierhal. "Since late 2008 when the credit markets first crashed, we have seen a significant increase in requests for quotes on both our HCPV [high-concentration photovoltaic] solar panels and our ground-based and rooftop tracker systems," he adds.

OPEL Solar claims that its gallium arsenide-based HCPV panels can generate up to 40% more kilowatt-hours than conventional flat-plate silicon solar panels. On 28 April, the firm also announced plans for US-based manufacturing of its utility-scale TF-800, a ground-mounted single-axis tracker (developed with FEiNA) that allows ease of installation and avoids shadowing from adjacent trackers (due to its reverse tracking ability).

Pierhal attributes the increase in quote activity to OPEL Solar's completion (with Spanish partner BETA-SOL) of a 330kW HCPV utility-grade power plant in Spain last October, as well as the firm's agreement in April to participate in a 1MW Portuguese HCPV installation with Tecneira S.A of Porto Salvo, Portugal, the renewable energy firm of power plant developer ProCME Group (and one of the largest renewable energy construction firms in Portugal). The latter is Portugal's first use of CPV technology, and will also use a dual-axis tracking system. Both installations, which are eligible for feed-in-tariffs (FIT), will provide investors with a guaranteed rate of return, OPEL assures.

Pierhal also notes an especially sharp and recent focus in the marketplace on solar power installations of at least 1MW in size. Also in first-quarter 2010, OPEL Solar was selected (via a partnership with French tracker firm Exosun) for an initial 1MW HCPV power plant in the South of France, with installation starting mid-year. Again, the plant will be grid connected, selling electricity to the country's utility. Deliveries on both the Portuguese and French 1MW projects will begin in second-half 2010.

"We are also partnering with one of the largest engineering and construction companies in the world to build utility-scale solar power farms in North America," Pierhal says.

"Neither the private sector nor forward-looking countries want to mortgage their future or straitjacket their ability to compete globally by relying exclusively on more traditional fossil fuel sources."

On 20 May, OPEL International Inc reported revenue for first-quarter 2010 up on both last quarter and a year ago. In addition, the firm says that the increased quoting activity on large-scale, utility-grade projects during first-quarter 2010 is due to its continued focus on forging relationships with large engineering, procurement and construction (EPC) companies and power producers. "With our new relationships and increased backlog, we are poised to significantly increase our revenue and shareholder value in 2010," asserts chief financial officer Michael McCoy.

● On 25 May, OPEL International said that it had mailed proxy materials to shareholders prior to their Annual Meeting in Toronto on 18 June at which they will be asked to consider a special resolution authorizing (subject to regulatory approval) a change of the firm's name to OPEL Solar International Inc. The firm says that, as it gains market share in solar energy, the name change better reflects its primary business and heightens awareness of OPEL's purpose.

www.opelinc.com

OPEL raises revenue forecast as firm reaches 'turning point'

OPEL International has raised its revenue outlook for the next 18 months significantly, even excluding the revenue potential of OPEL's Shelton-based affiliate ODIS Inc (Opel Defense Integrated Systems).

This is based on certain 'reasonable assumptions' including the status of projects in the pipeline as well as continued quoting and request for proposal activities with three significant solar project developers, the firm emphasizes. "We currently foresee solar revenues possibly approaching $50–80m over the next 18 months as 30–100MW of solar energy projects are installed," says chief financial officer Michael McCoy. "OPEL is definitely at a turning point and should grow dramatically in the next 12–18 months," he believes. The projects in which OPEL is currently involved will drive revenue growth from second-half 2010 through 2011, says the firm.

OPEL says that the positive forecast for its solar business is due to relationships forged with Bechtel Power Corp, ABB Ltd and alternative energy developer CME Energy as well as various engineering, procurement & construction firms over the past year. One result of these relationships is an installation with CME Energy, which has selected affiliate OPEL Solar Inc to supply panels and trackers for a 30MW installation in the Midwestern region of the USA.

SolFocus completes largest CPV plant in North America

Victor Valley College in Victorville, CA, USA has held an opening ceremony for the largest solar power plant in North America using concentrator photovoltaic (CPV) systems, provided by CPV system maker SolFocus Inc of Mountain View, CA. After two months of construction, the six acre, 1MW solar plant is now providing power. The plant is on Victor Valley College's main campus and consists of 122 SolFocus SF-1100S CPV arrays.

The college's solar micro-generating facility is now connected to the regional electrical grid operated by Southern California Edison and will produce about 2.6 million kilowatt-hours annually (about 30% of the college's electricity demand).

The college will also be developing curriculum within its existing academic and technical programs around the solar technology, including installation, operations, and maintenance. SolFocus says that it will support the college in its curriculum development, including materials, training, and instruction.

"Victor Valley College boasts one of the largest and most innovative on-campus solar plants in North America," says the college's superintendent & president Dr Christopher O'Hearn. "In addition to providing energy cost savings and a new revenue stream, these 122 arrays will provide the ideal testing ground for our students to build green careers that support the nation's new energy economy," he adds.

"We can provide 1MW of clean power in the desert with minimal land and water impact," notes SolFocus' president & CEO Mark Crowley. "At the same time, we can train the next generation of solar professionals with innovative technology... such distributed generation projects will mobilize other colleges, communities, and organizations across the US to incorporate renewable energy into their power supply on the path toward even larger utility-scale projects," he adds.

SolFocus CPV arrays at Victor Valley College.

"These types of infrastructure investments in sustainable technologies are a key driver for California's economy, and are creating jobs today within the local community," comments Abel Maldonado, Lieutenant Governor of California. "The clean tech sector is where the state can demonstrate its advanced innovation and growing green workforce. This trailblazing solar plant will provide students with training for a fast-growth career in California's new energy economy," he adds.

These types of infrastructure investments in sustainable technologies are a key driver for California's economy

"California is leading the nation in progressive environmental policy objectives and this project showcases how policies set forth by SB 1 (California Solar Initiative) and AB32 (California Global Warming Solutions Act) are enabling economic growth and generating jobs," says Barbara Riordan, a member of the California Air Resources Board.

"From groundbreaking to grid connection, this project was up and running in less than three months," says district program manager Al McQuilkin of gkkworks. "As the project manager for the solar plant we were pleased to find a solar technology that offered such high value. It exceeded our expectations with its advanced technology and a five-year payback period."

SolFocus' CPV design uses a system of patented reflective optics (curved mirrors) to concentrate sunlight 650 times onto GaAs-based solar cells (on germanium substrates) that have high solar energy conversion efficiency (approaching 40%, more than twice that of traditional silicon solar cells).

From groundbreaking to grid connection, this project was up and running in less than three months

Like its smaller SF-1000S system (approved by the CEC in September 2008), the firm's second product (the SF-1100S, launched that November) uses about a thousandth of the active solar cell material compared to traditional silicon-based PV panels, but boosts panel conversion efficiency from 18% to more than 25%.

www.solfocus.com

Natcore agrees acquisition of II-VI-on-CNT firm Vanguard

After signing a letter of intent at the end of March, Natcore Technology Inc of Red Bank, NJ, USA has executed a formal share purchase agreement with all of the security holders of Vanguard Solar Inc of Sudbury, MA, USA, a private firm controlling key solar energy intellectual property. Closing of the acquisition is expected soon, subject to approval of the TSX Venture Exchange.

The acquisition follows the formation of the joint venture Natcore China with a Chinese consortium to produce equipment and materials for solar cell manufacturing using Natcore's proprietary liquid phase deposition (LPD) technology, which was licensed exclusively from Rice University.

Two of Vanguard's founders and shareholders are professor Andrew Barron and Dr Dennis Flood, both of whom are scientific founders of Natcore. It was collectively felt that the acquisition of Vanguard and integration of its technology into Natcore's intellectual property portfolio would continue to expand the depth and breadth of Natcore's impact on the solar industry.

Vanguard has been focused on developing a flexible, thin-film photovoltaic material capable of silicon-like conversion efficiency, but potentially at one-tenth the manufacturing cost and one-twentieth the capital investment. The firm employs a proprietary chemical bath process similar to Natcore's LPD technology. However, Vanguard has grown II-VI compound semiconductor thin films on carbon nanotubes (CNTs) at room temperature and ambient pressure, while Natcore has so far concentrated on growing silicon dioxide films on silicon substrates.

First-generation products from Vanguard's method could produce 15–16% efficiencies at module costs of 60–70 cents per watt. It is anticipated that second-generation technology could achieve 20% efficiencies at even lower costs per watt. The investment for production facilities is projected to be as little as $10–15m per 100–150MW of production capability, compared with current costs of as much as $250m for standard solar-cell production facilities, it is reckoned. Vanguard's production equipment would be designed for insertion into an existing roll-to-roll film-coating line of the sort that has been displaced by the emergence of digital photography. All production materials are widely available and much cheaper than silicon and other thin-film systems, it is claimed. The process would enable a very cost-efficient production capability in large-scale facilities, Natcore reckons.

Vanguard has achieved proof-of-concept in small-area devices and is ready to move to a validation stage, during which it will demonstrate larger-area working devices at the targeted efficiencies. The firm has two pending patents covering its solar cell development, as well as a broad range of photodetectors and optical sensors. Applications for the latter include manufacturing process monitoring and controls, homeland security surveillance, and biomedical sensors for diagnostics and testing.

In exchange for purchasing Vanguard, Natcore has agreed to issue Vanguard shareholders a total of 373,606 common shares.

In conjunction, Natcore entered into an agreement with a firm performing services for Vanguard to pay legal fees incurred by it through the issuance of 120,075 common shares of Natcore and an agreement with a firm providing services to Natcore in relation to the Vanguard acquisition through the issuance of 20,000 common shares, all of which is subject to approval by the TSX Venture Exchange.

www.NatcoreSolar.com

IN BRIEF

Underwriters Laboratories India to use Spire solar simulator

Spire Corp of Bedford, MA, USA, which provides production equipment and turnkey production lines for manufacturing photovoltaic (PV) cells and modules as well as engineering, procurement, and construction (EPC) services for solar systems, says that Underwriters Laboratories (UL) has once again selected its SPI-Sun Simulator 4600SLP as a standard to test and certify PV modules. Already in use at UL facilities in the USA, China and Germany, the Simulator will now serve as the primary test equipment gauge at the new UL facility in Bangalore, India.

Spire's simulators have become the benchmark for PV module testing with most of the world's manufactured modules (both crystalline silicon and thin films) tested with Spire simulators. With a Class AAA rating, the simulators can provide high-volume production with a low cost of ownership. Spire's proprietary method of controlling the simulator's pulse or flash length, large irradiance range, and superior spectral control, allow test labs the ability to measure modules beyond their own test standards and understand critical aspects of their performance.

"Test agencies such as UL, NREL, TÜV, FSEC, CSA, KIER, Intervac, and Bodycote all use our simulators as their standard," says chairman & CEO Roger G. Little.

Underwriters Laboratories is an independent product safety certification organization that has been testing products and writing standards for safety for more than a century.

www.spirecorp.com/spire-bandwidth-semiconductor

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5N Plus' sales rise 22% to record $19.2m

For its fiscal third-quarter 2010 (to end-February 2010), 5N Plus Inc of Montreal, Quebec, Canada has reported (in Canadian dollars) record revenue of $19.2m, up just 0.4% on $19.15m a year ago but up 22% on $15.8m last quarter.

5N Plus produces high-purity metals like tellurium, cadmium and selenium, as well as II-VI semiconductor compounds such as cadmium telluride (CdTe) and cadmium sulphide (CdS) as precursors for the growth of crystals for applications including infra-red detectors for night-vision systems, radiation detectors for medical imaging, thermoelectric modules for cooling, and thin-film photovoltaic cells for solar panels. The firm is an integrated producer (with both primary and secondary refining).

Net earnings were $4.1m, down on $5.2m a year ago but up from $3.2m the prior quarter.

The record sales and improved profitability with respect to the previous two quarters are despite a continuing strengthening of the Canadian dollar with respect to its European and American counterparts, which had a negative impact on sales of about $3m, says president & CEO Jacques L'Écuyer. "Demand for our solar-grade products continued to be strong, but it is the increase in sales of our non-solar products which was largely responsible for the record quarter," he notes. "These non-solar products include for the first time those produced by our subsidiary Firebird Technologies, the performance of which positively impacted both our sales and earnings in the quarter."

5N Plus acquired Firebird Technologies Inc of Trail, British Columbia, a manufacturer of compound semiconductor products and pure metals, on 1 December.

"We made several announcements in the quarter primarily centered on our compound semiconductor wafer business and our recycling activities," L'Écuyer continues. Concurrently with the purchase of Firebird, 5N Plus also announced the a memorandum of understanding which Teck Metals Ltd, a subsidiary of Teck Resources Ltd (a producer of base metals and minor metals), for the long-term supply of strategic metals including indium, cadmium and germanium. The MOU was later converted into binding agreements, ensuring a reliable supply of critical feedstock including indium and germanium for Firebird.

"We also made great strides in the quarter to further establish our recycling business," says L'Écuyer. On 25 January, 5N Plus and CdTe thin-film PV module maker Abound Solar of Loveland, CO, USA said they had signed a PV module recycling agreement and a memorandum of understanding for the supply of semiconductor compounds.

Shortly after the quarter ended (on 18 March), a similar deal was announced with CdTe PV maker Calyxo GmbH of Bitterfeld-Wolfen, Germany. "Both agreements, together with our joint development efforts carried out with First Solar, are aimed at providing our customers, and more generally the solar industry, with environmentally sustainable recycling solutions," says L'Écuyer.

In addition, 5N Plus announced the sale of its stake in ZT Plus, formed just last August with BSST LLC of Irwindale, CA, USA (a subsidiary of Amerigon Inc of Northville, MI). This follows slower-than-expected commercial development of the joint venture.

As of end-February, 5N Plus' backlog of orders expected to translate into sales over the following 12 months was $53.8m, up 3.4% on $52m a year earlier.

"We are very hopeful about Firebird's future prospects and have begun construction of a new facility in Trail which will allow for expansion of their current activities," says L'Écuyer. "Investment in this new facility will enable Firebird to develop into a major producer of semiconductor wafers and a significant provider of products for the germanium and solar markets," he believes. "This is in line with the growth plan to which we remain committed, which calls for diversification of our product offering and accretive acquisitions."

www.5nplus.com

5N Plus promotes Audet to VP as it ends Amerigon partnership

5N Plus has promoted Nicholas Audet to vice president, with operational and commercial responsibility for all of 5N Plus' activities (excluding those of subsidiary Firebird Technologies). "Nicholas has been instrumental in our success through his leadership of our R&D activities, which included the development of our cadmium telluride technology," says 5N Plus president & CEO Jacques L'Écuyer.

"More recently, Nicholas was acting as managing director of our joint venture ZT Plus," L'Écuyer continues. ZT Plus was formed just last August as a partnership between 5N Plus and BSST LLC of Irwindale, CA, USA (a subsidiary of Amerigon Inc of Northville, MI). Its aim was to develop and manufacture more efficient thermoelectric materials for heating and cooling as well as power generation applications in industrial, consumer, medical, electronics and automotive markets.

"Unfortunately the commercial progress of ZT Plus was slower to develop than anticipated. In addition, there were differences over the future business strategy between the two partners that could not be reconciled," L'Écuyer explains. "Accordingly, it was mutually agreed that 5N Plus would sell its entire interest in the venture."

Abound Solar forms alliance with balance-of-system vendors

After entering full-scale commercial production last November, cadmium telluride (CdTe) thin-film photovoltaic (PV) module maker Abound Solar of Loveland, CO, USA (which was founded in January 2007 as AVA Solar but changed name in March 2009) has announced the Abound Alliance, which it describes as a unique ecosystem of balance-of-system partners that are collaborating with it to drive down the levelized cost of solar electricity.

The marketing partnership aims to allow each firm to better coordinate their product development, marketing and sales efforts, while optimizing products to improve performance, reduce costs, and/or increase system reliability.

The firm says that the Abound Alliance gives engineering, procurement and construction companies, utilities and project developers a straightforward path for vendor selection as they design large-scale systems, allowing customers to choose the appropriate best-in-class solution for their specific needs.

"Abound Solar understands the complexities facing solar project developers and engineering firms," says senior VP of sales & marketing Julian Hawkins. "We have assembled the Abound Alliance to assist our mutual customers in simplifying the design, qualification, and procurement process," he adds.

Alliance members include:

- KACO new energy Inc of San Francisco, CA, which has built designed and manufactured current inverters and power electronics for more than 60 years (with more than 2GW of PV inverters in operation worldwide).
- Northern States Metals of West Hartford, CT, the maker of Solar Flex Rack, which is reducing installation costs of commercial solar array projects in the USA and Canada with its patent-pending ground-mount and roof-mount systems.
- PV Powered of Bend, OR (founded in 2003 and acquired recently by Advanced Energy Industries), which provides grid-tied PV inverters in the residential, commercial and utility markets, and aims to tackle three issues affecting the growth of solar worldwide: (1) improving inverter reliability, (2) lowering the levelized cost of ownership for PV power generation, (3) making distributed PV a scalable and controllable resource on the utility grid.
- Germany's REFU Elektronik (which has a North American office is in San Jose, CA) specializes in custom power engineering applications and inverters since 1965. REFU Solar Electronics offers solar inverters from 4kW to 1.3MW with conversion efficiency of up to 98.2%.
- Schletter Inc of Tucson, AZ, which has more than 40 years experience of manufacturing custom-designed solar module mountings for roof- and ground-mounted systems (with ground-mounted systems up to 70% pre-assembled in the factory, to reduce cost and decrease installation time in the field).
- SunLink Corp of San Rafael, CA, which provides scalable solar module mountings for commercial rooftop and ground-mounted systems that have been used by integrators on more than 90MW of projects at 500 sites across North America (most recently for a 50MW supply agreement with Southern California Edison).

The marketing partnership aims to allow each firm to better coordinate their product development, marketing and sales efforts, while optimizing products

www.abound.com

IN BRIEF

Abound partners with GP Joule to power 3.2MW of projects

Cadmium telluride (CdTe) thin-film photovoltaic (PV) solar module maker Abound Solar of Loveland, CO, USA and solar project developer GP Joule GmbH of Reußenköge Germany are partnering on two large ground-mount projects in Bosbüll and Treia Germany that will use Abound Solar modules.

The Bosbüll installation has already begun and will total 800kW DC in capacity. Preparation for the Treia installation is underway and will total 2.4MW DC in capacity. Both systems use REFUSol 500k and 630k inverters from REFU Solar Electronics.

"GP Joule is rapidly expanding to meet the incredible demand for high-quality, end-to-end renewable energy project development," says GP Joule's managing director Heiner Gaertner. "Abound Solar is uniquely positioned to help us continue that growth as it continues to ramp production capacity and support its customers," he adds.

Abound Solar has significantly ramped up production and module efficiencies since its commercial launch

"Abound Solar has significantly ramped up production and module efficiencies since its commercial launch," says the firm's CEO Tom Tiller. "We are glad to work together to demonstrate the performance and reliability of Abound Solar modules in large-scale installations in Germany."

www.gp-joule.de

First Solar to acquire solar project developer NextLight

Acquisition includes 1100MW project pipeline in southwestern USA

First Solar Inc of Tempe, AZ, USA, which makes thin-film photovoltaic modules based on cadmium telluride (CdTe) as well as providing engineering, procurement and construction (EPC) services, has entered into a definitive agreement to acquire NextLight Renewable Power LLC of San Francisco, CA, USA, an independent developer of utility-scale solar projects in the southwestern USA that was founded in 2007.

The all-cash transaction (about $285m, subject to certain closing adjustments) is expected to be completed in third-quarter 2010, pending the satisfaction of closing conditions specified in the agreement.

Further solidifying First Solar's position in the US utility renewable power market, the acquisition includes a 1100MW solar project pipeline:

- 570MW (AC) under signed power purchase agreements with western utilities, increasing First Solar's contracted photovoltaic (PV) solar project pipeline to 2200MW;
- 530MW (AC) of additional PV projects in various stages of development.

NextLight's projects are largely located on private land and range in size from 30MW to 290MW, expanding the scope and diversity of First Solar's pipeline. "NextLight has assembled a project pipeline that very much complements First Solar's project portfolio," says the CdTe PV maker's CEO Rob Gillette. "We are looking forward to having the highly experienced NextLight team join First Solar," he adds.

"The combination of NextLight and First Solar brings best-in-class power development experience and discipline to the emerging utility-scale solar industry," says NextLight CEO Frank De Rosa. "We look forward to joining the First Solar organization and leveraging their expertise to deliver high-quality solar generation," he adds.

NextLight's projects are largely located on private land and range in size from 30MW to 290MW, expanding the scope and diversity of First Solar's pipeline

First Solar says that the transaction is a strategic step in the firm's expansion in the US utility-scale power market, which began in 2007 with the acquisition of Turner Renewable Energy and continued with the acquisitions of solar project pipelines from OptiSolar in 2009 and Edison Mission Group in 2010.

The transaction is a strategic step in the firm's expansion in the US utility-scale power market, which began in 2007 with the acquisition of Turner

"Success in today's competitive solar market requires a complete solution for our customers' renewable energy needs," says Gillette. "First Solar is uniquely positioned to deliver utility-scale solar power plants, including project development, module manufacturing, engineering, procurement and construction (EPC), project finance expertise and operations and maintenance."

www.nextlight.com

Profit rises in Q1/2010 despite 11% dip in sales

Addition of new 220MW factory gets board approval

For first-quarter 2010, First Solar Inc of Tempe, AZ, USA, which manufactures thin-film photovoltaic modules based on cadmium telluride (CdTe) as well as providing engineering, procurement and construction (EPC) services, has reported net sales of $568m, up 36% on $418.2m a year ago, due mainly to strong module demand and increased production, partially offset by a decline in pricing. However, sales are down 11% from $641.3m last quarter, due mainly to a shift from turnkey systems to modules.

Net income was $172.3m, up from $164.6m a year ago and $141.6m last quarter due to higher volumes, increased module prices, and the absence of certain non-recurring expenses.

For 2010, First Solar forecasts net sales of $2.6–2.7bn (up from 2009's $2.07bn), reflecting reallocation of module capacity from the systems business to meet stronger module demand from European customers. The firm also expects operating cash flow to rise from $675m in 2009 to $725–775m, and total capital spending to rise from $280m in 2009 to $625–650m.

First Solar's board of directors has approved an additional four-line manufacturing plant

To expand capacity, First Solar's board of directors has approved an additional four-line manufacturing plant (with an annual capacity of more than 220MW at the first-quarter 2010 line run-rate). The plant is expected to begin production in fourth-quarter 2011.

www.firstsolar.com

First Solar to double German plant's capacity to 446MW

Expansion to create several hundred new jobs

First Solar Inc of Tempe, AZ, USA, which makes thin-film photovoltaic modules based on cadmium telluride (CdTe) as well as providing engineering, procurement and construction (EPC) services, says that — to serve its strong European customer base — it intends to double the annual production capacity of its German manufacturing plant in Frankfurt an der Oder from 223MW to about 446MW by fourth-quarter 2011. First Solar says that the expansion should also help to increase its natural income hedge against the euro/dollar exchange rate risk by producing more in Germany for European customer demand.

The firm, which already employs more than 600 in Frankfurt (Oder), is in advanced talks with the German regional and federal authorities to obtain the necessary regulatory permits and financial framework for the expansion, which should create several hundred new jobs and would be the first major foreign direct investment in the German green technology sector this year, it is claimed.

The German state of Brandenburg described the announcement as an endorsement of its strategy to further expand renewable energy production. "Companies that are willing to invest also in times of economic crises ensure a bright future of the state," comments Minister President Matthias Platzeck. "The expansion of production capacity of solar modules will foster our top position in renewable energy and will help the state to achieve its ambitious energy and climate goals," he adds.

"The announcement provides a further boost to one of the most innovative and fastest-growing sectors in Brandenburg," says Ralf Christoffers, Brandenburg's Minister for Economic Affairs. "In recent years, there has been quite a boom of solar companies moving here... I am especially pleased by the fact that additional jobs will be created in eastern Brandenburg," he adds.

"This announcement confirms our belief in and continuing commitment to the growth of the German and European markets for clean, affordable solar electricity," says First Solar's president Bruce Sohn. "It also reflects our confidence in our workforce in Frankfurt (Oder) and the strong partnership we have with the Frankfurt and Brandenburg governments."

The Frankfurt (Oder) plant was recently honored as the only industrial firm in eastern Germany to receive recognition by the 'Great Place to Work' Institute. The site includes a recycling facility as part of First Solar's commitment to resource efficiency and sustainability.

First Solar says that the expansion should also help to increase its natural income hedge against euro/dollar exchange rate risk by producing more in Germany for European customer demand

First Solar employs more than 4700 staff worldwide and has expected annual production capacity of more than 1.3GW in Germany, the USA and Malaysia in 2010. The firm also has three more plants in various phases of construction in France and Malaysia. When fully completed in Q1/2012, total capacity should be more than 2.1GW (based on the annualized run rate for first-quarter 2010).

www.firstsolar.com

First Solar joins US Clean Energy trade mission in China

Along with 45 other executives from 24 businesses, Bruce Sohn — president of First Solar Inc of Tempe, AZ, USA — participated in a cabinet-level Clean Energy Trade Mission led by US Commerce Secretary Gary Locke travelling through China from 19—21 May. The aim is to explore opportunities to meet China's growing demand for clean energy, and help US firms already doing business in China to grow by increasing their exports and assist experienced US exporters to enter the Chinese market for the first time.

"As they grow their presence in fast-growing countries like China, companies like First Solar can help solve unprecedented energy and environmental challenges while creating good paying jobs for the people of America and China," said Locke.

"China has the potential to become a leading global solar market and we intend to contribute to sustainable solar developments in all key markets globally," said Sohn.

First Solar makes thin-film photovoltaic modules based on cadmium telluride (CdTe) as well as providing engineering, procurement and construction (EPC) services. The firm has a solar module manufacturing plant in Perrysburg, OH, and a US workforce exceeding 1400 (which has more than doubled since 2006, largely due to exports).

Last September, First Solar signed an agreement with the Ordos City Government to develop the world's largest solar power plant (with a capacity of 2GW) in Inner Mongolia, involving supplying its PV technology to China and leveraging its experience of building large-scale PV power plants.

"We are encouraged by the Chinese government's focus on adopting sustainable clean energy technology and making renewable electricity economically viable," says Sohn.

Enfinity becomes Solyndra Gold Level Solutions Provider

Solyndra Inc of Fremont, CA, USA, which makes copper indium gallium diselenide (CIGS) photovoltaic (PV) systems consisting of panels and mounting hardware for commercial rooftops, has signed a 'Solyndra Gold Level Solutions Provider' agreement with Belgium-based Enfinity, which offers financing and development for renewable energy systems and — through its four business units (Develop, Invest, Technics and Trade) — develops, finances, constructs and sells PV and wind energy plants.

"Enfinity demonstrated their excellent customer service with a 340kW project completed in Belgium this past year," says Solyndra's CEO Chris Gronet. "We have been working closely with them to evaluate our systems in Northern Europe, resulting in a new 2MW order and a multi-megawatt pipeline," he adds. "Their global reach and outstanding reputation for technical and service excellence makes them a great addition to our Solutions Provider Program."

"We have been very impressed with the ease of installing Solyndra panels and the lightweight, non-penetrating mounting system," says Enfinity Group's CEO Hans De Backer. "With the low balance of system costs, and other benefits, Solyndra is a great addition to our product lines."

www.enfinity.biz

Global sales network enhanced with Solution Provider Program

At the end of March, Solyndra unveiled its Solution Provider Program, designed to create unique value for distributors and integrators that sell and service Solyndra's PV systems around the world.

"The Solyndra Solution Provider program brings additional value to our customers by identifying new sales opportunities, enhancing their technical capabilities, and offering them strategic differentiation in the marketplace," says Kelly Truman, senior VP of marketing & business development. "Top-tier solution providers have demonstrated expert-level knowledge of Solyndra systems and a commitment to high standards of customer service."

Solution providers receive benefits including: lead streams, marketing resources, technical training, and support for project financial analysis. The Solution Provider Portal offers 24/7 online access to an exclusive database of sales tools, including models to demonstrate Solyndra's low levelized cost of electricity (LCOE).

Under the tiered program, solution providers are eligible for either Platinum, Gold or Certified status.

Platinum Solution Providers to date include: alwitra GmbH & Co, Carlisle Energy Services, SunConnex B.V., Nazca (a GSE Group Company), Phoenix Solar AG, and USE Umwelt Sonne Energie GmbH.

Gold Solution Providers to date include: Advanced Green Technologies, Allied Building Products Corporation, Canada Solar Consortium, DC Power Systems, EBITSCHenergietechnik GmbH, Helios Energy, Orion Energy Systems, and Sun System S.p.A.

www.solyndra.com

First phase of Nova Coop rooftop installation completed

Solyndra Inc and Milan-based Enerqos Group, one of Italy's largest turnkey suppliers of solar systems and plants, have completed a 200kWp project for Nova Coop, one of the largest distribution chains in the Piedmont region of Italy. A rooftop installation in Villa Dossola, in the Vibo Valencia province of Italy, was connected at the end of April, representing the first phase of a multi-store installation project involving ultimately more than 15 distribution centers in Italy.

Solyndra CIGS PV installation at Nova Coop, Villa Dossola

Nova Coop is using unused rooftop space to generate solar energy, says Clemens Jargon, Solyndra's managing director for Europe.

Enerqos has implemented the Solyndra system through its Industrial Roof business unit and with the help of local partner PhotoVoltaic Systems. "Working closely with Solyndra, we are able to deliver the lowest balance of system costs and best return on investment," says Giovanni Landi, head of Enerqos' Industrial Roofs business unit.

Solyndra exhibited its CIGS PV modules at the recent SolarExpo 2010 in Verona, Italy (5–7 May).

www.enerqos.com
www.solyndra.com

ZSW sets thin-film PV cell efficiency record of 20.1%

German institute surpasses NREL's record of 19.9% using CIGS

Scientists at the Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg, Germany (Centre for Solar Energy and Hydrogen Research, ZSW) have achieved record efficiency for thin-film solar cells of 20.1%. This surpasses the previous record, which has been held for the last 16 years by the US Department of Energy's National Renewable Energy Laboratory (NREL) — most recently 19.9%, achieved in March 2008.

The CIGS (copper indium gallium di-selenide) solar cell was produced in ZSW's research laboratory in Stuttgart. The development could significantly improve the cost-effectiveness of CIGS thin-film photovoltaics in the medium term, the institute reckons.

"This record is for thin-film technology in general and not just CIGS solar cells," says Dr Michael Powalla, ZSW board member & head of the Photovoltaics Division. "It is the result of continuous systematic research which has been supported for years by the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, the Baden-Württemberg Ministry of Economics, and the European Community," he adds. "A major factor in the achievement is the close cooperation between basic research at university, applied research at ZSW, and production development at our industrial partner Würth Solar."

The solar cell has an area of 0.5cm^2 and was produced in a CIGS laboratory coating plant using a modified co-evaporation process, which in principle can be scaled up to a commercial production process. The solar cell consists of the semiconducting CIGS layer and contact layers, and has a total thickness of 4μm. The electrical and optical properties must be exactly matched when manufacturing the cell, which is difficult to master. The new results have been confirmed by Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany.

Higher efficiencies improve the electrical power output and thus the financial returns of photovoltaic systems. "Further up-scaling for industrial application is the next development step," says Powalla. However, it would take a while before the increased efficiency of CIGS solar cells can be commercially utilized, he adds.

Compared to standard crystalline silicon solar cells, thin-film photovoltaic cells save materials and costs, since their active layers are just a few microns thick. The market share of thin-film photovoltaics has hence risen from 7% to about 17% in recent years.

Of the three basic variants of thin-film solar technology (amorphous silicon, cadmium telluride, and CIGS), CIGS offers the highest efficiency. Commercially available CIGS modules currently range from 10% to 12% (a complete module always has a lower total efficiency than a single solar cell). Nevertheless, the new efficiency record shows the great potential of CIGS technology for lower-cost, efficient photovoltaic systems, says ZSW. Powalla assumes that efficiency levels of up to 15% can also be achieved in commercial modules within the next few years.

While ZSW develops CIGS thin-film modules, as the R&D partner of the firm Würth Solar it has advanced the technology to enable industrial production. In 2006, Würth launched what is claimed to be the world's first mass production of CIGS solar modules (in Schwäbisch Hall, Germany) and it now has an annual capacity of 30MW.

www.zsw-bw.de

Taiwan government forms CIGS industry alliance

Efficiency of 15% and product cost of $0.6 per Watt targeted by 2015

On 6 April, Taiwan's Ministry of Economic Affairs (MOEA) announced the formation of the Taiwan CIGS Industry Alliance in an attempt to promote the development of CIGS (copper indium gallium diselenide) thin-film PV modules in Taiwan, reports Digitimes.

The targets are to achieve an energy conversion efficiency, yield rate and average production cost of, respectively, 10%, 75% and US$1 per Watt by 2011; then 12%, 80% and US$0.8/Watt by 2013; and 15%, 85% and US$0.6/Watt by 2015.

Taiwan Semiconductor Manufacturing Company (TSMC) and AU Optronics (AUO), plus a number of suppliers of CIGS materials and equipment as well as module makers, have joined the new alliance.

The Taiwan CIGS Industry Alliance is intended to be a platform for sharing information and cooperation to facilitate the integration of resources and technological capabilities.

A roadmap has been drawn up to develop key materials and equipment in a first phase from July 2010 to the end of 2011, then to integrate them to offer turnkey production lines in a second phase by the end of 2012, according to MOEA.

www.digitimes.com/news/a20100407PD202.html

AQT partners with module maker and solar system firm

Applied Quantum Technology of Santa Clara, CA, USA has agreed partnerships with high-volume PV cell and module maker Solar Enertech and solar power design and installation firm HelioPower to drive delivery and deployment of its low-cost copper indium gallium diselenide (CIGS) thin-film photovoltaic cells into commercial projects this year. AQT says that the partnerships validate its unique 'CIGS 2.0' business model and will accelerate fulfillment of the growing number of orders for its low-cost alternative to traditional solar cells.

Solar Enertech's R&D team will act as a module manufacturing partner to help complete the final process of turning AQT's CIGS cells into modules, and will assist with product certification and qualification, starting in second-half 2010. "It is in line with our value-added strategy to the non-silicon segment and leverages our creative technology team," says Solar Enertech's CEO Leo Young.

HelioPower has engineered solar power solutions for residential, commercial, community and utility-scale partners since 2001, and has designed and installed more than 1000 systems worldwide. It will jointly address AQT's initial customer installations, aiming to provide a smooth market introduction for AQT's products. "Reliability, flexibility and economic viability are the cornerstones of our business model," says Ty Jagerson, HelioPower's executive VP, commercial sales. "We see AQT's products as a natural addition to our solar portfolio."

"AQT's CIGS 2.0 business model relies as much on world-class partners like Solar Enertech and HelioPower as it does on our breakthrough solar cells, and we will leverage the existing PV ecosystem to rapidly deliver solar solutions to market," says AQT's CEO Michael Bartholomeusz. "Leverage is perhaps the most effective force multiplier in this space and will go a long way towards helping us to collectively attain grid parity."

www.aqtsolar.com

AQT raises $10m to fund first, 15MW production plant

In early April, AQT completed the initial close of a $10m second round of venture funding from its original investor syndicate plus new investors, boosting funds to almost $15m since the firm was founded in 2007 with about $4.75m in backing from East Coast investment house STPV Holdings.

The new funds have been used to build out an initial 15MW production line in a new, leased Silicon Valley R&D and manufacturing facility (close to the firm's headquarters) in order to fulfill current customer orders due by year end. AQT also plans to boost staffing (currently just a dozen full-time staff and some contractors) in anticipation of full-scale production over the next 12 months (targeting production of 50MW in 2011).

"We have unique CIGS process technology, a dedicated group of investors, a seasoned team of executives and a core syndicate of established partners," says CEO Michael Bartholomeusz. "This latest investment is a testament to the enormous progress we have made in the last 12 months and will fuel substantial milestones over the next four quarters."

AQT's sample cells were validated by the US Department of Energy's National Renewable Energy Laboratory in April 2009 to have 10% efficiency. AQT has since reached 12% in its labs, and targets 14% by the start of commercial production. Efficiency will be about 2% lower once integrated into modules.

AQT is leveraging manufacturing technologies and platforms that are field-proven in the hard-disk-drive industry. Its proprietary 'CIGS 2.0' technology allows continuous in-line manufacturing, simplifying and streamlining the process for what is claimed to be the industry's highest projected capital utilization efficiency while minimizing costs.

AQT has also agreed a strategic partnership for Santa Clara-based Intevac, which develops high-productivity 'lean' manufacturing systems, to supply production equipment.

AQT has created a highly scalable architecture to produce low-cost drop-in replacements for conventional crystalline silicon cells by using its patented CIGS process on Intevac's production-proven manufacturing platform, which uses reactive sputtering with rapid thermal annealing to deposit layers of materials on soda lime glass.

"This agreement is an important milestone for Intevac as this tool will represent our first shipment in the solar industry," says Kevin Fairbairn, president & CEO of Intevac, which supplies semiconductor manufacturing equipment as well as magnetic-media processing systems to the hard-drive industry. "By leveraging our proven high-throughput lean manufacturing platform, Intevac enables the economic solution to AQT and the solar cell industry for conventional cell sizes," he adds.

"This agreement with Intevac is a major step towards capitalizing on AQT's breakthrough CIGS 2.0 approach," says Bartholomeusz. "Our leverage-based business model depends on strategic partners like Intevac in order to address the three critical success factors required by the new PV market realities: scalability, aggressive cost reduction, and continuous technical advancement," he adds. "Intevac enables AQT to address our mission to achieve the highest cost/performance ratio of any solar cell manufacturer."

www.intevac.com

Ascent's CIGS modules installed at ProLogis' test site

Ascent Solar Technologies Inc of Thornton, CO, USA, which manufactures flexible thin-film photovoltaic modules based on copper indium gallium diselenide (CIGS), says that its building-integrated photovoltaic (BIPV) class of laminates have been installed at the Rooftop Photovoltaic Test Site in Denver, CO of global distribution facility provider ProLogis Renewable Energy group.

ProLogis was formed in 2009 to procure new business, manage installations and provide development services for renewable energy projects globally. It has more than 475 million square feet (44 million square meters) of roof space worldwide available for solar photovoltaic installations, and leases industrial facilities to more than 4400 customers, including manufacturers, retailers, transportation companies, third-party logistics providers and other enterprises with large-scale distribution needs. ProLogis has solar projects installed or under construction on 32 buildings in France, Germany, Japan, Spain and the USA covering more than 10.6 million square feet of roof space and totalling 24.6MW. The firm has also become the first real-estate firm to develop a dedicated PV test site.

ProLogis' test site totals 11kWp DC of power generation capacity from 99 modules and eight different module makers: Ascent Solar, First Solar, GS-Solar, MiaSolé, Solyndra, Suniva, United Solar Ovonic, and Xunlight. Already generating power, the initial configuration provides side-by-side comparisons of several module technologies, including monocrystalline, glass-on-glass thin film and membrane-applied thin film. The installation also contains 16 individually monitored strings, each designed to test a certain system parameter.

ProLogis' test site totals 11kWp DC of power generation capacity from eight different module makers

"We were the first real estate company to develop a program dedicated to accelerating the deployment of large-scale distributed solar, and now we are expanding our efforts in this area with a dedicated test site," says ProLogis' CEO Walt Rakowich. "As PV technologies evolve and new companies enter the market, it is critical that ProLogis understands the technology and installation differences to ensure we arrive at the optimal solutions for our installations at each building and location," he adds. "We are proud of the growth of this program and what it means to the renewable energy industry."

"We commend ProLogis for establishing this test site to open the door for testing of emerging technologies such as ours in parallel with other established PV technologies," says Ascent's president & CEO Farhad Moghadam. "This important installation for Ascent Solar will provide us with valuable, real-time performance data that's critical in setting the stage for our product readiness in rooftop and building-integrated market opportunities."

As a part of the test site, ProLogis has partnered with HatiCon Solar to design a new racking system for utility-scale rooftop solar installations. "As a real-estate developer and owner, we seek the most compatible solution for our rooftop installations, both in terms of structural loads and roof integrity," says ProLogis' VP of renewable energy Matt Singleton. "This new attached rack design combines standardized, lightweight aluminum parts with the long-term assurance of a maintainable and warrantable watertight connection to our buildings."

www.AscentSolar.com

MiaSolé's CIGS PV modules tested at ProLogis

MiaSolé of Santa Clara, CA, USA, which was founded in 2001 to make copper indium gallium diselenide (CIGS) thin-film photovoltaic modules, is participating in ProLogis Renewable Energy's rooftop photovoltaic test site in Denver, CO, USA.

ProLogis' test site will provide side-by-side comparisons of modules from eight solar manufacturers. Performance will be measured for a variety of module technologies, including thin film, monocrystalline, glass-on-glass and membrane-applied thin film.

ProLogis' site is the first Colorado project for MiaSolé and is the seventh testing facility in the USA to feature MiaSolé's modules.

"Continued improvements in conversion efficiencies, manufacturing yields, and cost reductions have helped make photovoltaic solar one of the most affordable and efficient types of renewable energy today," says MiaSolé's CEO Joe Laia. "MiaSolé and ProLogis share a common goal of expansion for large-scale distributed solar installations," he adds. "We are pleased to participate in the ProLogis test site to demonstrate that our distinct manufacturing process produces CIGS modules that offer compelling value."

MiaSolé will have shipped 6.5MW in first-half 2010 and expects to ship 22MW in full-year 2010. Its CIGS panels currently convert 10.5% of sunlight into electricity. The products are designed for large-scale rooftop and ground-mount installations for utilities, independent power providers and industrial scale deployments.

www.miasole.com
www.prologis.com

Cambrios selects Ascent as partner for US Army contract

Electronic materials firm Cambrios Technologies Corp, which has developed wet-processed, transparent conductive films, has chosen Ascent Solar Technologies Inc of Thornton, CO, USA as its research partner to investigate how the films can be applied to lightweight, flexible CIGS photovoltaics, which is a topic of a recently awarded US Army contract W911QY-BAA-09-11-1 from the Army's Natick research facility.

As part of the program, which will be undertaken on behalf of the US Army Natick Soldier Research, Development and Engineering Center (NSRDEC), Cambrios will deliver flexible solar cells that incorporate a Cambrios ClearOhm electrode layer. Because of the material's improved transparency and light-handling capability, it is expected that these cells will be 1–3% more efficient than the equivalent cells made with the conventional transparent electrode material (such as indium tin oxide and other transparent conductive oxides).

"Ascent Solar has very high efficiency CIGS solar cells, so they are the perfect partner for this program," says Cambrios' CEO Dr Michael Knapp. "Unlike transparent conductive oxides typically used as thin-film solar cell electrodes, Cambrios' ClearOhm material is also highly flexible," he adds. "Together, our companies have the right technologies to provide the Army with lightweight, flexible CIGS solar cells with better efficiency than what has been possible to date."

The US military is the single largest consumer of energy in the world, and energy supply is an important issue for each soldier, says Ascent. Solar energy has been widely deployed by the US military to power permanent and temporary military installations and to reduce the weight carried by soldiers. Flexible PV cells can facilitate the use of this power source by making them more easily deployed on a variety of surfaces, such as tents, clothing and backpacks.

"Their technology, with its higher optical transmission and improved electrical performance, offers us the potential to enhance the performance of our photovoltaic modules," says Ascent's president & CEO Farhad Moghadam about Cambrios. "Combined with the potential to implement direct-write deposition technology, it is possible to simplify our manufacturing process," he adds. "Finally, the performance of their technology matches up well with our future needs in high-performance flexible PV modules."

www.cambrios.com

Ascent Solar announces nomination of new board members

Kim J. Huntley and G. Thomas Marsh have been nominated for election to Ascent Solar's board of directors. Together with president & CEO Farhad Moghadam, they are standing for election at the firm's Annual Meeting on 16 June.

"Huntley and Marsh add invaluable experience and knowledge to Ascent Solar that support our strategy and enhance our ability to capture high-value defense, near-space and space market opportunities," says Moghadam. Both have an understanding of procurement cycling and design integration in defense and space markets that should provide opportunities in these specialty markets, he adds.

Huntley served in the Defense Logistics Agency (DLA) of the US Department of Defense (DOD) for over 32 years. From July 2008 until retiring this January, he was director of the DLA's Defense Energy Support Center (DESC) in Fort Belvoir, VI, responsible for providing energy solutions to the DOD and federal civilian agencies. As principal executive officer, Huntley was in charge of 1100 staff and over $25bn in annual appropriations involving energy infrastructure and products.

From March 2006, Huntley served in roles involving supply chain management, including deputy commander for the Defense Supply Center in Richmond, VI and Columbus, OH, and executive director of Customer Support and Readiness. From December 2003 to March 2006, he was chief of the Customer Support Office in Fort Belvoir. From January 2009 to January 2010, he chaired the Inter Agency Working Group for Alternative Fuels and Renewable Energy, which included senior energy representatives from DOD, DOE, EPA, and other Federal Agencies.

Huntley brings extensive supply chain, budget and defense industry experience, comments Moghadam.

Marsh retired in June 2006 as executive VP of Lockheed Martin subsidiary Lockheed Martin Space Systems Co, which designs, tests, makes and operates advanced technology systems, including human space flight systems, satellites and instruments, space observatories and interplanetary spacecraft, laser radar, fleet ballistic missiles, and missile defense systems. From 1969 until its merger in 1995 to form Lockheed Martin Corp, Marsh worked at Martin Marietta Corp, latterly as president Manned Space Systems. After 1995, roles at Lockheed Martin included president & general manager of the Missiles and Space Operations business unit from 2002 until appointment as executive VP of Lockheed Martin Space Systems in 2003. Marsh was responsible for business operations and the activities of 18,000 Space Systems staff. He has also been on the board of ION Geophysical Corp since December 2008.

Marsh would bring a background in executive management and deep experience with the space and defense industries, says Moghadam.

Ascent starts production of monolithically integrated flexible CIGS PV modules at FAB 2

Ascent Solar Technologies has begun initial production of monolithically integrated flexible copper indium gallium diselenide (CIGS) modules from its high-volume FAB 2 plant.

In March 2009, Ascent expanded from its initial facility in Littleton, CO (with a 1.5MW-capacity manufacturing line that entered production in first-quarter 2009) by opening its new 145,000ft^2, 30MW-capacity headquarters in Thornton, CO.

"Ascent Solar is the first company to commence regular production of monolithically integrated lightweight thin-film CIGS modules using a plastic substrate," claims president & CEO Farhad Moghadam. "This milestone marks the initiation of our regular production capability and our factory ramp-up based on market demand," he adds.

"Initial production from FAB 2 is producing 10.5%-efficient modules with peak module aperture efficiency as high as 11.9%, which gives Ascent a very competitive product across our target market opportunities," Moghadam reckons.

Ascent Solar has posted a video virtual tour of the new FAB 2 on its web-site.

www.ascentsolar.com/video

CIGS PV modules to be integrated by Kirloskar and made in India

Following a memorandum of understanding last September, Ascent Solar Technologies has signed a multi-phase strategic alliance agreement with Kirloskar Integrated Technologies Ltd of Pune, Maharashtra State, India.

The two firms will commence integration, marketing and distribution of Ascent's flexible CIGS photovoltaic modules into products designed to address multiple markets in India. Target markets include defense, consumer portable power, off-grid rural power solutions and hybrid solar and diesel generation back-up power systems.

Phase two of the agreement aims to establish a complete back-end module assembly plant in India, while the third and final phase is designed to expand production in India to include complete end-to-end module manufacturing.

"Having successfully established energy solutions using technologies like anaerobic digestion of organic waste and non-edible vegetable oil and biodiesel, we were in search of an appropriate partner for solar photovoltaics which can compliment Kirloskar's strength as a leader in distributed power generation," says Kirloskar's CEO L.A. Joshi. "We are pleased to have Ascent as our partner in the endeavor to harness the very large solar energy potential related to off-grid and on-grid applications, by taking advantage of the favorable policies of the Indian government."

"Our relationship with Kirloskar provides Ascent Solar with a partner for development of multiple market opportunities in a rapidly advancing country like India," says Ascent's CEO Farhad Moghadam. "Kirloskar has significant relationships and well established sales and marketing channels in key target markets for defense, space, consumer electronics and hybrid diesel generators."

www.kirloskar.com

Samsonite to integrate CIGS modules into carrying cases

Ascent Solar's lightweight flexible CIGS thin-film PV modules have been selected by luggage maker Samsonite for integration into its new line of solar consumer products being rolled out this summer.

The firms have been working together throughout product development. The launch symbolizes progress in incorporating portable power into everyday products, they add.

"As our lives depend more and more on mobile electronics and the need to power and carry such devices, we believe that integrating solar panels into our carrying case solutions will be a game changer in the industry," says Samsonite's VP sales & marketing Lynne Berard. "By utilizing the unique, flexible, lightweight, rugged and subtle modules from Ascent Solar, we are able to provide our customers with power on the go, while not compromising our stringent standards for quality and style," she adds.

"Our selection by Samsonite gives Ascent Solar a clear path to market with solar integrated consumer products and establishes Ascent as a solar technology solution provider that can meet the needs of consumers demanding a rugged and lightweight portable way to power their electronics," says Ascent's president & CEO Farhad Moghadam. "Our goal is to enable and lead a new wave of portable solar charging solutions through Samsonite that will revolutionize the way we power our electronics anywhere and everywhere."

www.AscentSolar.com

Capacity of InGaAs to increase drive current in nano MOSFETs

Yale simulations show on-state drive current boosted by 9.8x in InAs nMOS and 3.9x in Ge pMOS vs Si, despite capacitance reduction.

Many in the semiconductor industry and the supporting research community are seeking to apply compound semiconductor materials to improve metal-oxide semiconductor (MOS) field-effect transistor (FET) performance. These workers are particularly attracted by the increased electron mobilities of some III-V compound semiconductor materials, such as those in the indium gallium arsenide (InGaAs) system.

With other factors being equal, increased mobility would lead to increased transistor performance. This being the real world, other factors are not equal. A particular one that has recently come to prominence is that high-mobility materials tend to have a lower density of electron states. This leads to a reduced ability of gate potentials to increase electron densities in the channel, turning transistor devices on for drive current flow.

A number of groups are working on this problem. The Yale University Center for Research on Interface Science and Phenomena (CRISP) has recently published its simulations for the resulting drive current potential in InGaAs, along with the more traditional silicon and germanium [Abigail Lubow et al, Appl. Phys. Lett., vol96, p122105, 2010], based on the completed PhD work of Dr Abigail Lubow.

Since nano-scale devices are being targeted, effects that were previously unimportant have come to prominence. One such problem is the distribution of charge carriers at the oxide-semiconductor interface. In larger devices, this can be treated as a two-dimensional sheet. For future nano-devices, a sheet thickness of a few nanometers could kill performance (Figure 1). A shift in the centroid of charge away from the gate potential adds to the equivalent oxide thickness (EOT), reducing the inversion capacitance.

Simulations based on a Schrodinger–Poisson model suggest that there is indeed a reduction of capacitance in higher-mobility materials (Figure 2). Many experimental studies do not show such a reduction; an effect that is probably due to charging/discharging of interface traps masking the centroid shift. Reducing interface trap densities to less than $10^{11}/cm^2$ should reveal the reduction in capacitance in high-mobility materials, the Yale researchers believe.

Table 1. Mobility (μ), inversion capacitance (C_{inv}), and expected nMOS drive current (I_d) ratios for EOT=1nm and $V_g - V_t$=1.4V.

	μ $cm^2/V\text{-}s$	C_{inv} $x10^{-6}F/cm^2$	μC_{inv} $x10^{-3}F/V\text{-}s$	I_d ratio
Si	1350	2.62	3.53	1
Ge	3600	2.50	9.01	2.5
GaAs	8000	1.67	13.3	3.7
InGaAs	11200	1.44	16.1	4.5
InAs	30000	1.16	34.9	9.8

Despite this, the Yale researchers suggest that the drive current in the on-state could be increased by up to 9.8x, compared with silicon, in InAs for n-type MOS transistors (nMOS, with negative-charge 'electron' carriers) — see Table 1. For pMOS (with positive-charge 'hole' carriers), there is little advantage in the III-V InGaAs system, but germanium-based channels could achieve a 3.9x drive current, compared with silicon. However, achieving this level of performance depends on finding suitable gate dielectric materials.

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Other research groups have also been looking at quantum and centroid effects on inversion capacitance with a view to III-V logic. The MIT group under Jésus del Alamo presented a model at the International Electron Devices Meeting (IEDM) in December 2009 [D. Jin et al, session 20.4; also see short report on this in Mike Cooke, Semiconductor Today, February 2009, p116] for quantum gate capacitance effects. This work was applied to describing experiments involving

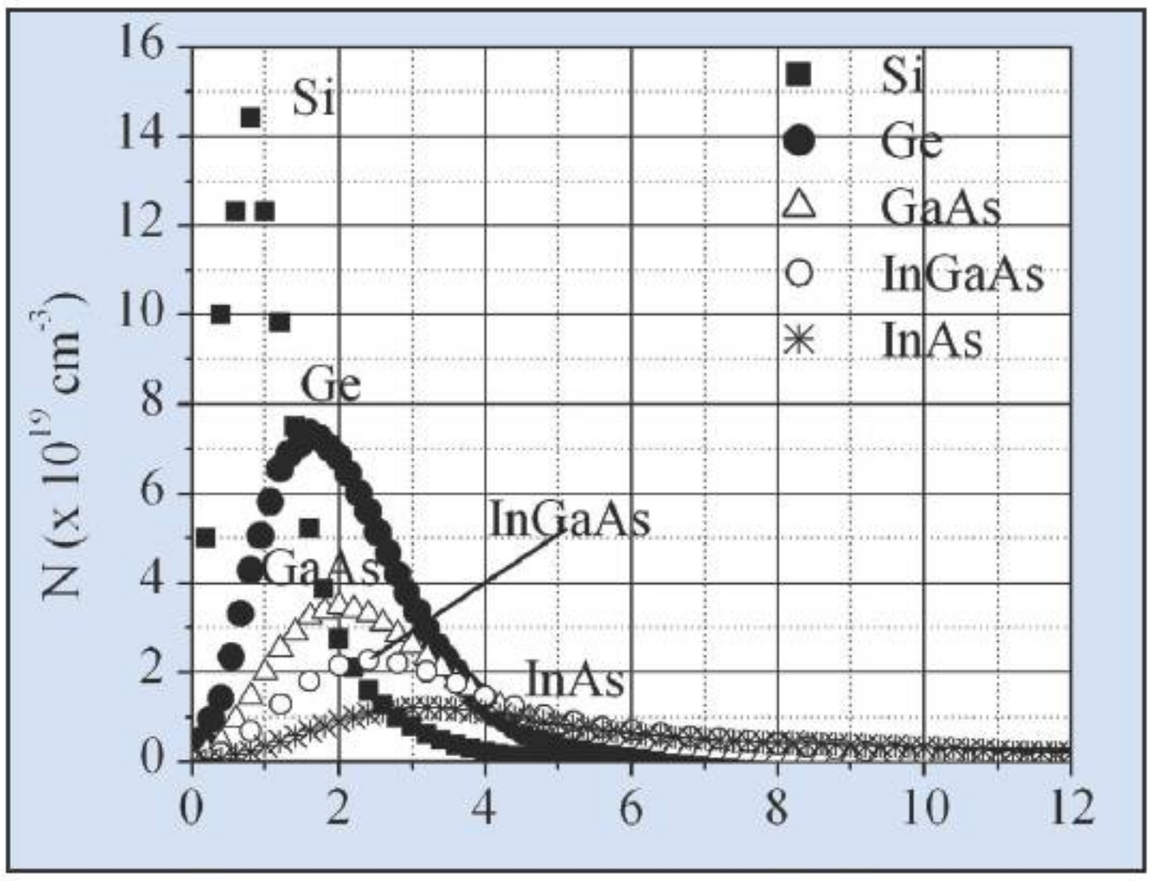

Figure 1. Electron carrier concentration in silicon and four high-mobility channel materials as a function of distance from the oxide-semiconductor interface for EOT = 1nm and V_g–V_t= 1.4V. As density of states decreases, the charge centroid moves further from the oxide–semiconductor interface.

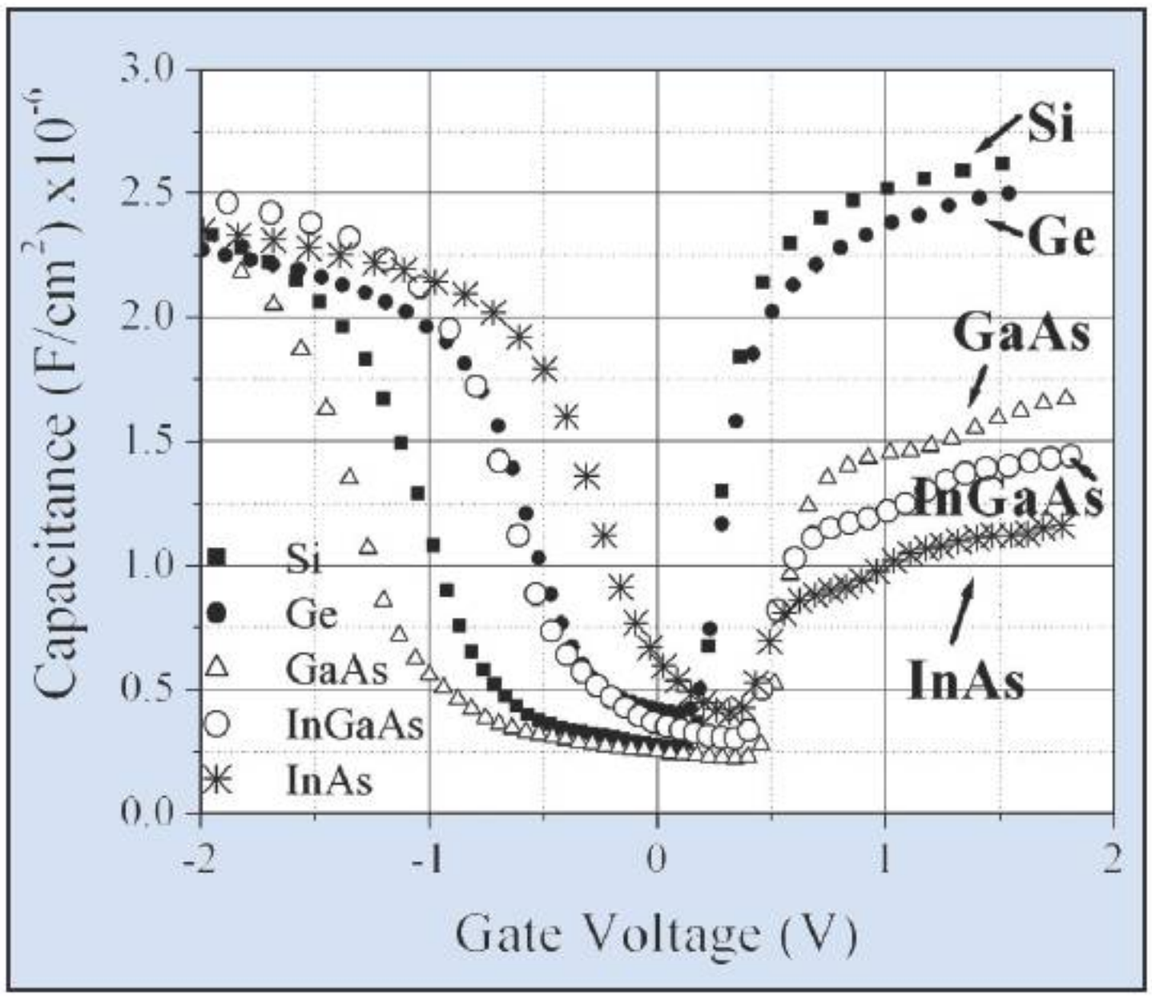

Figure 2. Capacitance–voltage curves for Si/Ge/GaAs/InGaAs/InAs in the nMOS device for EOT=1nm and V_g–V_t=1.4V. Quantum effects cause a reduction in inversion capacitance.

Schottky-gate high-electron-mobility transistor (HEMT) devices, rather than with insulated-gate MOSFETs. ■

http://link.aip.org/link/APPLAB/v96/i12/p122105/s1

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

Sumitomo powers up vertical nitride transistors

Using 2DEG channel, rather than inversion layer, lowers on-resistance

Researchers at Japan's Sumitomo Electric Industries (SEI) have developed a new nitride semiconductor vertical transistor structure with a view to power applications [Masaya Okada et al, Appl. Phys. Express, vol3, p054201, 2010]. Until recently vertical structures have been difficult to realize for nitride semiconductor systems, particularly those grown on insulating sapphire.

Nitride semiconductor transistors are attractive for power applications due to high breakdown fields and high electron saturation velocities. However, the planar format of high-electron-mobility transistors (HEMTs) is not ideal from a power handling perspective. Despite this, HEMTs have been developed for wireless base-station power amplifiers, power supplies, power conditioners for green energy, and inverters for automobiles.

Vertical structures should enable lower specific on-resistance, high breakdown voltages and high current flow, since the flow is not restricted to a thin layer, but rather travels down through the wafer structure.

SEI has taken advantage of newly available free-standing gallium nitride substrates with low dislocation densities to realize its vertical heterostructure field-effect transistor (VHFET) using a sloped two-dimensional electron gas (2DEG) as the channel (Figure 1). SEI produces 50mm-diameter GaN crystal substrates using its own vapor-phase technique.

The new VHFET device can be arranged to be normally-off, which is an attractive feature for reduced power consumption. The specific on-resistance achieved was as low as 7.6mΩ-cm^2, while the (hard) breakdown voltage was 672V. Reasonable current blocking was maintained up to more than 600V.

The epitaxial layers of the device were grown using MOCVD on

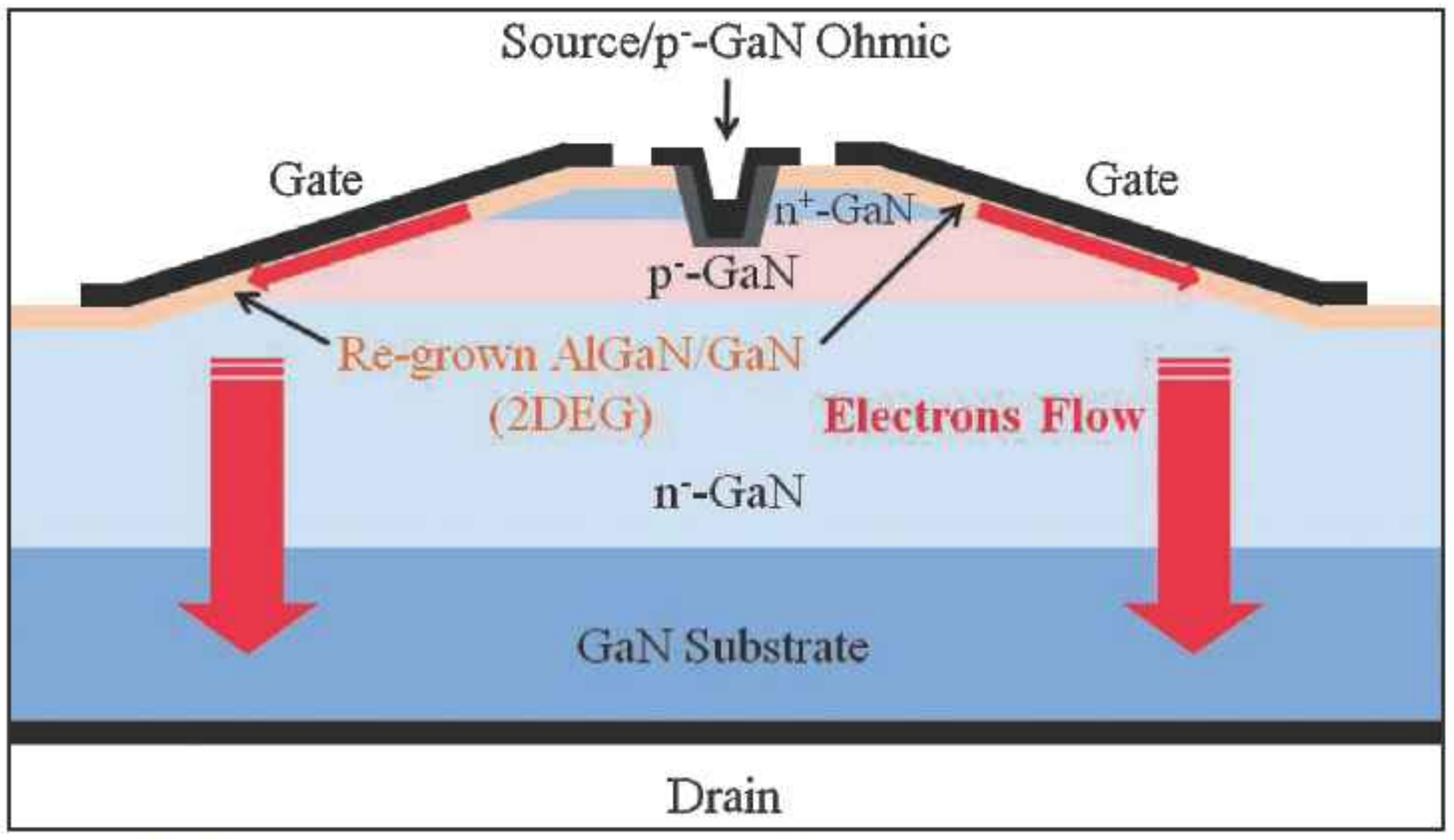

Figure 1: VHFET with re-grown AlGaN/GaN 2DEG channels on GaN substrate.

c-plane GaN substrates. Silicon (Si) and magnesium (Mg) were used for n- and p-doping, respectively. The layer thicknesses were 5μm for the n$^-$-GaN (Si 7x10^{15}/cm^3), 1μm for the p$^-$-GaN (Mg 5x10^{18}/cm^3) and 0.2μm for the n$^+$-GaN (Si 3x10^{18}/cm^3).

To create the sloped channels (Figure 2), mesa structures with a slope angle of about 16° were formed using inductively coupled plasma-reactive ion etching (ICP-RIE). The 2DEG was then formed by MOCVD re-growth on the slopes of undoped GaN (75nm) and aluminum gallium nitride ($Al_{0.2}Ga_{0.8}N$, 10–35nm). Standard photolithography and lift-off was used to form the electrodes.

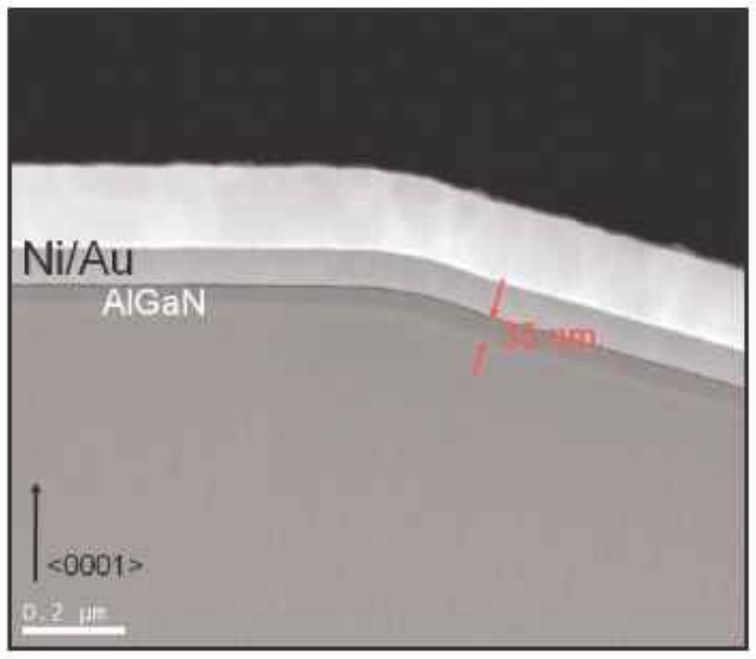

Figure 2: Transmission electron micrograph (TEM) of re-grown AlGaN layer on slope of mesa structure.

The source and drain contacts consisted of Al-based ohmic material. A Schottky nickel–gold contact was used for the gate.

The researchers comment that their specific on-resistance is lower than that achieved previously by other groups (e.g. 9.3mΩ-cm^2, Rohm, reported in 2008) attempting to create vertical MOSFETs using nitride semiconductors. SEI believes that this is due to the channel using a 2DEG, rather than an inversion layer.

The researchers believe that the specific on-resistance can be further lowered, to near the theoretical drift limit for nitride semiconductors, by improving material quality, shortening the channel length, down-scaling the structures, and increasing the packing density.

The threshold voltage was controlled by the thickness of the AlGaN layer. The normally-off threshold of +0.3V was achieved with 10nm of AlGaN. The researchers say that the 3V threshold required for power applications should be possible with an insulated, rather than Schottky gate scheme.

http://apex.ipap.jp/link?APEX/3/054201/
http://global-sei.com

Author: Mike Cooke

First demonstration of semipolar III–nitride 'deep-UV' LED

South Carolina and Nitek achieve shortest-wavelength non c-plane LED

Researchers based in South Carolina have developed 'first demonstration' semipolar nitride semiconductor 307nm ultraviolet LEDs [Krishnan Balakrishnan et al, Jpn. J. Appl. Phys., vol49, p040206, 2010]. The 307nm wavelength is claimed as the shortest emission wavelength ever reported for a non c-plane III–nitride semiconductor-based LED. The researchers classify 307nm as 'deep-UV' (although some other groups define wavelengths shorter than 300nm as 'deep-UV').

By developing nitride semiconductor LEDs with reduced electric polarization fields, it is hoped that better recombination efficiencies will be achieved, boosting emission of UV light. In nitride semiconductors grown in the normal 'c-direction', electric fields of the order of several MV/cm can build up due to polarization effects. These fields tend to separate the negative (electron) and positive (hole) carriers, making it more difficult for them to recombine and emit photons.

The use of semipolar and non-polar nitride semiconductors is being actively developed for longer-wavelength LEDs, such as for green indium gallium nitride (InGaN) devices. It has been harder to develop such materials for UV wavelengths shorter than 350nm since the aluminum-based nitrides that are needed tend to form stacking faults and multiple structural phases when grown in non-standard directions.

The latest research by University of South Carolina and Nitek Inc of Irmo, SC, USA uses m-plane sapphire substrates (Figure 1). A layer of aluminum nitride is then grown using pulsed metal-organic chemical vapor deposition (PMOCVD). A strain-relieving short-period super-lattice (SPSL) of alternating ultra-thin layers of AlN and AlGaN is used to enable crack-free MOCVD of subsequent layers.

The bottom contact consisted of n-AlGaN; the active, light-emitting region was a four-period multi-quantum well (MQW); the structure was topped off with a p-AlGaN electron-blocking layer (EBL) and a p^+-GaN contact. EBLs are widely used in nitride LEDs to reduce over-spill of electrons into the p-type layers where they recombine non-radiatively or with parasitic wavelengths, reducing the efficiency for producing the desired short wavelength.

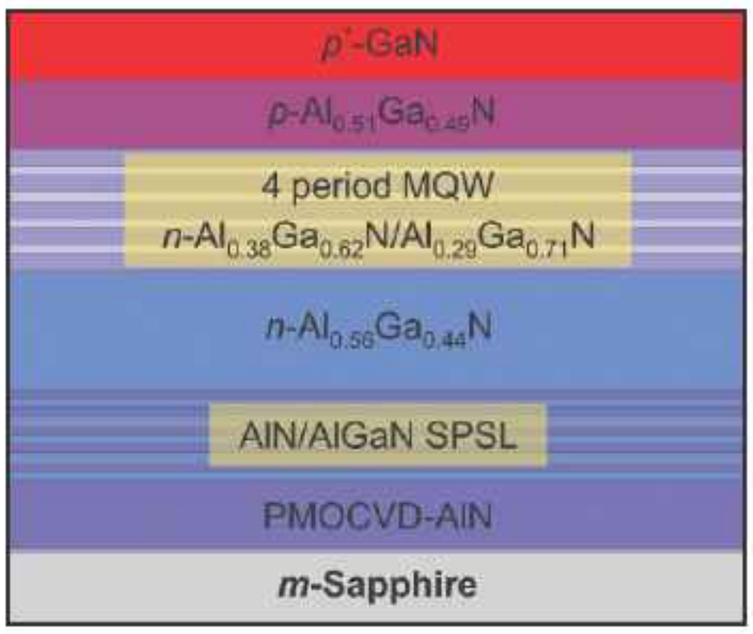

Figure 1. Cross section of the semi-polar deep-UV LED structure.

The researchers comment that they chose Al compositions in the MQW, n-contact, and SPSL that, like AlN and sapphire, were transparent to UV in the wavelength range 260–320nm. Various standard material characterizations were carried out: high-resolution x-ray diffraction, transmission electron microscopy, atomic force microscopy and scanning electron microscopy.

The x-ray diffraction measurements showed that the nitride layers grew in the $(11\bar{2}2)$ semipolar direction and that the SPSL was effective in improving the crystallinity of the material above — a typical rocking curve scan of a diffraction peak gave a full-width at half maximum (FWHM) value of 1386 arcsec for the AlN template, but for the n-AlGaN contact layer this was reduced to a sharper ~1110 arcsec.

Photoluminescence (PL) and electroluminescence (EL) studies were also carried out. The wavelength of the emission peak shifts very little (~0.5nm) with excitation power in PL measurements, unlike in comparison with c-direction devices where polarization effects led to a red-shift of ~1.9nm.

Conventional 100μm square LEDs were produced to carry out the EL work (Figure 2). A shoulder at 380nm is seen in the EL spectrum, which is believed to be due to recombination involving the magnesium acceptors used to create the p-type layers. The shoulder was absent in the PL spectra carried out on material without the p-type EBL or contact layers.

The output power at 20mA DC input was 20μW, which the researchers find 'reasonable for the first ever demonstration of a semipolar deep-UV LED'. Further work is being carried out to improve the device design and material quality in the hope of increasing optical output powers.

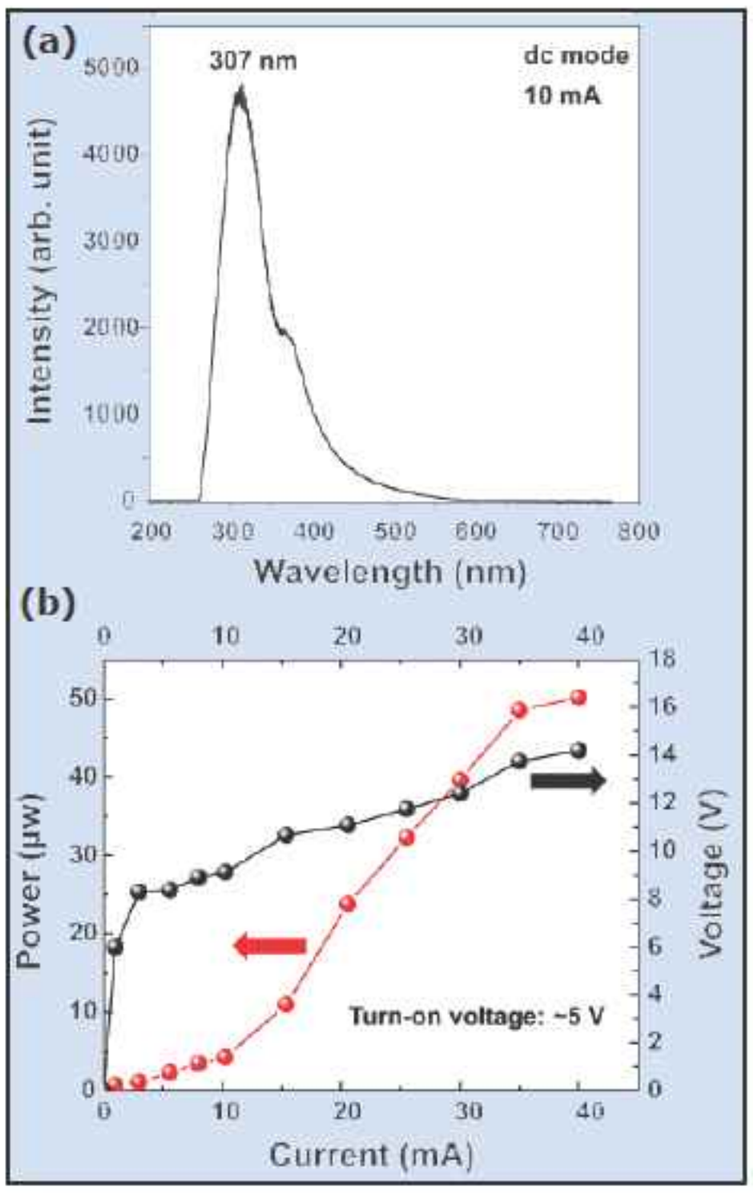

Figure 2. EL emission spectrum (a) and current–voltage–light output power (I–V–L) characteristics (b) of semipolar deep-UV LED.

http://jjap.ipap.jp/link?JJAP/49/040206
www.ee.sc.edu/research/microlab
www.nitekusa.com

Author: Mike Cooke

Tunneling a way to understand efficiency droop in InGaN

Defect states in quantum well barriers proposed for current leakage.

Researchers based in St. Petersburg, Russia, have turned their attention to the droop in light-emission efficiency with electrical current in nitride semiconductor light-emitting diodes [N.I. Bochkareva et al, Appl. Phys. Lett., vol96, p133502, 2010]. The collaboration suggests a droop mechanism involving tunneling leakage of carriers from the quantum well (QW) to defect states in barriers, and a reduction in carrier injection efficiency through an excess tunneling current between deep defect states in the barriers, bypassing the QW (Figure 1). The work involved the A.F. Ioffe Physical-Technical Institute, St. Petersburg State Polytechnical University and the V.F. Fock Institute of Physics.

As evidence for these tunneling-related mechanisms, the scientists cite three experimental results of their work: the efficiency droop occurs in the low-energy part of the photon emission spectrum; the forward voltage where the efficiency droop sets in (~2.9V) is independent of temperature (77–300K); and, at forward voltages greater than the maximum efficiency voltage, the diode ideality factor is greater than 2 (4.4 at 300K).

An ideality factor greater than 2 can be a signal for Auger recombination, which is one of the more popular explanations for efficiency droop effects in nitride LEDs. 'Auger recombination' refers to a mechanism where the energy from a recombination event is given to another carrier, rather than being emitted as light, reducing the light-emission efficiency. Since Auger recombination involves three carriers, it is only expected to occur at higher currents.

The collaboration suggests a droop mechanism involving tunneling leakage of carriers from the quantum well to defect states in barriers

In opposition to such an explanation, the St. Petersburg researchers point to a reduction in the efficiency peak current at lower temperatures (0.47mA at 300K, 7μA at 90K). "This efficiency decrease at low currents can hardly be attributed to Auger recombination."

The constancy of the forward voltage where maximum efficiency occurs is also seen as significant, since it gives electron energies close to the bandgap of the well material (2.89eV). The researchers suggest that this maximum efficiency forward voltage is when the quasi-Fermi levels in the barriers reach the relevant band edge in the well (bottom of conduction band; top of valence band — see Figure 1).

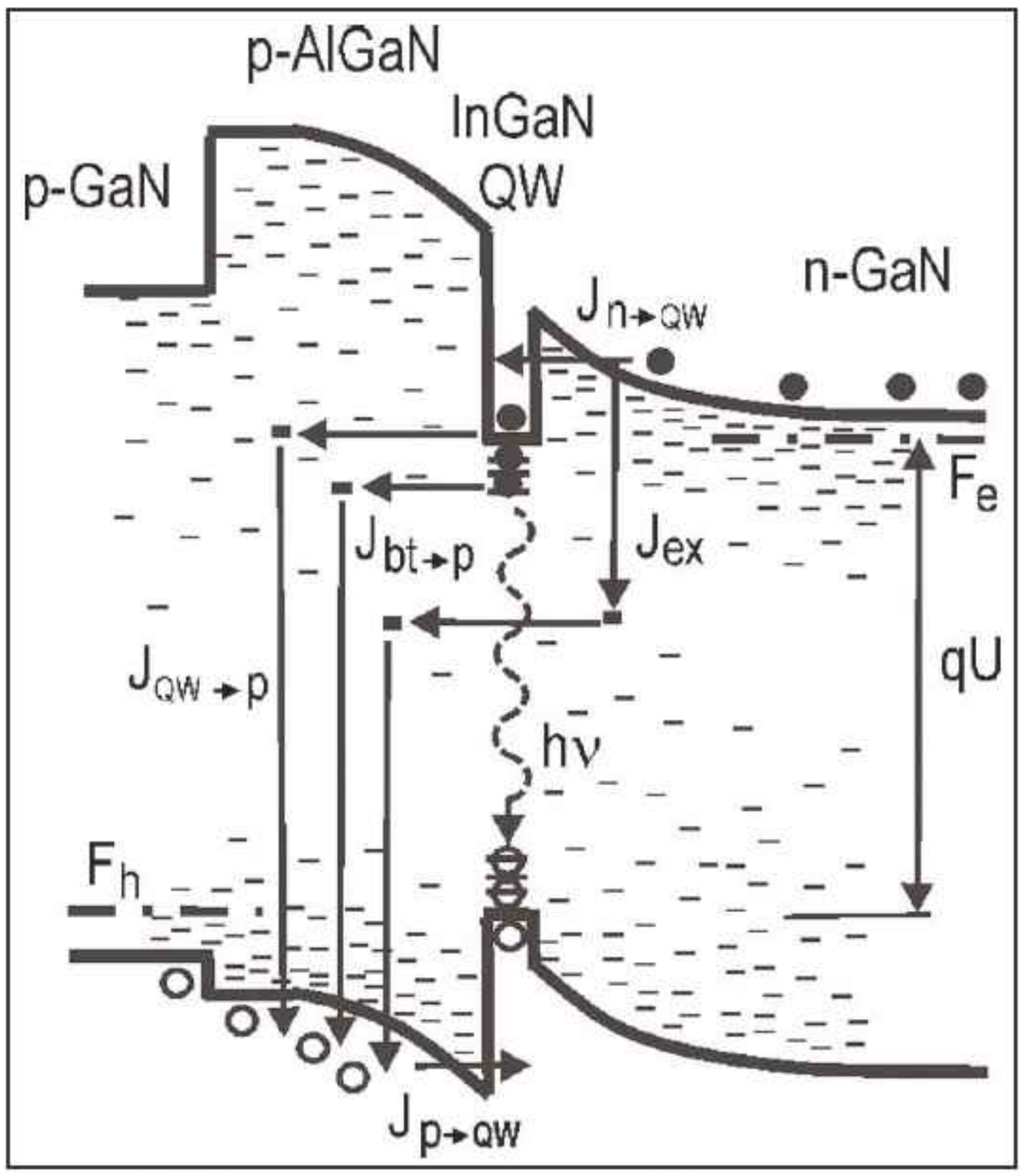

Figure 1. St. Petersburg defect-related tunneling model for a p-n structure with an AlGaN/InGaN/GaN QW. As the potential difference between the injection regions pushes the quasi-Fermi levels to the band edges, new current paths become available from the QW to deep defects in the p-type barrier (J_{QW-p}). Also, localized states that create lower-frequency emissions are killed by a similar mechanism at lower forward voltages (J_{bt-p}). The hole and electron injection currents into the well are J_{pQW} and J_{n-QW}, respectively. The excess current operates through tunneling between defect states in the two barrier regions (J_{ex}).

These effects would particularly hit localized carrier states that are often cited as the reason for the surprisingly high efficiencies of nitride semiconductor LEDs. Recombination from these states is a slow process, and faster non-radiative channels would have a larger effect in killing their efficiency. The reduction in efficiency in these longer-wavelength states leads to a blue-shift in the emission spectrum (Figure 2).

The LEDs used in the work (from Nichia, model NSPB-500S) were grown on sapphire substrates with an active region consisting of a single 30Å indium gallium arsenide ($In_{0.2}Ga_{0.8}N$) QW. The n-type injection region was 4μm of GaN. A p-type barrier consisted of 100nm of aluminum gallium nitride ($Al_{0.2}Ga_{0.8}N$). The emission wavelength was about 470nm (blue).

The epoxy-encapsulated LEDs were mounted on a cold finger of a cryostat chamber for temperature control. The LEDs were tested under continuous-wave (DC) operation. Room-temperature studies often use pulsed operation to avoid self-heating of the devices from resistance effects. This is not necessary for deliberately cooled devices. ■

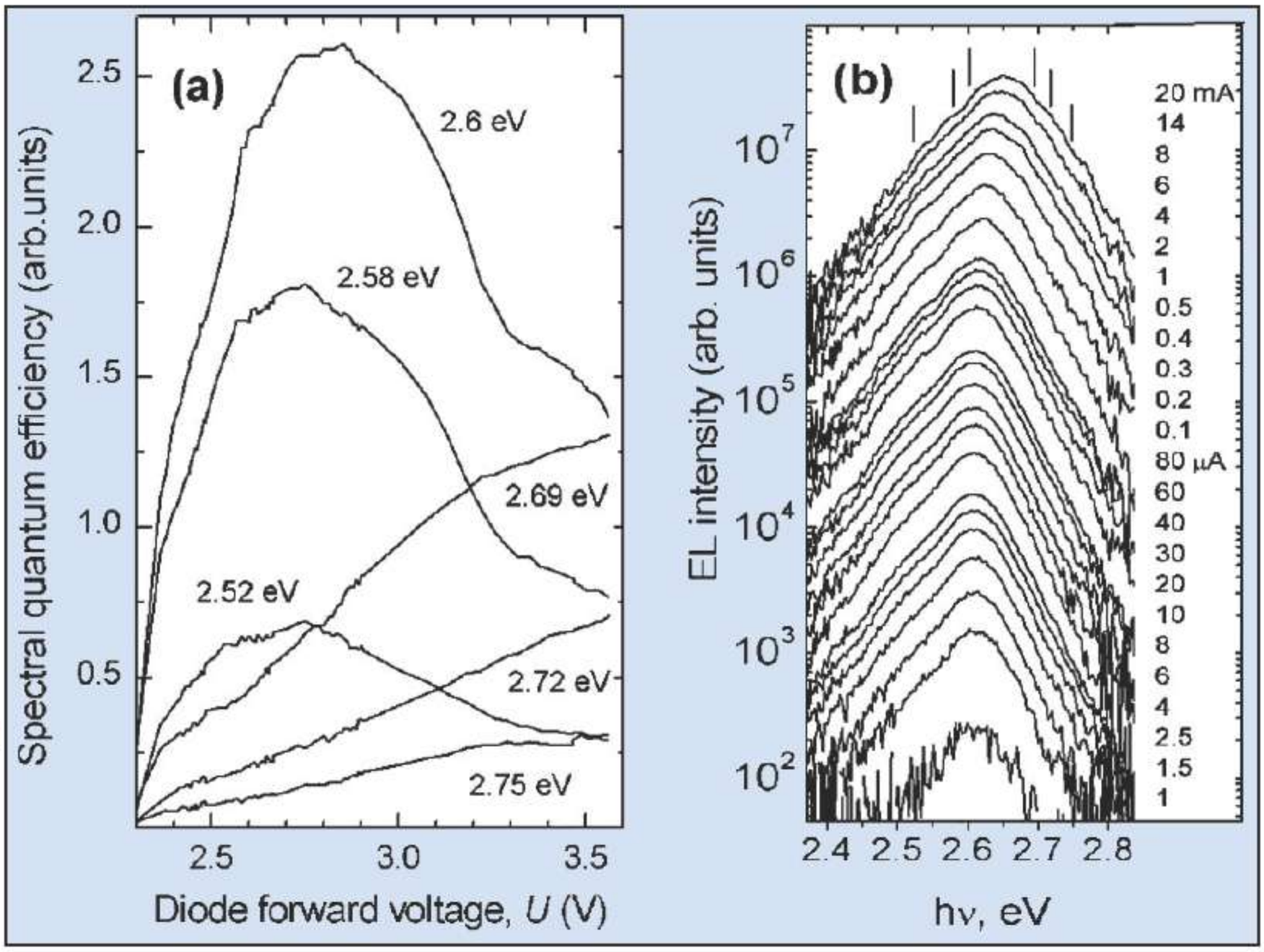

Figure 2. (a) Spectral efficiency of electroluminescence (EL) vs diode forward voltage for different spectral regions. (b) Room-temperature EL spectra at various driving currents.

http://link.aip.org/link/APPLAB/v96/i13/p133502/s1 *Author: Mike Cooke*

Nano-patterned silicon substrate for higher-output-power nitride LEDs

A self-ordered anodized aluminum oxide etch mask has been used with a view to lowering the cost of improving the quality of nano-hetero-epitaxial lateral overgrowth nitride semiconductors.

Hong Kong University of Science and Technology and Taiwan National Chiao Tung University researchers have reported lower leakage current and higher light output power for violet (380–450nm) indium gallium nitride (InGaN) LEDs grown on nano-patterned silicon substrates, compared with those grown on Si substrates with micro-scale patterning [Dongmei Deng et al, Appl. Phys. Lett., vol96, p201106, 2010].

The nano-patterning was achieved with an anodized aluminum oxide (AAO) etch mask giving a pore diameter of 150nm and a separation of 120nm, on average (Figure 1). The use of such substrates encourages nano-hetero-epitaxial lateral overgrowth, giving higher crystal quality in the subsequent nitride semiconductor layers and hence improving performance.

The attraction of silicon substrates is the lower manufacturing costs from both the raw material and economies of scale from the larger wafer sizes available. A further attraction over the sapphire substrates more often used for nitride semiconductor growth is the higher thermal conductivity of silicon that allows better thermal control of devices.

The lattice mismatch of GaN with silicon is ~17%, compared with the ~14% for sapphire and ~3% for silicon carbide. Large mismatches lead to a high defect density of 10^9–10^{11}/cm^2 for GaN/Si. Commercial GaN substrates typically specify defect densities less than 10^9/cm^2.

The researchers had previously developed micro-scale patterning using a silicon nitride (SiN) mask. Some improvement in GaN layers was achieved, but the SiN deposition process can be difficult to control in terms of thickness and surface uniformity/flatness. The researchers were attracted to the self-ordering AAO process as being a low-cost, high throughput way of creating nano-patterning, compared with the use of lithography.

The AAO mask was formed on 2″ Si (111) wafers at 6°C in 0.3M phosphoric acid with 120V applied for 30mins. The pattern was transferred to the underlying Si substrate using inductively coupled plasma (ICP) etching. The AAO mask was removed using a wet etch.

LED structures were grown using MOCVD. Devices on micro-scale patterned templates (340x340μm grid-pattern separated by 20μm trenches, SiN mask) were also made for comparison.

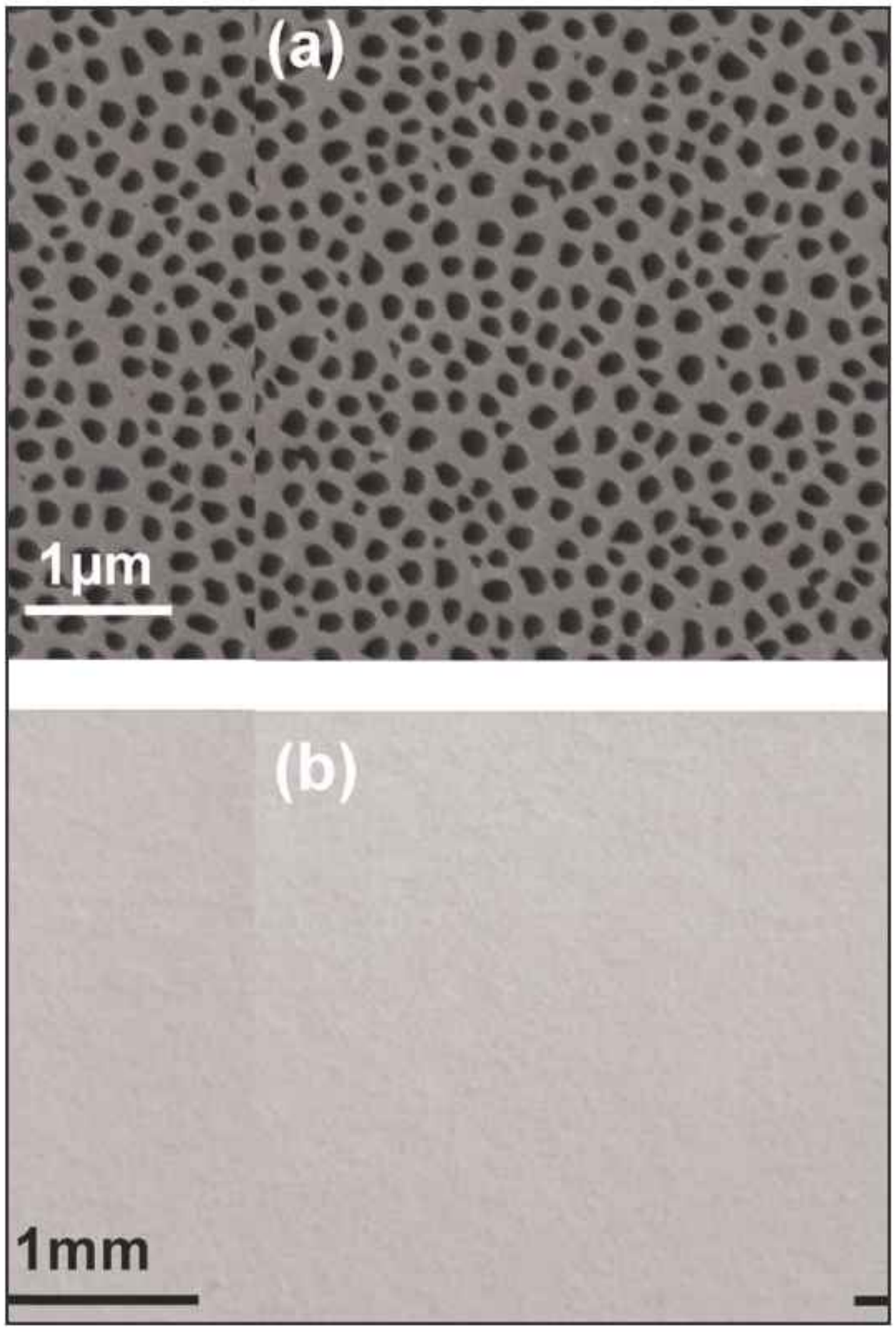

Figure 1. (a) Top-view SEM of nano-patterned silicon. (b) Optical micrograph of LED surface grown on nano-patterned silicon.

The buffer consisted of aluminum gallium nitride (AlGaN), starting with a ~40nm AlN nucleation layer, 200nm AlGaN and 800nm undoped GaN, and finally a 250nm AlGaN/AlN interlayer. Then a 1μm-thick n-type silicon-doped GaN contact layer was deposited. A five-period InGaN/GaN quantum well was grown as the active layer. The final p-type contact layer consisted of Mg-doped GaN.

Optical microscopic inspection of the resulting wafers showed the material to be crack-free, and the surface was described as being 'mirror-like'. Closer analysis with transmission electron microscopy (TEM) showed threading dislocations, but the density was less in the nano-patterned sample, compared with the micro-patterned one.

Both samples were used to form 300μmx300μm LEDs. The forward voltage of both devices was ~4.7V at 20mA. Much lower leakage currents were observed at reverse bias for the nano-patterned device (Figure 2). The output power at 20mA was 1.28mW for the nano-patterning, a 21% improvement over the micro-patterned material. Also the nano-patterned LED saturation current was 110mA, compared with 90mA for the micro-patterned device.

The researchers believe that the blue-shift indicates stress relief in the nano-patterned samples, making higher quality, low defect material layers easier to grow

The emission wavelength of the nano-pattern LED was blue-shifted compared with the micro-LED. This was expected from Raman spectral analyses of the material carried out before the LED structures were made. The researchers believe that the blue-shift indicates stress relief in the nano-patterned samples, making higher quality, low defect material layers easier to grow.

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The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

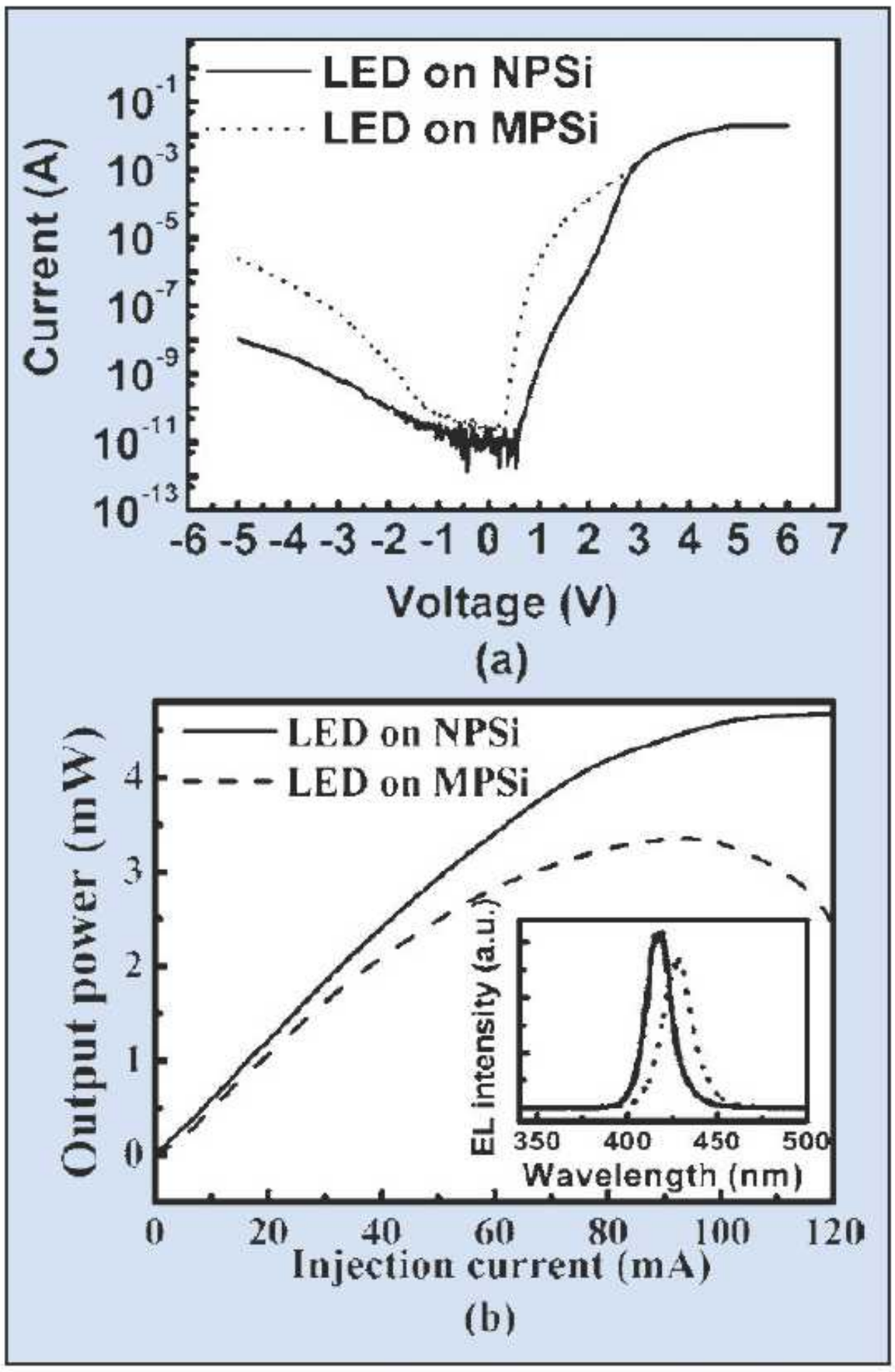

Figure 2. (a) I–V characteristics of nano- (NPSi) and micro-patterned silicon (MPSi) LEDs. (b) L–I curves with (inset) electroluminescence spectra at 20mA injection current.

Combination to unlock high yields & throughput in LED production?

The entry of a leading silicon semiconductor equipment supplier into the nitride light-emitting diode arena suggests that a new era for mass solid-state lighting technology is on the horizon. Mike Cooke reports.

The news earlier this year that Applied Materials is planning to enter the nitride semiconductor light-emitting diode (LED) production equipment market is a sign of a new stage in the wider dissemination of semiconductor lighting technology. Initially, Applied Materials' efforts in this direction will be channeled through its participation in one of 17 projects under the US Department of Energy (DOE) Solid-State Lighting (SSL) Program Manufacturing Initiative. The DOE in turn received its money to advance these projects through the American Recovery and Reinvestment Act.

Eight of the DOE projects ('manufacturing') focus on cost reductions and enhanced quality via manufacturing equipment, processes, or monitoring technique enhancements. Three projects cover 'core technology' emphasizing efficiency, performance, and cost targets. The final six 'product development' projects are closer to end-products, developing commercially viable solid-state lighting source, component, or integrated luminaire products. Total DOE funding for the 17 projects is nearly $37.8m.

Applied Materials' project is in the manufacturing section. The company has for many years dominated much of the mainstream silicon complementary metal-oxide-semiconductor (CMOS) semiconductor equipment market. More recently, the company has emphasized its participation in the photovoltaic solar production equipment sector, particularly for silicon-based devices.

Figure 1. LED lighting at the Yas Hotel, Abu Dhabi (courtesy Enfis Ltd).

Lighting legislation

In the lighting area, Applied has already done some work in organic LEDs (OLEDs) through the European OPAL 2008 (Organic Phosphorescent lights for Applications in the Lighting market 2008) program. OPAL 2008 targets a cost target of a few cents per cm^2 for a high-performance white OLED device. Other members of the consortium include Aixtron, Osram, Philips and BASF.

The main challenges for general LED lighting include reducing overall production costs and increasing efficiency and lifetimes. LED lighting is already used in a wide variety of applications such as signs and displays, back-lighting of LCD displays, traffic signals, automotive (dashboard and external lights), and for architectural displays (Figure 1).

The pressure is high to develop more general lighting applications, particularly to replace highly inefficient incandescent lamp bulbs. The European Union (EU) countries began prohibitions of certain types of incandescent bulbs in September 2009 with the aim of a complete ban on any light bulb that does not fall into the EU efficiency classes A or B by 2016. These classes use less than 75% of the power of the best available incandescent bulb.

Australia also began a phase-out in 2009, with the ambition of a complete ban by 2012. Canada is also looking to remove incandescents by 2012. Less prominent countries such as Brazil, Venezuela and Cuba began phase-outs in 2005.

The USA is looking at the 2012–2014 time period for its phase-out, with states such as California, Connecticut and New Jersey having previously announced some plans in advance of this.

In Japan, the government is looking to end incandescent production by 2012, and Toshiba announced that it had ended its 120-year history of producing incandescent bulbs in March 2010. Toshiba plans to redirect its lighting efforts into the LED market.

The white-light LED will be coming up against the existing compact fluorescent lamp/light (CFL) bulbs and, for LCD back-lighting, cold-cathode fluorescent lamps (CCFL). CFL efficiency typically falls in the EU A-class (20–50% that of the best incandescent bulb). Opposition to such bulbs focuses on the color rendering index (CRI) being around 80 — in contrast, black-body spectrum radiation that seems more 'natural', e.g. as given out by incandescent bulbs and the sun, is 100. The mercury content is also a concern for disposal and breakage.

Present 'low-cost' LEDs that use a blue–UV emitting chip powering a yellow phosphor give a 'white' CRI of about 70. Using a phosphor wastes some energy in photon conversion. In addition, improving the CRI with more complex phosphors adds to costs.

A more efficient option with greater control of color could be achieved, for example, by combining red, green and blue LEDs. While LED technology for red and blue light is well advanced, the green region poses problems due to the difficulties with growing even the most promising material system — indium gallium nitride (InGaN) semiconductors — with sufficient quality at the high fractions of indium needed.

Table 1. Target performance characteristics for Applied Materials' proposed epitaxial growth system.

Metric	Baseline (state of the art)	Proposed system
Cycle time (hrs)	8	Cut by half
Total wafer area /run (cm^2)	900	Increase
Wafer area per unit run time (cm^2/hr)	112	Increase $2x^+$
Intensity uniformity	20%	Improve 2x
Wavelength uniformity within wafers (STD) (nm)	2.5	Improve 2x
Wafer-to-wafer wavelength uniformity (nm)	3.0	Improve 3x
Run-to-run wavelength uniformity (nm)	4.0	Improve 2x
Binning yield of devices commanding highest price	20%	Increase 3x
Internal quantum efficiency	50%	Improve 50%
Source efficiency	34%	Improve 20%

Yield concerns

Many in the industry see low yields as the No.1 manufacturing issue for high-brightness LEDs. IMS Research made an industry-wide analysis suggesting that overall yields were 18% for a process where the yield is 40% for chips out of the front-end epitaxial layer growth process and 45% for packaging and binning into in-spec HB-LEDs (0.4x0.45 = 0.18).

Applied's DOE project is focusing on the epitaxial portion of the process, with the aim of developing 'an advanced epitaxial growth system that will decrease operating costs, increase internal quantum efficiency, and improve binning yields' (Table 1). Operating costs are to be reduced by lowering the

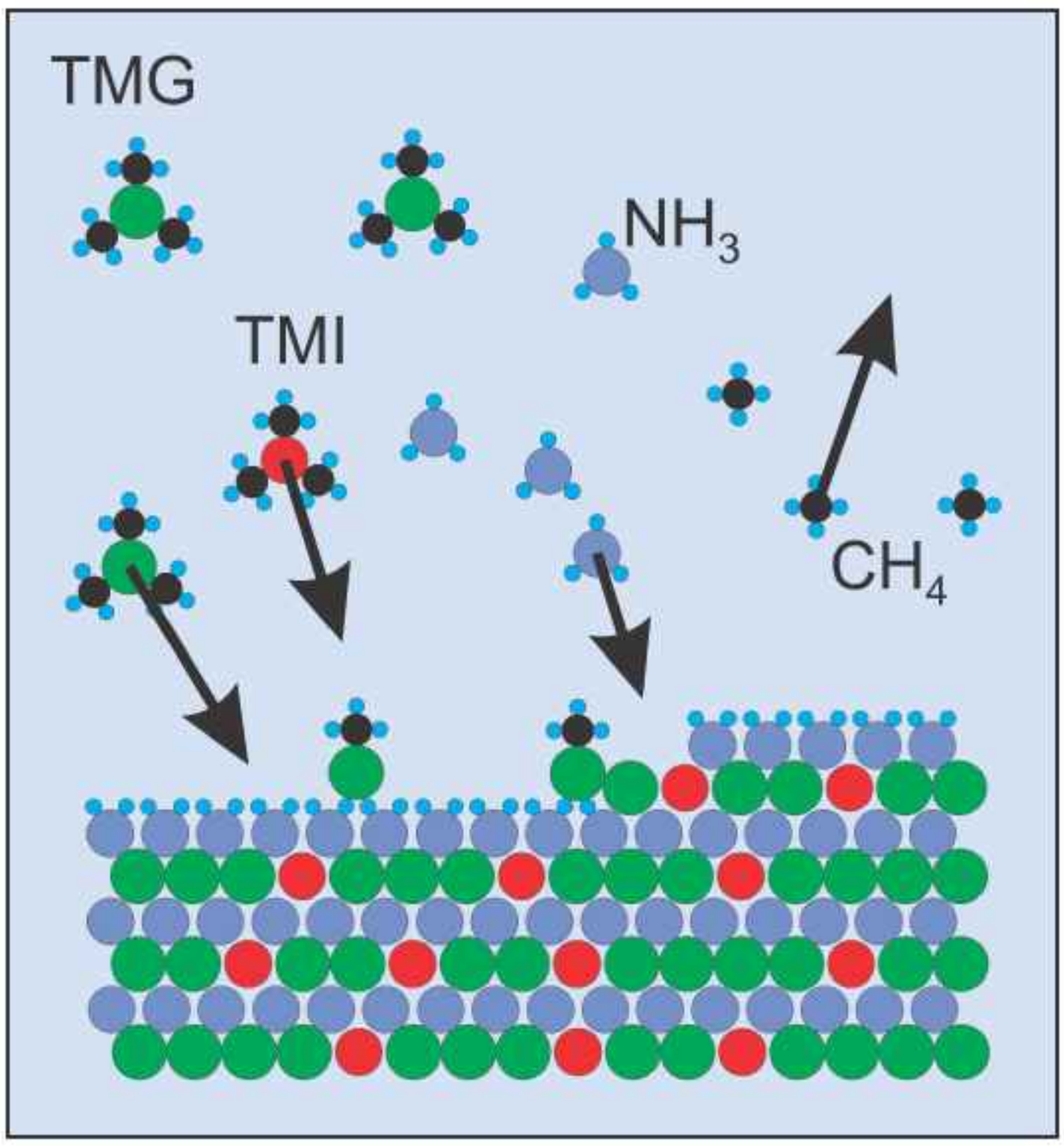

Figure 2. Schematic of MOCVD process with trimethylgallium/indium and ammonia sources, creating InGaN crystal layers and methane byproduct.

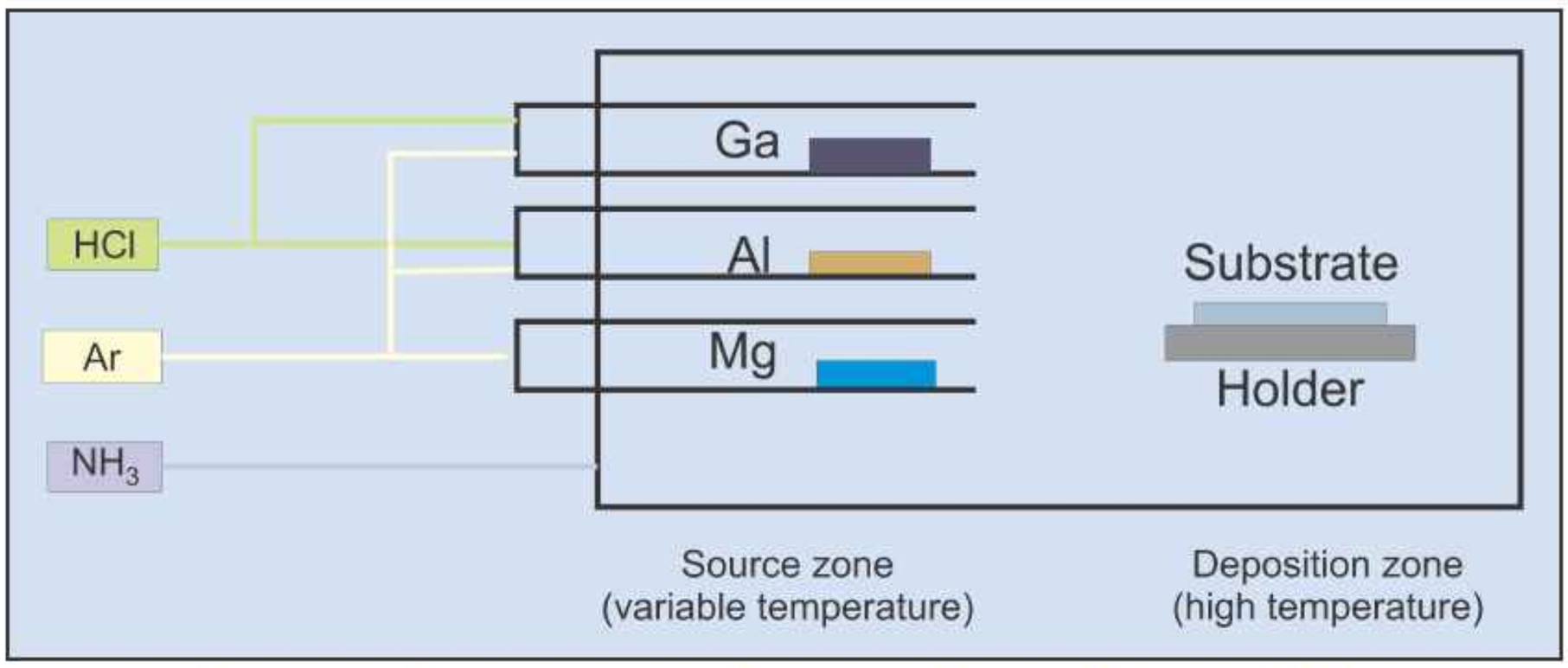

Figure 3. Schematic of HVPE process set-up for producing AlGaN with Mg doping and argon carrier gas.

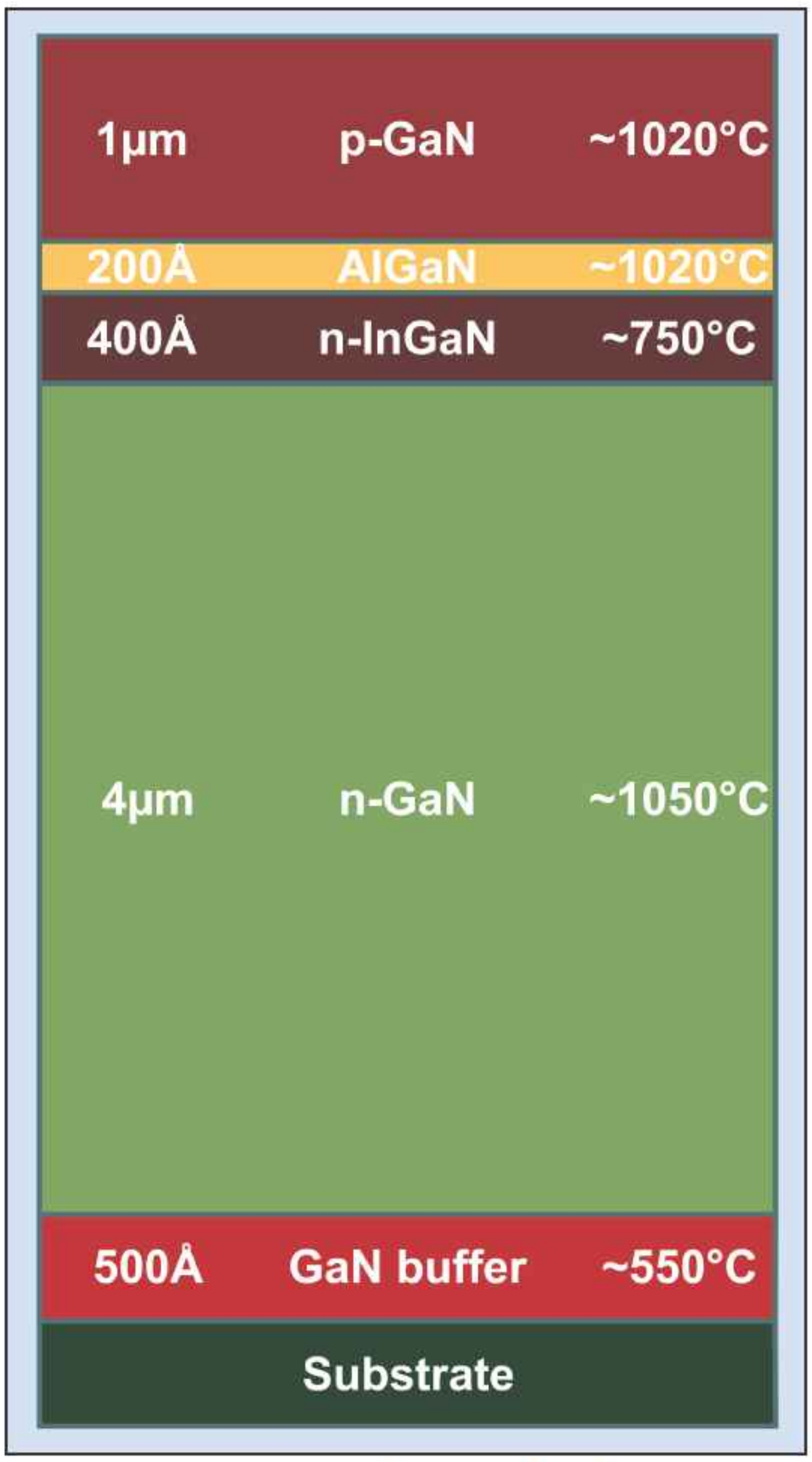

Figure 4. Cross-section of a generic LED device and typical deposition temperatures.

cycling time, increasing throughput and cutting chemical bills. Internal quantum efficiency is to be boosted through reducing the density of extended and point defects.

The present low level of binning into the better-quality product is to be tackled by increasing the uniformity of results for wavelength performance and output power. The uniformity improvement should not be just within a single wafer, but also across a production run, and from run-to-run. One reason for turning to a leading equipment producer for the mainstream silicon semiconductor industry is that such demands for uniformity have driven that industry for some time and there are hopefully lessons that can be transferred wholesale into LED production.

Applied Materials aims to develop a multi-chamber tool, combining metal-organic chemical vapor deposition (MOCVD) and hydride vapor phase epitaxy (HVPE). The intended growth rate is to be twice as fast as a traditional MOCVD system, while maintaining high-quality nitride layers.

Both growth techniques are vapor phase epitaxy processes, but using different kinds of precursor — indeed, MOCVD is often referred to as metal-organic or organo-metal vapor phase epitaxy.

For MOCVD, one often finds trimethyl-gallium (TMG), TM-aluminum (TMA) and TM-indium (TMI) being used for the metal sources, while ammonia (NH_3) supplies the nitrogen (Figure 2). Suppliers of MOCVD equipment include Aixtron in Germany, Veeco in the USA, and Taiyo Nippon Sanso in Japan. South Korean equipment firm Jusung also recently announced its first MOCVD tool sale to Epi Valley, a local producer of GaN LEDs.

Veeco is also the recipient of $4m in DOE SSL Program Manufacturing Initiative money to lower costs of producing high-brightness LEDs with improved MOCVD technology — initially with high-volume systems that provide a 4x reduction in the cost of epitaxial growth for LED devices, with the ultimate goal of a 10x reduction. Veeco will work with the Sandia US National Laboratory and Philips Lumileds. Specifically, a complementary set of high-resolution short-wavelength and infrared in-situ monitoring tools for accurate substrate temperature measurement and growth rate monitoring will be developed with Philips Lumileds testing the resulting tool. The researchers will be seeking a 100% improvement in wavelength yield and

a 75% cost reduction for LED epitaxy.

Meanwhile, in a separate SSL Program Manufacturing Initiative project, Philips Lumileds plans to develop an epitaxial process for GaN on 150mm-diameter silicon with a 30% yield improvement and 60% reduction in manufacturing costs. Philips Lumileds hopes to develop technology already used in its thin-film flip-chip Luxeon Rebel lamp.

For HVPE, one uses pure metal sources that are converted to hot gaseous metal chlorides by flowing hydrogen chloride gas over them (Figure 3). Again, ammonia is a common nitrogen source. Companies promoting HVPE include Oxford Instruments, headquartered in the UK, through its 2008 acquisition of US-based Technologies and Devices Inc (TDI). A number of Japanese companies and research groups use HVPE to grow free-standing GaN substrates.

HVPE dates back to the 1960s and was the first technique used to create GaN crystals. Interest in the process has recently revived; one of its most attractive features is its two-orders-of-magnitude faster growth rate compared with typical MOCVD and molecular-beam epitaxy processes. Not just GaN growth is being explored — AlGaN alloy and even pure AlN layers are commonly grown using the technique. Typical HVPE substrates are sapphire and silicon carbide. Researchers at the University of Florida reported GaN growth on silicon (111) using a merged HVPE/MOCVD system in 2005.

Figure 5. Applied Materials project timeline.

Task	Description	Quarters 1	2	3	4	5	6	7	8
1	Multi-wafer HVPE chamber	***	***	***	***				
2	Tools with three chamber split process				***	***	***	***	
3	Process for growing low- defect, high-quality HB-LEDs			***	***	***			
4	In situ cleaning				***	***	***		
5	Optimized three-chamber MOCVD/ HVPE (2+1) tool and process							***	***
0	Project management	***	***	***	***	***	***	***	***
	Reporting	Q	Q	Q	A	Q	Q	Q	F

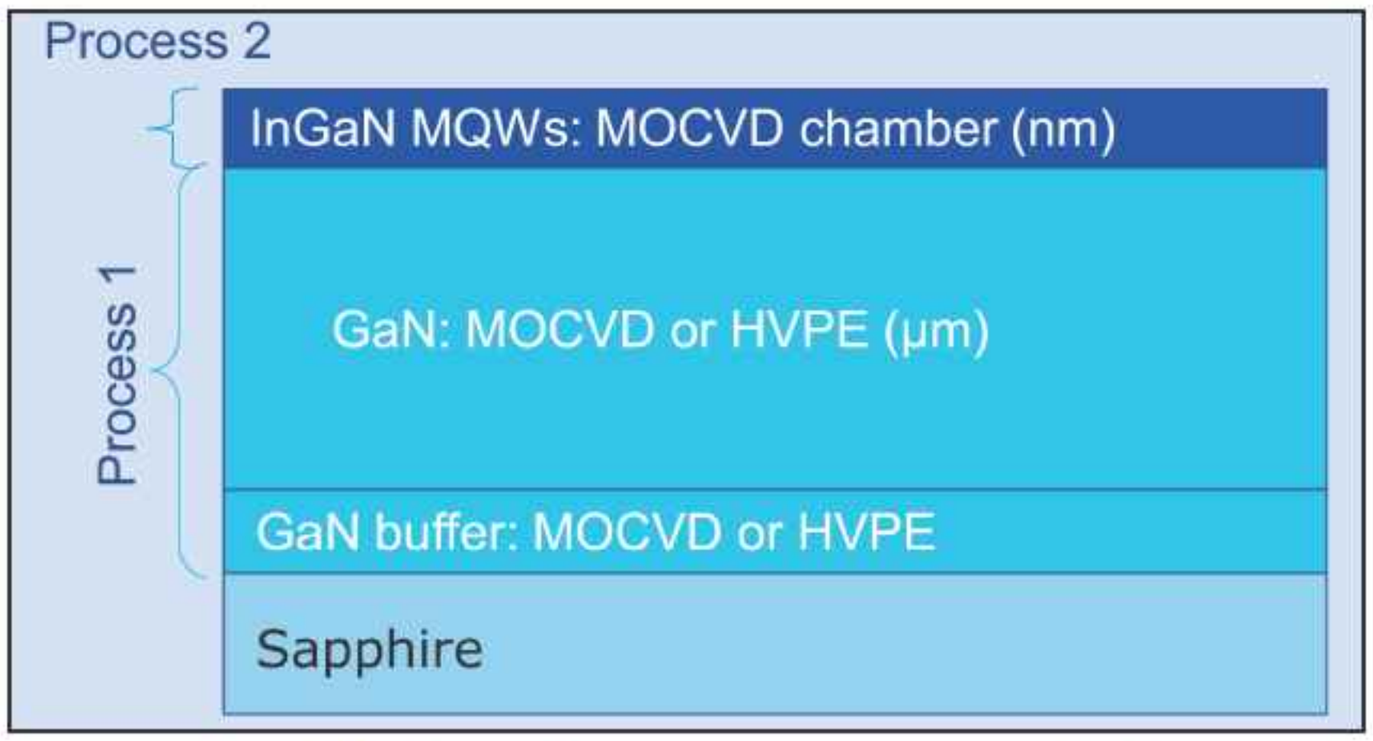

Figure 6. InGaN QW structure on sapphire used in PL uniformity tests.

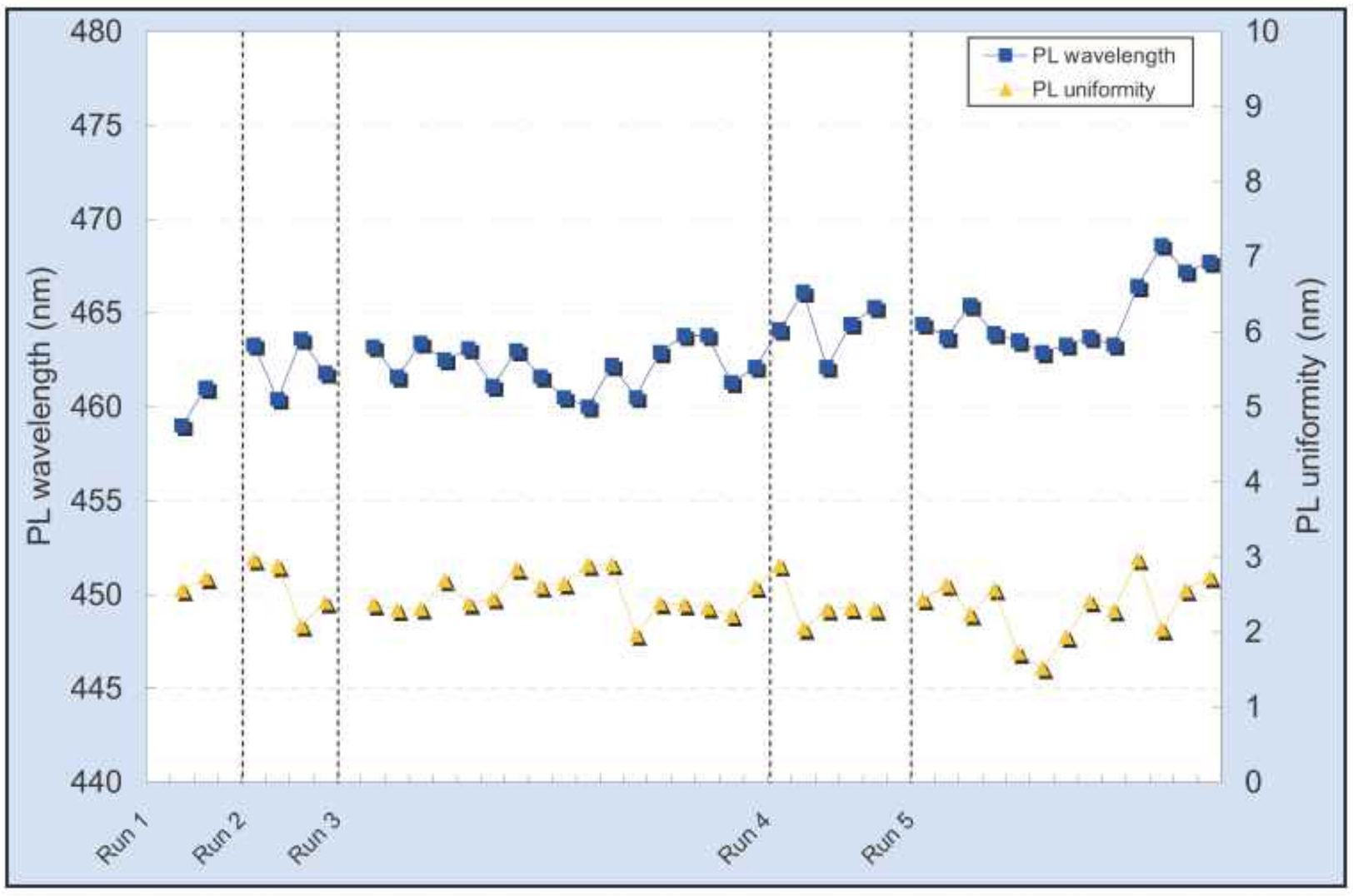

Figure 7. PL wavelength and uniformity over a series of five production runs.

In-situ cleaning

Applied's system is to include an automated in-situ cleaning subsystem to speed the process of returning production to specification when there has been drift due to the ceilings and walls of the reactor chambers becoming covered with various residues. In-situ cleaning will involve finding reactor conditions (temperature, pressure, flow rate) and chemical species that react with and remove these parasitic

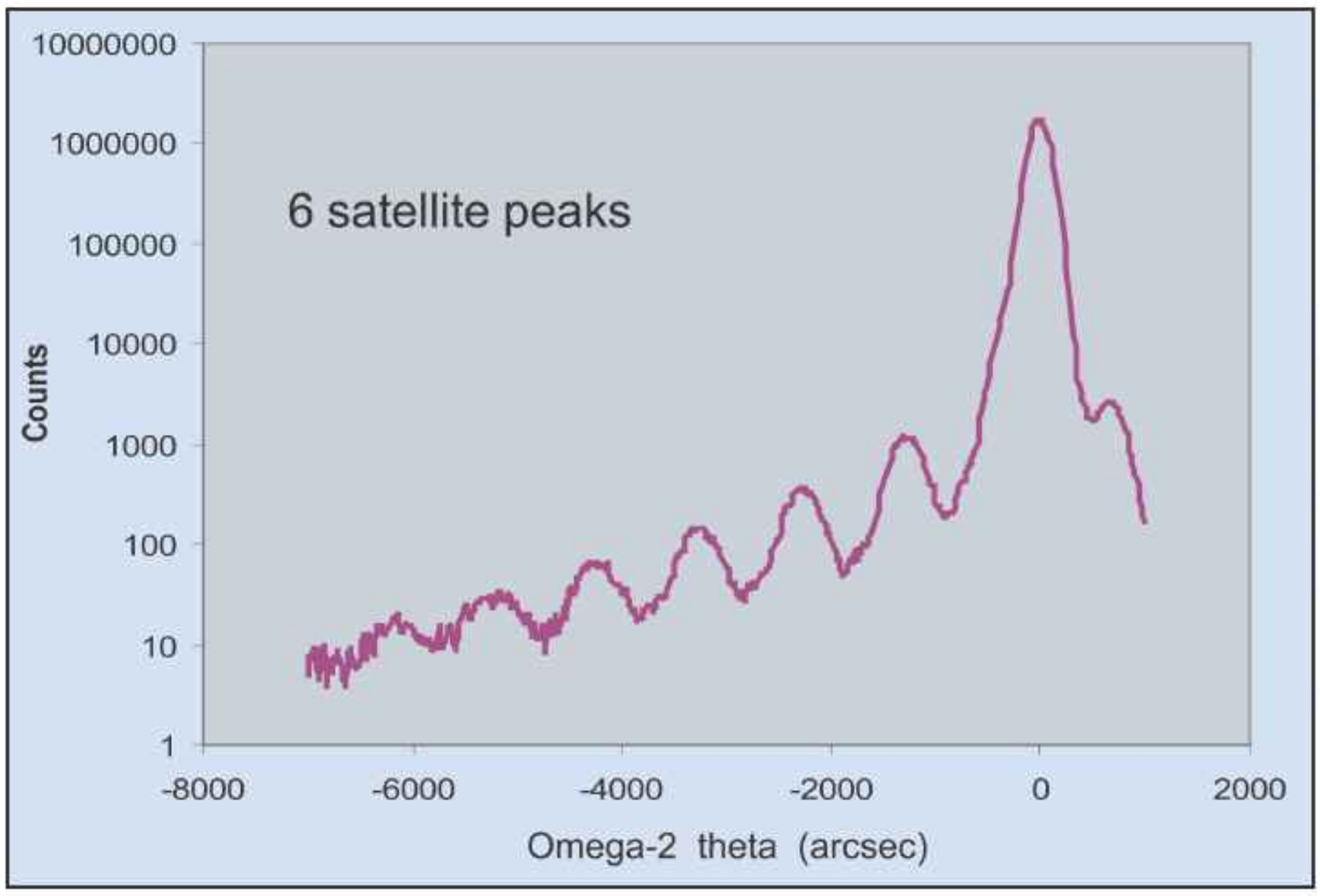

Figure 8. X-ray ω-scan of InGaN QW structure showing six satellite peaks.

deposits. It is hoped that these automated cleaning procedures will return the chamber to a clean/fresh condition before each run without ever opening the machine.

Applied Materials also believes that using lamp heating could give better temperature control of the processes in the needed range from ~550°C up to ~1050°C (Figure 4). For the quantum wells a rapid change of temperature (ΔT of ±100°C) is required for sharp interfaces. Lamp heating is widely used in silicon semiconductor production to provide rapid thermal processing (RTP) e.g. for annealing (RTA) of implanted dopant materials, 'activating' the carriers by repairing the ion crystal damage without diffusing the acceptors/donors and thus smearing the interfaces between n-type and p-type semiconductor regions.

The company also claims that use of its Centura platform would reduce material defects through its 'flexible configuration'. In the silicon industry, Applied has developed specialized chamber materials to lower defect densities and to increase the mean time between chamber cleaning. The company claims that its installed base of silicon epitaxy tools is about a thousand.

The DOE work has been divided into five tasks, along with an overall 'project management' section (Figure 5). The project is to be carried out over two years.

In the first year the multi-wafer HPVE chamber is to be developed (task 1). The next section (task 3) is to develop the process for growing low-defect, high-quality HB-LEDs on the most relevant substrates, with work starting in the third quarter (Q3) and ending in the fifth quarter (Q5). Another three-quarter project (Q4–Q6) is the in-situ cleaning process (task 4). A longer project (Q4–Q7) is to develop a three-chamber split process (task 2). The final piece of work is to optimize the resulting three-chamber MOCVD/HVPE (2+1) tool and process (task 5, Q7–Q8).

Applied has already begun testing a split process producing InGaN quantum wells on sapphire substrates (Figure 6). This showed uniformity in photoluminescence (PL) wavelength better than 4nm over five runs (Figure 7).

In terms of thermal control, Applied's system achieves temperature ramping of 5°C/second. X-ray diffraction analysis of the resulting InGaN quantum wells can show up to six satellite peaks in ω-scans (Figure 8). Company researchers claim not to have observed any of the V-defects usually associated with threading dislocations or indium segregation/quantum dots commonly seen in high In-content InGaN (Figure 9). ■

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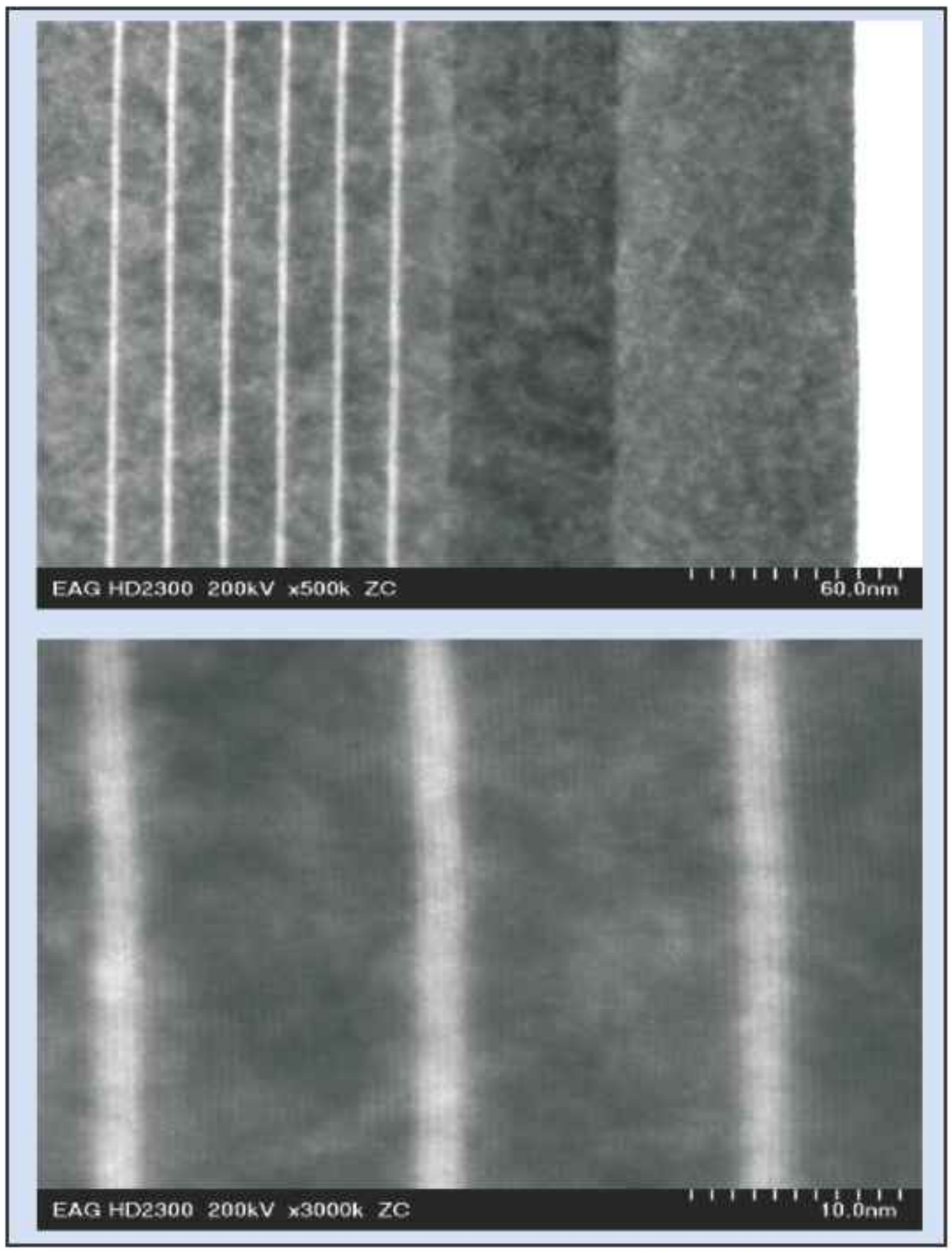

Figure 9. Electron micrographs of InGaN QW structures produced at Applied Materials.

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.



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Temescal, the expert in metallization systems for the processing of compound semiconductor-based substrates, provides the finest evaporation systems available. Multi-layer coatings of materials such as Ti, Pt, Au, Pd, Ag, NiCr, Al, Cr, Cu, Mo, Nb, SiO_2, with high uniformity are guaranteed. Today the world's most sophisticated handsets, optical, wireless and telecom systems rely on millions of devices that are made using Temescal deposition systems and components.

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Veeco is a world-leading supplier of compound semiconductor equipment, and the only company offering both MOCVD and MBE solutions. With complementary AFM technology and the industry's most advanced Process Integration Center, Veeco tools help grow and measure nanoscale devices in worldwide LED/wireless, data storage, semiconductor and scientific research markets—offering important choices, delivering ideal solutions.

7 Wafer processing materials

Air Products and Chemicals Inc
7201 Hamilton Blvd.,
Allentown, PA 18195, USA
Tel: +1 610 481 4911
www.airproducts.com/compound

MicroChem Corp
1254 Chestnut St. Newton,
MA 02464, USA
Tel: +1 617 965 5511
Fax: +1 617 965 5818
E-mail: sales@microchem.com
www.microchem.com

Power + Energy Inc
(see section 8 for full contact details)

Praxair Electronics
(see section 5 for full contact details)

8 Wafer processing equipment

EV Group
DI Erich Thallner Strasse 1,
St. Florian/Inn, 4782,
Austria
Tel: +43 7712 5311 0
Fax: +43 7712 5311 4600
www.EVGroup.com
Technology and market leader for wafer processing equipment.
Worldwide industry standards for aligned wafer bonding, resist processing for the MEMS, nano and semiconductor industry.

Logitech Ltd
Erskine Ferry Road,
Old Kilpatrick, near Glasgow G60 5EU,
Scotland, UK
Tel: +44 (0) 1389 875 444
Fax: +44 (0) 1389 879 042
www.logitech.uk.com

Oxford Instruments Plasma Technology
(see section 6 for full contact details)

Power + Energy Inc
(see section 8 for full contact details)

SAMCO International Inc
532 Weddell Drive, Sunnyvale, CA,
USA
Tel: +1 408 734 0459
Fax: +1 408 734 0961
www.samcointl.com

SPP Process Technology Systems Ltd
Imperial Park, Newport NP10 8UJ,
Wales, UK
Tel: +44 (0)1633 652400
Fax: +44 (0)1633 652405
www.spp-pts.com

Synova SA
Ch. de la Dent d'Oche,
1024 Ecublens,
Switzerland
Tel: +41 21 694 35 00
Fax: +41 21 694 35 01
www.synova.ch

TECDIA Inc
(see section 16 for full contact details)

Tegal Corp
2201 S McDowell Boulevard,
Petaluma,
CA 94954,
USA
Tel: +1 707 763 5600
www.tegal.com

Veeco Instruments Inc
(see section 6 for full contact details)

9 Materials & metals

Goodfellow Cambridge Ltd
Ermine Business Park,
Huntingdon,
Cambridgeshire
PE29 6WR,
UK
Tel: +44 (0) 1480 424800
Fax: +44 (0) 1480 424900
www.goodfellow.com
Goodfellow supplies small quantities of metals and materials for research, development, prototyping and specialised manufacturing operations.

TECDIA Inc
(see section 16 for full contact details)

10 Gas and liquid handling equipment

Air Products and Chemicals Inc
(see section 7 for full contact details)

Cambridge Fluid Systems
12 Trafalgar Way, Bar Hill,
Cambridge CB3 8SQ,
UK
Tel: +44 (0)1954 786800
Fax: +44 (0)1954 786818
www.cambridge-fluid.com

CS CLEAN SYSTEMS AG
Fraunhoferstrasse 4,
Ismaning, 85737,
Germany
Tel: +49 89 96 24 00 0
Fax: +49 89 96 24 00 122
www.cscleansystems.com

EMF Semiconductor Systems Ltd
(see section 6 for full contact details)

IEM Technologies Ltd
Fothergill House, Colley Lane,
Bridgwater, Somerset TA6 5JJ,
UK
Tel: +44 (0)1278 420555
Fax: +44 (0)1278 420666
www.iemtec.com

Power + Energy Inc
106 Railroad Drive,
Ivyland,
PA 18974,
USA
Tel: +1 215 942-4600
Fax: +1 215 942-9300
www.powerandenergy.com

SAES Pure Gas Inc
4175 Santa Fe Road,
San Luis Obispo,
CA 93401,
USA
Tel: +1 805 541 9299
Fax: +1 805 541 9399
www.saesgetters.com

11 Process monitoring and control

EMF Semiconductor Systems Ltd
(see section 6 for full contact details)

k-Space Associates Inc
3626 W. Liberty Rd.,
Ann Arbor,
MI 48103,
USA
Tel: +1 734 668 4644
Fax: +1 734 668 4663
www.k-space.com
k-Space Associates Inc specializes in in-situ, real-time thin-film process monitoring tools for MBE, MOCVD, PVD, and thermal evaporation. Applications and materials include the research and production line monitoring of compound semiconductor-based electronic, optoelectronic, and photovoltaic devices.

LayTec GmbH
Seesener Str.
10–13, 10709
Berlin, Germany
Tel: +49 30 39 800 80 0
Fax: +49 30 3180 8237
www.laytec.de

LayTec develops and manufactures optical in-situ and in-line metrology systems for thin-film processes with particular focus on compound semiconductor and photovoltaic applications. Its know-how is based on optical techniques: reflectometry, emissivity corrected pyrometry, curvature measurements and reflectance anisotropy spectroscopy.

Optical Reference Systems Ltd
OpTIC Technium,
St Asaph Business Park,
St Asaph, LL17 0JD,
UK
Tel: +44 (0)1745 535 188
Fax: +44 (0)1745 535 186
www.ors-ltd.com

WEP (Ingenieurbüro Wolff für Elektronik- und Programmentwicklungen)
Bregstrasse 90, D-78120
Furtwangen im Schwarzwald,
Germany
Tel: +49 7723 9197 0
Fax: +49 7723 9197 22
www.wepcontrol.com

12 Inspection equipment

Bruker AXS GmbH
Oestliche Rheinbrueckenstrasse 49,
Karlsruhe, 76187,
Germany
Tel: +49 (0)721 595 2888
Fax: +49 (0)721 595 4587
www.bruker-axs.de

KLA-Tencor
160 Rio Robles, Suite 103D,
San Jose, CA 94538-7306,
USA
Tel: +1 408 875 3000
Fax: +1 510 456 2498
www.kla-tencor.com

13 Characterization equipment

J.A. Woollam Co. Inc.
645 M Street Suite 102,
Lincoln, NE 68508,
USA
Tel: +1 402 477 7501
Fax: +1 402 477 8214
www.jawoollam.com

Lake Shore Cryotronics Inc
575 McCorkle Boulevard,
Westerville, OH 43082, USA
Tel: +1 614 891 2244
Fax: +1 614 818 1600
www.lakeshore.com

14 Chip test equipment

Keithley Instruments Inc
28775 Aurora Road,
Cleveland, OH 44139, USA
Tel: +1 440.248.0400
Fax: +1 440.248.6168
www.keithley.com

SUSS MicroTec Test Systems
228 Suss Drive,
Waterbury Center, VT 05677, USA
Tel: +1 800 685 7877
Fax: +1 802 244 7853
www.suss.com

15 Assembly/packaging materials

ePAK International Inc
4926 Spicewood Springs Road,
Austin, TX 78759, USA
Tel: +1 512 231 8083
Fax: +1 512 231 8183
www.epak.com

Gel-Pak
31398 Huntwood Avenue,
Hayward, CA 94544, USA
Tel: +1 510 576 2220
Fax: +1 510 576 2282
www.gelpak.com

Williams Advanced Materials
2978 Main Street, Buffalo, NY 14214,
USA
Tel: +1 716 837 1000
Fax: +1 716 833 2926
www.williams-adv.com

16 Assembly/packaging equipment

Ismeca Europe Semiconductor SA
Helvetie 283, La Chaux-de-Fonds, 2301,
Switzerland
Tel: +41 329257111
Fax: +41 329257115
www.ismeca.com

J P Sercel Associates Inc
220 Hackett Hill Road,
Manchester, NH 03102,
USA
Tel: +1 603 518 3200
Fax: +1 603 518 3298
www.jpsalaser.com

Kulicke & Soffa Industries
1005 Virginia Drive,
Fort Washington, PA 19034, USA
Tel: +1 215 784 6000
Fax: +1 215 784 6001
www.kns.com

Palomar Technologies Inc
2728 Loker Avenue West,
Carlsbad, CA 92010, USA
Tel: +1 760 931 3600
Fax: +1 760 931 5191
www.PalomarTechnologies.com

TECDIA Inc
2700 Augustine Drive, Suite 110,
Santa Clara, CA 95054, USA
Tel: +1 408 748 0100
Fax: +1 408 748 0111
www.tecdia.com
Tecdia is a manufacturer of single-layer chip capacitors, chip resistors, DC boards, bias-Ts, diamond scribing tools and dispensing nozzles.

17 Assembly/packaging foundry

Quik-Pak
10987 Via Frontera,
San Diego, CA 92127,
USA
Tel: +1 858 674 4676
Fax: +1 8586 74 4681
www.quikicpak.com

18 Chip foundry

Compound Semiconductor Technologies Ltd
Block 7, Kelvin Campus,
West of Scotland, Glasgow,
Scotland G20 0TH,
UK
Tel: +44 141 579 3000
Fax: +44 141 579 3040
www.compoundsemi.co.uk

United Monolithic Semiconductors
Route departementale 128,
BP46, Orsay, 91401,
France
Tel: +33 1 69 33 04 72
Fax: +33 169 33 02 92
www.ums-gaas.com

19 Facility equipment

MEI, LLC
3474 18th Avenue SE,
Albany, OR 97322-7014,
USA
Tel: +1 541 917 3626
Fax: +1 541 917 3623
www.marlerenterprises.net

20 Facility consumables

W.L. Gore & Associates
401 Airport Rd,
Elkton, MD 21921-4236,
USA
Tel: +1 410 392 4440
Fax: +1 410 506 8749
www.gore.com

21 Computer hardware & software

Ansoft Corp
4 Station Square, Suite 200,
Pittsburgh, PA 15219, USA
Tel: +1 412 261 3200
Fax: +1 412 471 9427
www.ansoft.com

Crosslight Software Inc
121-3989 Henning Dr.,
Burnaby, BC, V5C 6P8,
Canada
Tel: +1 604 320 1704
Fax: +1 604 320 1734
www.crosslight.com

Semiconductor Technology Research Inc
10404 Patterson Ave., Suite 108,
Richmond, VA 23238,
USA
Tel: +1 804 740 8314
Fax: +1 804 740 3814
www.semitech.us

22 Used equipment

Class One Equipment Inc
5302 Snapfinger Woods Drive,
Decatur, GA 30035,
USA
Tel: +1 770 808 8708
Fax: +1 770 808 8308
www.ClassOneEquipment.com

23 Services

Henry Butcher International
Brownlow House, 50–51
High Holborn,
London WC1V 6EG,
UK
Tel: +44 (0)20 7405 8411
Fax: +44 (0)20 7405 9772
www.henrybutcher.com

M+W Zander Holding AG
Lotterbergstrasse 30,
Stuttgart,
Germany
Tel: +49 711 8804 1141
Fax: +49 711 8804 1950
www.mw-zander.com

TECDIA Inc
(see section 16 for full contact details)

24 Consulting

WSR Optical Device Solutions
P.O. Box 248,
Flemington,
NJ 08822,
USA
Tel: +1 908 428 4986
www.wsr-ods.com

25 Resources

SEMI Global Headquarters
3081 Zanker Road,
San Jose, CA 95134,
USA
Tel: +1 408 943 6900
Fax: +1 408 428 9600
www.semi.org

Yole Développement
45 rue Sainte Geneviève,
69006 Lyon,
France
Tel: +33 472 83 01 86
www.yole.fr

event calendar

If you would like your event listed in *Semiconductor Today*'s Event Calendar, then please e-mail all details to the Editor at mark@semiconductor-today.com

20–25 June 2010
35th IEEE Photovoltaic Specialists Conference (PVSC)
Oahu, HI, USA
E-mail: wendy_larsen@nrel.gov
http://pv-solar.org

21–24 June 2010
Solid State and Organic Lighting (SOLED)
Karlsruhe, Germany
E-mail: cust.serv@osa.org
www.osa.org/meetings/topicalmeetings/SOLED

22–25 June 2010
LED Expo and OLED Expo 2010
KINTEX, Seoul, South Korea
E-mail: led@exponu.com
www.ledexpo.com

30 June 2010
Nanoscale Plasma Processing Workshop
Oxford Instruments Plasma Technology & Glasgow James Watt Nanofabrication Centre, University of Glasgow, Scotland, UK
E-mail: plasma@oxinst.com
www.oxford-instruments.com

30 June – 2 July 2010
PV Japan 2010
Yokohama, Japan
E-mail: pvj@semi.org
www.pvjapan.org/PVJAPAN-EN

4–8 July 2010
3rd International Symposium on Growth of III-Nitrides (ISGN3)
Corum, Montpellier, France
E-mail: gil@ges.univ-montp2.fr
http://isgn3.org

7–8 July 2010
UK Semiconductors 2010
University of Sheffield, UK
E-mail: abstracts@uksemiconductors.com
www.uksemiconductors.com

12–13 July 2010
2010 International Symposium on Optoelectronic Materials and Devices
Chicago, IL, USA
E-mail: yanter@epir.com
www.epir.com/symposium.html

12–16 July 2010
SEMICON West 2010, including Intersolar North America
San Francisco, CA, USA
E-mail: customerservice@semi.org
www.semiconwest.org

advertisers' index

15–16 July 2010
Oxford Instruments 2010 Seminar Series: New Frontiers in Plasma Nanopatterning
Molecular Foundry, Lawrence Berkeley National Laboratory, Berkeley, CA, USA
E-mail: plasma@oxinst.com
www.oxford-instruments.com

1–5 August 2010
SPIE Optics + Photonics
San Diego, CA, USA
E-mail: CustomerService@spie.org
http://spie.org/optics-photonics.xml

22–27 August 2010
MBE 2010
Berlin, Germany
E-mail: info@mbe2010.de
http://mbe2010.de

29 August – 2 September 2010
8th European Conference on Silicon Carbide and Related Materials (ECSCRM 2010)
Oslo, Norway
E-mail: info@ecscrm10.com
www.ecscrm10.com

6–9 September 2010
12th China International Optoelectronic Exposition (CIOE 2010)
Shenzhen Convention and Exhibition Center, China
E-mail: shirly@cioe.cn
www.cioe.cn/html/list_543.html

6–9 September 2010
NUSOD 2010 (10th International Conference on Numerical Simulation of Optoelectronic Devices)
Georgia Institute of Technology, Atlanta, GA, USA
www.nusod.org/2010

6–10 September 2010
25th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) and 5th World Conference on Photovoltaic Energy Conversion
Feria Valencia, Valencia, Spain.
E-mail: pv.conference@wip-munich.de
www.photovoltaic-conference.com

6–10 September 2010
2010 International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz)
Rome, Italy
www.irmmw-thz.org

13–17 September 2010
Solid-State Device Research — 40th European Conference (ESSDERC-2010) and Solid-State Circuits Research — 36th European Conference (ESSCIRC-2010)
Seville, Spain
E-mail: cor.claeys@imec.be
www.esscirc.org

26–29 September 2010
27th North American Conference on Molecular Beam Epitaxy (NAMBE 2010)
Breckenridge, CO, USA
E-mail: della@avs.org
www2.avs.org/conferences/nambe

27 September – 1 October 2010
13th European Microwave Week (EuMW2010)
Paris, France
E-mail: eumw2010@iemn.univ-lille1.fr
www.eumweek.com

27–28 September 2010
Oxford Instruments 2010 Seminar Series: Workshop on Dry Processing for Nanoelectronics and Micromechanics
University of Freiburg, Germany
E-mail: plasma@oxinst.com
www.oxford-instruments.com

28–29 September 2010
Strategies in Light Europe (SIL Europe 2010)
Frankfurt, Germany
E-mail: kellys@pennwell.com
www.sil-ledeurope.com

29 September – 1 October 2010
LED Japan Conference & Expo: Strategies in Light
Pacifico Yokohama, Japan
E-mail: tcarli@strategies-u.com
www.sil-ledjapan.com

3–6 October 2010
2010 IEEE Compound Semiconductor IC Symposium
Monterey, CA, USA
E-mail: customer.service@ieee.org
www.csics.org

5–9 October 2010
CEATEC JAPAN 2010 (Combined Exhibition of Advanced Technologies)
Makuhari Messe, Tokyo, Japan
E-mail: contact@ceatec.com
www.ceatec.com

Photo: Close-up of SolFocus concentrated photovoltaic (CPV) power unit.