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semiconductorTODAY

COMPOUNDS & ADVANCED SILICON

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LED demand stretches raw materials supply

MO precursor suppliers expand • AZZURRO raises €14.5m
Epistar's record 162lm/W cool-white LED • SEI unveils 6" GaN

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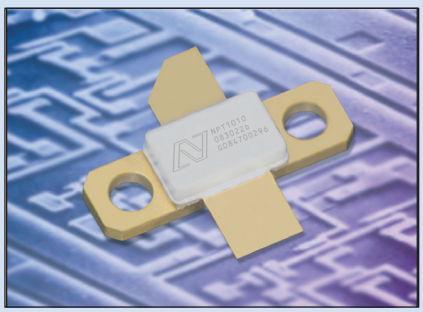
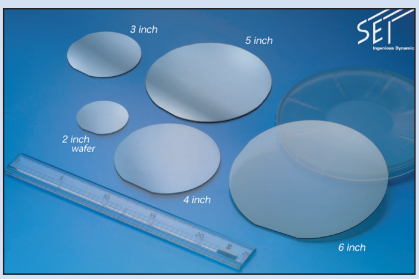
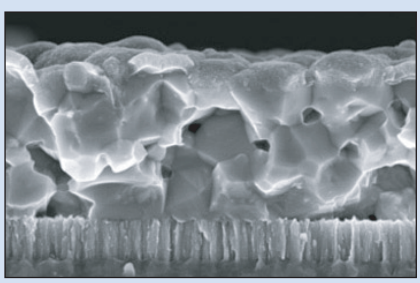


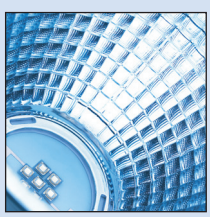
p24 Nitronex's NPT1012 GaN HEMT, the second product based on its new power transistor platform technology.



p50 Sumitomo Electric Industries has developed the first 6" GaN substrates for white LEDs, seen here with the firm's existing 2-4" GaN wafers.



p99 Microscope image of IBM's CTZS cell, which is to be co-developed with Showa Shell subsidiary Solar Frontier.



Cover: At electronica in Munich, Osram Opto Semiconductors added to its OSLON SSL product family (which has a beam angle of 80°) by launching the OSLON SSL 150 LED, which has a 150° beam angle, enabling lamps and luminaires to be simpler and more efficient, as well as suiting diffused lighting. **p54**

editorial

Responding to demand through the supply chain

After a recent pause in growth of LED chip sales due to a supply/demand rebalancing in Europe for consumer display backlighting applications (see Cree's Q3/2010 on page 56 of the last issue), Taiwanese LED chipmaker Lextar expects a surge in demand for LED-backlit LCD TV panels in January–February prior to TV vendors launching new models in March (see this issue, page 7).

The overall boom in LED demand has driven announcements (reported on pages 32–33 of this issue alone) of capacity expansions by manufacturers of metal-organic precursor materials, particularly trimethyl gallium (TMG). These include SAFC (at its Taiwan site), Dow (a new plant in Korea) and AkzoNobel (a second doubling in capacity this year). Meanwhile, the USA's ATMI has bought a stake in Korea's Lake LED Materials. All this follows US MO manufacturer Albemarle announcing plans to build a TMG plant in Korea, as well as Chemtura expanding TMG and TMA production via a joint venture with UP Chemical in Korea (see September issue, pages 26–27).

According to Lextar, the short supply of LEDs is expected to ease in 2011. However, the increase in production of LEDs will place greater demand on not only MOCVD precursors but also on raw materials.

In this issue's feature article on pages 114–118 we hence focus on the effect that growing demand is having on both the availability and supply of raw materials including gallium and indium. Although the US government does not maintain stockpiles of either indium or gallium, in recent years both Japan and Korea have established stockpiles of such rare metals. Meanwhile, China Securities Journal has reported moves by China's Commerce Ministry to place stricter controls on rare-metal exports — a 2–3% cut in quotas per year, according to some sources. There have been recent disruptions in supplies to Japan and the USA of rare earth materials (of which China has a near-monopoly), while there have been some reports that indium and gallium are among ten rare metals that China's State Bureau of Material Reserve is considering stockpiling.

LED makers in China have up to now been starting up and expanding by ordering MOCVD reactors at an unprecedented rate (due in part to government subsidies). However, there have most recently been some concerns about possible overcapacity of LED manufacturing. In particular, according to a report in Digitimes, due to fears of an oversupply of LED chips used in LCD TV backlight units (BLUs), Neo-Neon Holdings is downsizing its LED epiwafer capacity expansion by reducing the installation of additional MOCVD systems from its originally planned 50 by the end of 2011 to 30 (see page 58). The possible oversupply of LED chips used in BLUs is attributed to TFT-LCD panel makers expanding capacity for LED chips among their subsidiaries in order to increase in-house supply. Digitimes reports that Taiwan-based LED makers Tekcore and Formosa Epitaxy (Forepi) have also delayed installing additional MOCVD reactors.

While such push outs may seem alarming, this may be a good sign that the industry is responding quickly to temporary pauses in growth, perhaps forestalling overcapacity as well as easing strains on materials supply.

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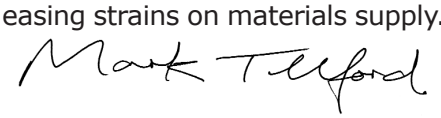

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news

Packaged LED market to grow at 28.2% annually to 2015

Brief oversupply from late 2011 to affect mostly low end of market

The market for packaged LEDs is experiencing tremendous growth, with an expected compound annual growth rate (CAGR) of 28.2% between 2009 and 2015, according to new reports on the status of the LED industry ('SLI 2010') and LED Manufacturing Technologies ('LED ManTech 2010') to be available from market research firm Yole Développement and the European Photonics Industry Consortium (EPIC) of Paris, France from 15 November. In a base scenario, revenue should reach $8.9bn in 2010 and grow to $25.7bn in 2015 and nearly $30bn in 2020.

In terms of volume, LED die surface is expected to increase at a CAGR of 41.6% from 6.3 billion mm^2 to 51 billion mm^2 in 2015. This will prompt substrate volumes to growth from 12.7m TIE (two-inch equivalent) in 2009 to 84.4m TIE in 2015, a CAGR of 37.1% (smaller than the increase in die surface due to significant manufacturing yield improvements). The equipment market will also experience a dramatic growth cycle, with demand driving the installation of nearly 1400 reactors in 2010–2012.

"Anticipation of future demand and generous subsidies in China will trigger the installation of another 700–1000 reactors in the same period, leading to a short period of oversupply starting in late 2011," reckons EPIC's general secretary Tom Pearsall. "However, this oversupply will mostly affect the low end of the market."

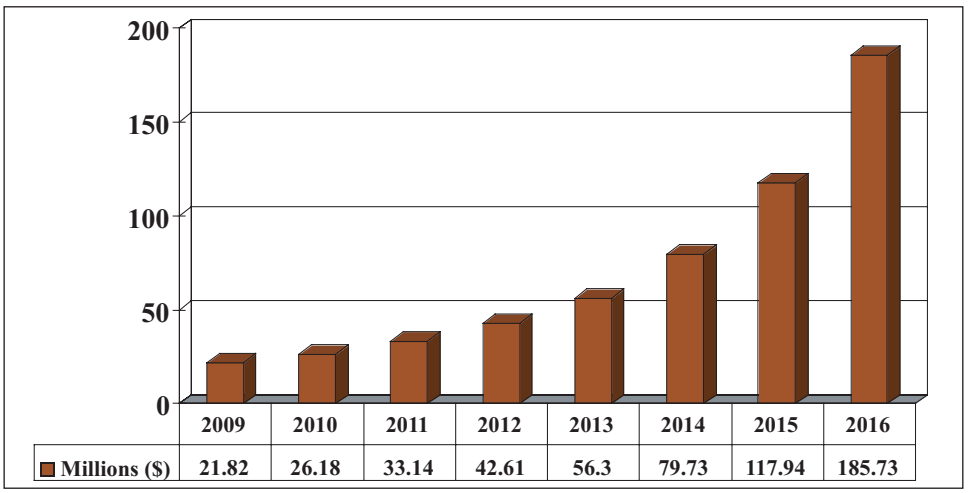
Growth in general lighting applications will be enabled by significant technology and manufacturing efficiency improvements that will help to lower the cost per lumen of packaged LEDs by 10-fold between 2010 and 2020. These factors will include: economies of scale; LED efficiency improvement, including at high power (droop effect); improved phosphors; improved packaging technologies; and significant improvements in LED epitaxy cost of ownership through yield and throughput. However, additional breathroughs are needed — Haitz's Law (stating that every decade the cost per lumen falls 10-fold and the amount of light generated per LED package increases 20-fold, for a given wavelength) is not enough, comments the report.

www.yole.fr
www.epic-assoc.com

Market for LEDs used in test/measurement and medical/science device to grow at 35.8% annually

According to ElectroniCast Consultants, consumption of packaged component-level LEDs used in test/measurement and medical/science devices will rise at an average annual growth rate of 35.8% from $21.82m in 2009 to $185.73m in 2016, despite a drop in average prices in some categories partially offsetting comparably strong unit growth.

"With new performance records in red LEDs, record efficacy for green LEDs, fascinating accomplishments with DUV (deep ultraviolet) LEDs, huge consumer/professional interests with blue and other color LED photo-dynamic therapy (PDT), as well as explosive growth opportunities for white LED (WLED) lighting in the operating theater (OT), the bio-photonics, test/measurement and related sectors are poised for rapid market demand during the forecast period," says Stephen Montgomery, president of International Business at ElectroniCast.



Test/measurement and medical/science LED market ($m).

The LED market is segmented into the following sub-application categories: sensing/detection and analytical/monitoring; photo-therapy/sanitation/cell regeneration/curing; instrumentation light source and imaging; and operating theater (OT)/surgical/dentistry lighting.

www.electronicast.com

LED-based lighting market to drive optoelectronics sales

The increasing demand for energy-efficient systems is expected to drive the sales of LED-based lighting devices, according to a new report 'Optoelectronics Market to 2020 — Push for Energy Efficiency to Increase Demand for LED based Applications' from GBI Research. The display and lamp market is expected to rise at a compound annual growth rate (CAGR) of 9.41% over 2009–2020. Lighting accounts for 20% of the world's electricity consumption and there is increasing demand for energy-efficient and environmentally friendly technologies. These requirements are largely fulfilled by optoelectronic applications such as LEDs, which consume only 20% of the energy compared to a traditional incandescent bulb and can last up to 25,000 hours.

Also expected to boost optoelectronics sales during 2010–2020 is the increasing use of consumer devices that require solid-state lighting and image sensors, such as smartphones, digital cameras, mp3s, iPods, and LCD TVs. The rapid adoption of smart phones with LED backlighting is expected to boost demand for optoelectronic products, especially LEDs and image sensors. Smartphone usage is set to increase dramatically, with the sales volume forecasted to rise from 174 million in 2009 to 500 million in 2014.

Revenue for image-sensor devices is predicted to grow 29% year-on-year (YoY) to an unprecedented $8.3bn in 2010, with demand for digital cameras, camera phones, and machine-vision systems recovering with the global economy. In 2010, CMOS-based devices had a 61% share of revenue and charge-coupled devices (CCDs) the remaining 39%. CMOS image sensors dominate high-growth portable system applications (such as camera phones, webcams in notebook computers, and other embedded cameras in handheld products) and will drive growth in demand for image sensors. In particular, new specialized and high-speed CMOS imagers are increasingly used in automotive systems, medical equipment and wireless video security networks. CMOS imagers are also used in optical mouse, toys and video games.

The automotive industry will be a key consumer of optoelectronic devices during 2009–2020, with a revenue share of 8% in 2010. The application of optoelectronic devices has started to gain momentum in the automotive industry, which will increasingly depend on the opto industry for safety and convenience solutions. LEDs are extensively used for interior as well as exterior lighting. Other opto devices such as image sensors (used mainly in mobile phones and digital cameras) are also being used to provide additional safety features such as lane departure warning and blind-spot assistance. Opto revenue from the automotive sector is expected to grow at a CAGR of 11.22% from 2009 to 2020.

Government support in countries like Japan and China is expected to boost sales of solar cells. Incentives are given in the form of tax credits, relief or exemption. Japanese firms in particular undertake large-scale R&D programs in optoelectronics, which are supported extensively by the Japanese government. Meanwhile, China plans to generate 10GW of energy from solar cells by 2020. The Chinese government subsidizes the costs of installing solar energy systems on buildings. Solar technology, which was previously limited to applications in satellites, is now being used in a wide range of industrial and home applications, notes the report.

www.gbiresearch.com

LED TV panel demand to boom in January/February

...but shortage to ease in 2011 as LEDs per TV falls

Demand for LED-backlit LCD TV panels will increase significantly in January–February 2011 as TV vendors are planning to launch new models in March, according to David Su, president of LED chipmaker Lextar Electronics Corp, a subsidiary of Taiwanese display panel maker AU Optronics (AUO).

In a report in Digitimes, Su says that, based on past experience, growth in demand will rise significantly when LED-backlit TV market share reaches 15–20%, and this should reach about 20% in 2010.

Most new models will be LED-backlit, Su notes. Market watchers estimate that, due to falling demand in Q4/2010, average selling prices (ASPs) for LED-backlit products will drop by 11–15%. He adds that LED price declines happen every quarter based on market demand, and demand in Q1/2011 is still unclear, so it is hard to estimate the drop.

Due to expanding market demand in 2011, LED backlighting designs for LCD monitors and TVs will focus on reducing overall costs, and the tight LED and component supply is expected to ease in 2011 due to component suppliers' efforts to expand capacity as well as new backlight unit (BLU) designs.

The main designs of LED TV BLUs in Q1/2010 were edge-type (on the top and bottom of displays) and needed about 144 LEDs for a 32" model, 192 LEDs for 37", 208 LEDs for 42", 240 LEDs for 46", and 288 LEDs for 55" models. However, in Q1/2011 LED TV BLU designs will change to edge-type on the sides, so LED usage will drop to 100, 120, 144, 172 and 200, respectively. Also, some suppliers are developing single-side bottom edge-type designs, which can cut LED usage to 80 for 32", 100 for 37" and 120 for 42" models, Digitimes notes.

www.digitimes.com

GaN power device market to reach $350m in 2015

Market to be evenly split between ICs, discretes and modules

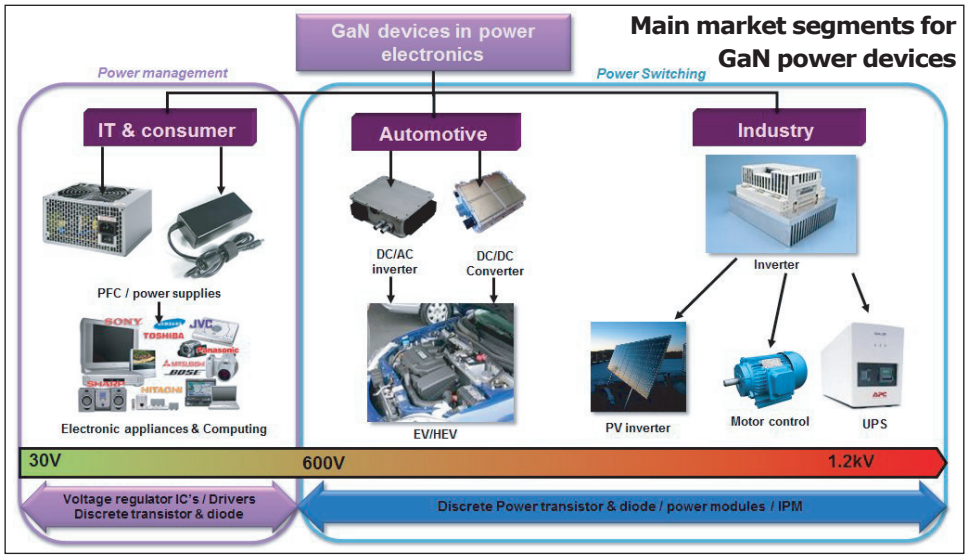
Yole Développement is forecasting a $350m market in 2015 for gallium nitride power devices [Power GaN: Market & Technology Analysis — GaN Technologies for Power Electronics Applications: Industry and Market Status & Forecasts, 2010]. Presently the France-based market research firm sees a total accessible market (TAM) of $16.6bn for power IC, discrete and module components.

Nitride semiconductors already dominate the market in short-wavelength (green, blue, violet, ultraviolet) light-emitting devices, and has made inroads into the RF power amplification market (~2GHz, e.g. mobile phone network).

GaN devices for lower-frequency power switching are maturing in terms of transistor, diode and even IC parts in the 0–600V range. Based on its assessment of the state-of-the-art for GaN production, Yole believes that the most promising applications for nitride semiconductors could be (see Figure) IT and consumer, automotive, better inverters for photovoltaic (PV) DC–AC conversion, uninterrupted power supply (UPS), and motor control. These applications take advantage of features such as higher breakdown electric field, better electron mobility, and higher melting point, leading to higher breakdown voltages, switching frequencies and overall system efficiency offered by GaN over silicon-based devices.

"About 67 % of the power electronics market is looking at 0–900V voltage range, mostly made of cost-driven consumer and IT applications," says the report's author Dr Philippe Roussel, project manager at Yole Développement.

These markets will require high volume and low cost. The use of either bulk GaN or GaN-on-silicon carbide (SiC) substrates is seen as being too expensive for this. Particularly attractive for this market are GaN-on-silicon 6"-diameter wafers that both lower costs (by using a silicon base) and create economies of scale (with larger wafers). Yole is assuming that this will be the dominant option chosen for power GaN devices. The substrate market supporting power GaN is expected to reach $100m in 2015. There is hence expected to be erosion in the price of GaN-on-Si substrates.



GaN-on-Si high-electron-mobility transistors (HEMT) could be 50% cheaper than the same sort of device built using silicon carbide (SiC) technology. Yet today's state-of-the-art remains twice and even three-times more expensive than the similar silicon device.

However, there are system-level arguments for choosing the more expensive component. For example, GaN devices operate better than silicon at higher temperatures, allowing a reduction or even elimination of cooling systems. Also, GaN has a higher switching speed at high power handling, allowing a reduction in RF filtering costs with the use of smaller capacitors and inductors. The smaller-sized housing due to the smaller GaN components will also allow further cost reductions.

This year saw the first product announcements in the sector from International Rectifier (IR) and Efficient Power Conversion Corp (EPC). The devices cover breakdown voltages ranging up to 200V (V_b). However, the roadmaps of IR and EPC are promising 600V and even 900V in the short term. These ratings would bring industrial and automotive applications onto the agenda.

Other contenders due to enter the arena include MicroGaN, Furukawa, GaN Systems, Panasonic, Sanken, and Toshiba.

Since it takes time to qualify devices, particular for target applications that need to consider reliability and safety factors such as automotive, Yole is forecasting an 'inflexion point' for GaN market ramp-up occurring early in 2012, leading to a market size in excess of $50m in 2013 and ~$350m by 2015. The kinds of devices in 2015 are expected to be evenly split between ICs, discretes and modules.

Yole says that its report provides a complete analysis of the GaN device and substrate industry in the power electronics field, along with key market metrics. 'It provides company involvement as well as technology state-of-the-art. In addition, an extensive review of the possible substrates for GaN is provided, offering the most complete view of the power GaN industry available to date.'

www.yole.fr

Author: Mike Cooke

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Handset market grows to 346.2m in Q3, while Samsung gains market share

Component supply constraints to hit Nokia, but favor Samsung and LG

The mobile handset market is set for a stellar performance in 2010 after shipments reached 346.2 million in the third quarter, according to ABI Research.

For the first three quarters of the year, year-on-year growth has been hovering around 20%. "This is a remarkable feat, irrespective of the rebound effect following the deferred handset purchases during the economic recession," says Jake Saunders, VP for forecasting. "Layer on 'smartphone envy' and you have a recipe for high handset volumes," he adds.

This rebound is having some interesting consequences, says ABI:
(1) Component manufacturers have never had it so good. Nokia in particular reported a hardware crunch, especially with displays (e.g. AMOLED) and semiconductor components for low-cost handsets, where Nokia's leading market share has increased its exposure.
(2) Vendors that have strong portfolios in smartphones (RIM, Apple, HTC and Motorola) have seen their growth in market share outperform the market (likely to continue into Q4/2010 and 2011).
(3) Unless Nokia can resolve its component resourcing challenges, it is likely to be supply-constrained again in Q4, which typically equates to 30% of annual handset sales. "Nokia's market share could well come under further pressure," adds Kevin Burden, VP & practice director for mobile devices.
(4) Handset vendors with greater in-house ability to source their own components (e.g. Samsung and LG) will be able to take advantage of the market opportunity to expand volumes.
(5) Typically, a handset boom period is followed by market softening as customers wait for the next 'must have' handset feature innovation to make its way to market. However, there is still considerable room for innovation in the smartphone sector, not just 'feature innovation' but also 'cost-reduction innovation', which should keep customers keen.

Handset vendors with greater in-house ability to source their own components will be able to take advantage of the market opportunity to expand volumes

While Samsung increased its market share in Q3 (to 20.6%), other vendors contracted: Nokia to 31.9%, LG to 8.2%, Sony-Ericsson to 3%, and Motorola to 2.6%, notes ABI. Meanwhile, smartphone vendors Apple and Research In Motion (RIM) grew their shares to 4.1% and 4%, respectively.

www.abiresearch.com

Asia-Pacific helping to push handset shipments to 1.34bn in 2010

Global shipments of mobile handsets are expected to total 1.34bn in 2010 and should maintain their momentum all the way to 2015, which should see more than 1.7bn in shipments, according to ABI Research's 'Mobile Device Shipment Market Data' study.

"The Asia-Pacific region currently makes the largest contribution to global handset sales," says industry analyst Celia Bo. "Sales are projected to increase 9% this year compared to 2009, and will account for 38% of total shipments," she adds. "China is clearly a major source of handset demand, but it is not the only one. India and Indonesia are also expanding their domestic demand."

The Indian market is expected to grow 24% year-on-year from 84.3 million handsets in 2009 to 104 million in 2010. Similarly, Indonesia is not insignificant. Many of its 240 million people purchased 33 million handsets in 2009, and that is expected to surpass 37 million by the end of 2010. Both markets have traditionally been fertile ground for Nokia distributors and dealers. In those markets, the Finnish firm has enjoyed a market-share well above its global average.

Sales are projected to increase 9% this year compared to 2009, and will account for 38% of total shipments

Nokia has been very effective in producing ultra-low-cost handsets that are robust and user-friendly and at the right price-point. But Nokia has seen its market share steadily eroded in the mid to high tiers as India's and Indonesia's aspiring middle classes purchase high-end feature phones and smartphones. Samsung, LG and RIM have been net beneficiaries.

"Local handset vendors such as Micromax and Spice Mobile in India, and Nexian and SPC Mobile in Indonesia, are intent on catering to low-end and mid-tier end-users," notes VP & practice director Kevin Burden. "Their game-plan is to push the envelope on providing increasingly feature-rich handsets at aggressive price-points."

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IN BRIEF

RFMD adds high-linearity differential IF mixers to Multi-Market Product catalog

RF Micro Devices Inc of Greensboro, NC, USA has expanded its RF component catalog to include two new high-linearity differential IF mixers: the RFMX0015 and RFMX1015. Both are optimized for operation across a broad range of end markets, including cellular infrastructure, wireless backhaul and other high-performance wireless systems.

The firm says that increasing deployment of 3G and LTE wireless systems is spurring demand for very high-linearity down-converters (with IIP3 >28dBm). The RFMX0015 and RFMX1015 feature a passive gallium arsenide mixer core that delivers high linearity. When combined with the GaAs heterojunction bipolar transistor (HBT) intermediate-frequency (IF) amplifier, the combination provides what is claimed to be an industry-leading IIP3/DC current figure of merit (29dBm/200mA) for a down-conversion differential IF mixer with 7dB gain and 0dBm LO drive.

The RFMX0015 and RFMX1015 operate in the standard cellular bands of 600–1050MHz and 1500–2200MHz, respectively, and support both high- and low-side LO injection for IF frequencies up to 300MHz. In addition, the mixers feature an IF bias pin that enables users to reduce the DC current to save power when peak linearity performance is not required.

RFMD showcased its portfolio of RF components at the electronica 2010 trade show in Munich, Germany (9–12 November).

www.rfmd.com/CS/Documents/BR_RFMX0015_1015.pdf

RFMD's quarterly revenue grows 12% year-on-year to record $285.8m

Growth driven by diversification, with strength in smartphones, smart energy, and WiFi

For its fiscal second-quarter 2011 (ended 2 October 2010), RF Micro Devices Inc of Greensboro, NC, USA has reported its sixth quarter of sequential revenue growth, to $285.8m (up 4.4% on $273.8m last quarter and up 12.2% on $254.8m a year ago).

RFMD achieved substantial year-on-year and continued sequential revenue growth in both its Cellular Products Group (CPG) and its Multi-Market Products Group (MPG). During the quarter, RFMD secured major design wins, including components for smartphones, mobile tablet devices, smart energy applications, high-power GaN applications, and wireless infrastructure. Sales to customers outside RFMD's largest customer (Nokia) grew by about 53% year-on-year, driven by market share gains at targeted handset customers and broad-based growth in MPG's end markets. RFMD also launched 74 new and derivative products targeting diverse market segments.

"During the September quarter, RFMD continued to transition successfully to a more diversified revenue base, with notable strength in smartphones, smart energy, and high-performance WiFi," says president & CEO Bob Bruggeworth. "Importantly, RFMD is also experiencing strong design-win momentum for our new breakthrough products and technologies, including our PowerSmart power platform, our silicon-based switches and our GaN-based components," he adds.

"During the September quarter, RFMD demonstrated robust financial performance and achieved several all-time financial records," remarks chief financial officer and VP of administration Dean Priddy.

On a non-GAAP basis, gross margin has grown from 38.1% a year ago and 39.2% last quarter to 39.8%. Operating income has risen from $41.7m a year ago and $51.7m last quarter to $57.1m (the fifth consecutive quarter of record operating income). Operating margin was 20% (up from 18.9% last quarter). Net income has risen from $36.9m a year ago and $44.3m last quarter to a record $52.3m.

During the quarter, RFMD generated a record $56.1m in free cash flow (net cash from operating activities of $61.3m, minus $5.2m in property and equipment expenditures).

"RFMD's record quarterly financial performance is the direct result of prior structural changes in strategy and the organization's crisp execution on that strategy," comments Bruggeworth. "We are leveraging product and technology leadership to drive our growth in core markets, and we are securing the major design wins necessary to power the next wave of our revenue growth."

RFMD believes the demand environment in its end markets supports expectations that December-quarter results will be roughly in line with September-quarter results. In particular, it expects sequential growth in its core markets to be broad based and supported by strength in smart energy, high-performance WiFi, wireless infrastructure, fixed and mobile broadband, smartphones and 3G connected devices. RFMD also expects to continue ramping new customer programs to offset declining end-of-life legacy products. "We continue to forecast PowerSmart will ramp in the March 2011 quarter, and we now expect our lead PowerSmart customer will broadly feature PowerSmart across their next-generation smartphone portfolio," says Bruggeworth.

For fiscal 2011, RFMD now expects record free cash flow of $180–200m (up on fiscal 2010's $177m).

www.rfmd.com

Freescale teams with RFMD to deliver ZigBee solutions for smart energy applications

RF Micro Devices Inc of Greensboro, NC, USA has teamed with Freescale Semiconductor of Austin, TX, USA (which designs and makes embedded semiconductors for the automotive, consumer, industrial and networking markets) to deliver ZigBee solutions for a broad range of smart grid applications.

RF Micro Device's RF6535 ZigBee front-end module (FEM) has been combined with Freescale's MC1321x system-in-package (SiP) to create the RF6535/MC1321x reference design, which simplifies RF design requirements while reducing product cost and complexity. The reference design is targeted at ZigBee smart energy and home-area network (HAN) applications that require high RF performance to ensure a robust and reliable operation in varying environments. Working together, RFMD and Freescale aim to address the need for aggressive size reductions in IEEE 802.15.4 designs with a reduced solution footprint and minimized component count.

"RFMD and Freescale are leveraging each other's expertise to deliver high-performance, highly integrated solutions that reduce design cycle times, lower customer costs, and accelerate product time-to-market," says Bob Van Buskirk, president of RFMD's Multi-Market Products Group (MPG). "Large-scale smart energy projects are forecast to grow rapidly, with particular demand anticipated in low-power wireless technologies like ZigBee," he adds.

"Emerging markets such as smart energy require increased output power for extended range and reliable communications," says Brett Black, manager of Freescale's Wireless Connectivity Organization. "Freescale and RFMD are building on each other's strengths to offer complete solutions for these markets."

RFMD's highly integrated RF6535 features a 2.4–2.5GHz +22dBm power amplifier, Tx harmonic output filter, double-pole double-throw (DPDT) diversity switch and an LNA (low-noise amplifier). It is housed in a 3.5mm x 3.5mm x 0.5mm package that is claimed to be three times smaller than competitive offerings, reducing discrete component requirements while minimizing footprint and assembly costs. The transceiver interface is a two-port Rx/Tx integrated balun.

RFMD says that its expanding portfolio of ZigBee FEMs enables users to accelerate new ZigBee products to market while reducing component count, size, cost, and power consumption. The RF6535 single-chip ZigBee FEM is specifically optimized for smart energy/AMI (advanced metering infrastructure) applications including smart meters, and HAN devices including home energy gateways, in-home displays and appliances.

Large-scale smart energy projects are forecast to grow rapidly, with particular demand anticipated in low-power wireless technologies

Freescale's MC1321x family incorporates a low-power 2.4GHz radio-frequency transceiver and a microcontroller into a single LGA package to meet cost and limited product space budgets while providing excellent RF system performance. Coupled with RFMD's RF6535 FEM, the MC1321x suits most ZigBee applications in consumer electronics, energy management, healthcare, home automation, telecom services, and building and industrial automation.

www.ZigBee.org
www.freescale.com
www.rfmd.com

RFMD unveils 2.3–2.7GHz PA IC for WiFi, WiMAX, LTE wireless

RFMD has unveiled the RF5632, a 2.3–2.7GHz power amplifier IC optimized specifically for WiMAX systems that can be designed into multiple applications including customer premises equipment (CPE), gateways, access points, LTE wireless infrastructure, and WiFi-based wireless high-definition interface (WHDI) for wireless video distribution networks.

Based on indium gallium phosphide (InGaP) heterojunction bipolar transistor (HBT) technology and packaged in a leadless chip carrier with a backside ground, the RF5632 integrates a three-stage power amplifier (PA) and power detector into a 4mm x 4mm QFN package, minimizing customer design footprint requirements. Also, the device operates from a standard 5V supply, eliminating additional power supply requirements, enhancing design flexibility and lowering bill-of-material costs (BOM). The RF5632 is also fully DC and RF tested including EVM at the rated output power, maximizing application yields and accelerating time-to-market.

The RF5632 delivers an EVM of 2.5% and meets or exceeds WiMAX and LTE spectral mask requirements with an output power of 28dBm in the 2.3–2.4GHz, 2.4–2.5GHz and 2.5–2.7GHz frequency ranges. The bias of the PA may be controlled to accommodate a 22dB gain step to increase the dynamic range of the system. The RF5632 offers high gain of 34dB and high linear output power, with what is claimed to be best-in-class efficiency. The device maintains linearity over a wide range of temperatures and power outputs while the external match enables tuning for output power over multiple bands. It also features internal input and inter-stage matching, a power-down mode and power detection.

RFMD extends performance and frequency range of integrated configurable components

RF Micro Devices has announced a new family of integrated configurable components for multiple markets. The RFFC207x and RFFC507x product series perform multiple common RF functions in a reduced footprint while delivering the flexibility necessary to develop radio systems that operate over a wide dynamic range and across a broad range of frequencies and channel bandwidths.

The RFFC207x and RFFC507x series integrate RFMD's fractional-N PLL/VCO (phase-locked loop/voltage-controlled oscillator) combination with RF mixers to provide radio designers a radio partitioning option with what is claimed to be very high performance, superior integration and no compromise in flexibility. The RFFC207x and RFFC507x represent the second generation of RFMD's RF205x family of integrated configurable components, which enables radio designers across industries to shrink circuit board area, reduce risk and shorten product development time (all of which lower the total cost of radio implementation).

The new product families expand on the capabilities of RF205x by enhancing performance and extending frequency range to serve more industries and applications. General purpose in nature, the new integrated configurable components are applicable to fixed and mobile infrastructure, radio repeaters, super-heterodyne radios, diversity receivers, frequency band shifters, CATV, software-defined radios, point-to-point radios, satcom, VHF/UHF radios, military, industrial and other applications.

The product family's wide bandwidth enables use in multiple systems and applications. The RFFC207x series has a local oscillator (LO) range of 85–2700MHz, with a 30–2700MHz mixer on-chip. The RFFC507x series has an LO range of 85–4500MHz with mixer range extending up to 6000MHz.

With integrated phase noise of 0.18deg rms at 1GHz, the RFFC207x and RFFC507x improve system performance for radio designers, claims RFMD. Additionally, the integrated fractional-N synthesizer features an advanced sigma-delta modulator to achieve ultra-fine step sizes and lower spurious products, while integrated mixers enable a smaller implementation (5mm x 5mm) than competing solutions, it is claimed. Finally, by integrating the entire LO path on-chip, the RFFC207x and RFFC507x eliminate the need to work with the highly sensitive interface from VCO to mixer, saving design time and improving end-product manufacturing yields.

The RFFC207x and RFFC507x series also deliver what is claimed to be industry-low power consumption. Their bandwidth and phase noise specifications are achieved using only 125mA from a 3V supply (single-mixer, high-linearity setting), and the current can be cut to 100mA by reducing the programmable mixer linearity setting. Importantly, the 4500MHz components use only 10mA more than the 2700MHz components.

All of the components can be programmed through a simple 3-wire serial interface. They also feature a unique programming mode that allows up to four devices to be controlled from a common serial bus. By eliminating the need for separate chip-select control lines between devices and host controller, this lowers the cost of implementation and the risk of interference between RF and digital lines on the target PCB. Finally, two frequencies can be loaded into the device when it is initialized, allowing convenient switching between frequencies, and lock detect and general purpose pins are available, enabling control though the serial bus.

RFMD showcased its integrated configurable components at the electronica 2010 trade show in Munich, Germany (9–12 November). The single-mixer 2700MHz RFFC2072 starts at $7 per 10,000 units, and the single-mixer 5000MHz RFFC5072 starts at $9 per 10,000 units. Samples and evaluation boards are available now, and production quantities are expected to be available by the end of the December quarter.

RFMD unveils broadband 6-bit digital step attenuators

RFMD has launched its broadband 6-bit digital step attenuator (DSA) product portfolio with the availability of the RFSA2614 and RFSA2624, showcased at the electronica 2010 trade show in Munich Germany (9–12 November).

The firm's newest high-performance components are optimized for operation across multiple market segments, including 3G/4G/LTE cellular infrastructure, WiMAX, wireless backhaul and other wireless communications applications.

The RFSA2614 and RFSA2624 DSAs feature a 6-bit design with both serial or parallel mode programming, covering a broad frequency range from 50MHz to 4000MHz. Radio designers can use the DSAs to adjust the gain of high-linearity receive and transmit channels over a 31.5dB range with 0.5dB step resolution. The new DSAs have a settling time of 200ns, as well as a P1dB (1dB compression point) of 27dBm and a IIP3 (3rd-order intercept point) of +48dBm.

www.rfmd.com

TriQuint's Q3 revenue exceeds guidance by nearly 8%

Full-year revenue growth forecast raised again, from 25–30% to 33%

For third-quarter 2010, RF front-end product and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA has reported record revenue of $237m, up 14% on Q2's $207.5m and 37% on $173m a year ago (and 7.7% above the guidance of $215–225m).

Networks (23% of overall revenue) continued to enjoy a strong rebound from the lows of 2009, with sales up 61% on a year ago. Mobile Devices (68% of overall revenue) showed robust growth, with sales up 28% on Q2 and 37% on a year ago. Defense comprised 9% of revenue. "Our strategy of RF integration, multi-market innovation, and growth for scale has been effective," says president & CEO Ralph Quinsey.

On a non-GAAP basis, gross margin was 42.3%, level with Q2 and up from 35% a year ago (and well above the expected 40–41%). Operating expenses have been cut from 25.9% of revenue a year ago ($44.8m) and 26.4% of revenue last quarter ($54.7m) to 23.6% of revenue ($56m, slightly below the expected $57m). Net income has risen from $16m a year ago and $33.1m in Q2 to $44.2m.

"Looking forward I expect that the RF market will remain healthy and TriQuint will benefit from a strong product roadmap," reckons Quinsey. During the quarter, TriQuint released its TQP15 foundry process for millimeter-wave applications (VSAT, satellite and point-to-point radios); announced an integration strategy for base-station products (with four levels of integration); launched heat-spreading capability for high-power die sales (die on tab, or DoT); and was awarded a $17.5m Title III gallium nitride (GaN) manufacturing development contract by the US Air Force Research Laboratory (AFRL).

For fourth-quarter 2010, TriQuint expects revenue of $245–255m (taking full-year 2010 revenue up 33% on 2009, compared with previous forecasts of first 20% then 25–30%) — the firm is currently 91% booked to the midpoint of this Q4 guidance. In particular, strong growth in the mobile devices market should lead to non-GAAP gross margin of 41–42%. Operating expenses are expected to grow to about $59m (24% of revenue).

TriQuint expects that continued robust growth in demand should lead to revenue growth of about 20% for 2011, and that the RF market will remain strong for years to come. The longer-term goal is to grow revenue at 20% annually, and drive operating income to over 20%.

www.triquint.com

Navy awards contract for development of S-band MMIC amplifiers

In conjunction with the annual Military Communications (MILCOM 2010) conference in San Jose, (31 October – 3 November), TriQuint Semiconductor said that it had received a $2m contract from the US Naval Research Laboratory (NRL) to develop S-band amplifiers with new benchmarks for noise floor, linearity and efficiency performance.

TriQuint says that it was awarded the contract based on its expertise in developing new semiconductor processes and products with GaAs and other technologies. The monolithic microwave integrated circuit (MMIC) contract will focus on low-noise amplifiers and high-power amplifiers (LNAs/HPAs).

www.milcom.org/2010

TriQuint expanding Richardson fab for 6" GaAs wafers

In response to growing demand for its communications semiconductors, TriQuint is expanding its plant in Richardson, TX.

Covering 540,000ft^2 (including 48,000ft^2 of Class 1 cleanroom) on a 33 acre site, the Richardson fab (originally built for the TwinStar joint venture between Hitachi and Texas Instruments) currently uses 4-inch GaAs wafers and only about two-thirds of the cleanroom.

In addition to the Mobile Devices sector in Hillsboro (63% of total revenue of $654.3m in 2009), Richardson accommodates some operations of both the Defense & Aerospace sector ($78m, or 12% of 2009 revenue) and the Networks sector ($163.5m, 25% of 2009 revenue). Overall, Richardson accounted for 18% of TriQuint's revenue in 2009.

However, TriQuint is installing new 6" GaAs wafer equipment during fourth-quarter 2010 and first-quarter 2011 (occupying almost 100% of the cleanroom), for process qualification over Q2–Q3/2011 and ramp-up through Q4. In total, the firm aims to invest $100m in Richardson over the next five years.

Out of TriQuint's total worldwide staffing of 2329 at the beginning of 2010, Richardson's full-time staff accounted for 527, but this will rise by 165 (about 31%) this year to nearly 700, according to an interview with TriQuint Texas' VP of operations Howard Witham in The Dallas Business Journal.

In first-half 2011, TriQuint will add about 100 temporary staff, who will most likely become full-time staff within 6–9 months after they are hired.

www.bizjournals.com/dallas/stories/2010/10/18/story1.html

Anadigics' revenue grows 18.6% in Q3 to $61.3m

Q4 to see 7% drop due to inventory re-balancing

For third-quarter 2010, GaAs-based broadband wireless and wireline communications component maker Anadigics Inc of Warren, NJ, USA has reported a sixth consecutive quarter of revenue growth, to $61.3m. This is up 67% on a year ago and up 18.6% on Q2's $51.7m (exceeding the guidance of 11% growth to $57.5m).

The latter reflects Anadigics' increased 3G market share position within its wireless customer base and the positive traction and market share gains realized in both WiMax and cable infrastructure within Broadband, according to president & CEO Mario Rivas. According to a recent report from Strategy Analytics, Anadigics' global market share for wireline CDMA power amplifiers has risen from 18% in Q2 to 22%.

Of total revenue, Wireless grew 18.1% from $38.3m to $45.2m and Broadband grew by 20% from $13.4m to $16.1m (compared with growth of just 2% last quarter). "The third quarter benefited from stronger order pull in both Wireless and Broadband ahead of the typical fourth quarter holiday trade season, which will affect the revenue in our fourth quarter," notes Rivas.

With fab utilization exiting Q3 in the low 70s (up from the mid-60s in Q2), gross margin has risen from to 35.6% last quarter 37.2% (exceeding guidance of "nearly 37%").

Compared with a loss of $6.4m a year ago, non-GAAP net income has quadrupled from just $1.1m last quarter to $4.4m (exceeding guidance), which is attributed to the stronger revenue as well as operating leverage.

Cash flow from operations was $5m, contributing to cash, cash equivalents and short- and long-term marketable securities rising during the quarter by $4.2m to $96m, after capital expenditure of $1.4m.

For fourth-quarter 2010, Anadigics expects revenue to drop by 7% to about $57m. "This reflects a pause in orders, caused by inventory re-balancing, by our Broadband customers following the robust 20% sequential growth reported in the third quarter, and shortened order lead times by Wireless customers, particularly in Korea and China, attributable to the solid order pull in the third quarter," says executive VP & chief financial officer Tom Shields. Broadband revenue could fall by about 25%, but this is viewed as temporary given the typical fourth-quarter seasonality in Anadigics' business in prior years. "Our current backlog for Wireless is equal to the Wireless revenue reported in the third quarter [i.e. $45m], but higher than historical fill levels," notes Shields.

Fab utilization should rise to the mid 70s during Q4. "Sequentially, we expect slightly higher gross margin and lower operating expenses, with both GAAP and non-GAAP earnings per share in the fourth quarter to approximate third-quarter levels of $0.03 and $0.06, respectively," says Shields. "We also expect to exit the year above $100m in cash, cash equivalents and short- and long-term marketable securities on anticipated positive cash generation in the fourth quarter," he adds. "If we can strategically acquire either a company or a group of engineers that can help us accelerate development, then we will," says Shields.

We also expect to exit the year above $100m in cash, cash equivalents and short and long-term marketable securities... If we can strategically acquire either a company or a group of engineers that can help us accelerate development, then we will

"Looking into 2011, we are very excited about our new product design portfolio for 3G, 4G/LTE and multi-mode multi-band (MMMB) and several design engagements with chipset providers and tier 1 OEMs," says Rivas, who adds that, in Q3, Anadigics' new product pipeline produced over the last year accounted for more than 40% of revenue. "In particular, we officially signed a cooperation agreement with a new reference design partner [Infineon], initiated design activities with another new reference design partner, and increased design activities with an existing reference design partner," he adds. "Enhancing our business prospects longer term, we also completed negotiations on a product purchase agreement with one of the larger tier 1 OEMs," Rivas continues. "With the industry's strong 3G unit growth forecasted next year in wireless handsets, we expect 2011 to be another positive year for our company," he concludes.

"In Broadband, we have a line up of new products addressing market drivers in DOCSIS 3.0-enabled devices, cable modems, CATV subscriber home gateways, hybrid line amplifiers and 75Ω gain blocks for CATV infrastructure, mobile WiMax-enabled devices and small-cell wireless infrastructure for 3G and 4G coverage including picocells and femtocells, which positions the company well in 2011," says Rivas.

"Despite the short-term seasonal fluctuations in this business, we remain confident in the long-term growth opportunities for Anadigics," says Rivas. "Based on the industry research and our own internal estimates, we project a compounded annual growth rate (CAGR) from 2009 to 2014 for cable infrastructure and mobile WiMAX market to be 14% and 73%, respectively."

www.anadigics.com

Anadigics' PAs chosen for Samsung's GALAXY Tab

Anadigics' power amplifiers (PAs) have been selected by Samsung for its highly anticipated GALAXY Tab.

The AWC6323 is used in the GALAXY Tab offered by Sprint and Verizon Wireless in the USA, and the AWU6601 in the Samsung GALAXY Tab in the Korean market. Made from InGaP HBT MMIC technology, both are part of Anadigics' High-Efficiency-at-Low-Power (HELP) portfolio of products for 3G devices.

Based on the Android Operating System, GALAXY Tab is Samsung's first tablet computing device and is part of its new portfolio of mobile products. A 7" TFT-LCD display allows a wide variety of mobile applications, including watching TV and movies, viewing photos, browsing the web, playing games, e-book reading and document sharing. It is also one of the first tablets on the market to have two (front-facing & rear) cameras. Anadigics says that its high-efficiency PAs help to extend the Tab's battery life.

Samsung's Galaxy Tab, which uses Anadigics' power amplifiers.

"The Samsung GALAXY Tab is one of the most impressive mobile devices available today," says Anadigics' president & CEO Mario Rivas. "We continue to strengthen our long-standing relationship [with Samsung] by providing high-quality wireless computing solutions."

www.anadigics.com

Hittite exceeds revenue, margin and profit forecast in Q3

On course for 50% annual growth for full-year 2010

For third-quarter 2010, Hittite Microwave Corp of Chelmsford, MA, USA, which designs and supplies analog and mixed-signal RF, microwave and millimeter-wave ICs, modules and subsystems, has reported record revenue of $64.2m, up 54.7% on $41.5m a year ago and 6.4% on $60.3m last quarter (and just above the forecast $62–64m). Growth is attributed to improvements in Hittite's principal markets, increased market penetration, and new product launches.

About 43.8% of revenue came from the USA ($28.1m, up 2.3% on last quarter, driven by the military market) and 56.2% from outside the USA ($36.1m, up 10%, driven partly by cellular communications), compared with Q2's 45.6%:54.4% ($27.5m from the USA and $32.8m from outside the USA).

Gross margin of 74.6% is up from 72% a year ago but down slightly from 74.8% last quarter. Operating expenses have continued to rise from $11.6m a year ago, but by only 1.6% from $15.4m last quarter to $15.7m. Nevertheless, operating income has continued to rise from $18.3m (44.1% of revenue) a year ago and $29.7m (49.2% of revenue) last quarter to $32.2m (50.2% of revenue). Net income has also risen, from $12m a year ago and $19.2m last quarter to $20.8m. This is above the forecast of $19.1–19.8m (which assumed gross margin of just 72–73% and operating expenses up as much as 5–6% from last quarter).

"We achieved new records in revenue, operating profit, margins and net income," notes VP & chief financial officer Bill Boecke.

Capital expenditure was $2.1m (making $6.6m year-to-date), focused on facility, test equipment and software for engineering, and production masks and other production assets. During the quarter, total cash and cash equivalents rose by $31.2m to $273m.

CapEx was $2.1m, focused on facility, test equipment and software for engineering, and production masks and other production assets

At a macro level, the increasing demand for additional wireless data bandwidth and network capacity has been driving growth. "Our strategy is to expand our product portfolio to capitalize on this trend and to take market share," says chairman & CEO Stephen Daly.

During the quarter, Hittite's engineering teams launched 30 new products (making 85 year-to-date), bringing the standard product portfolio to more than 880. "These 30 new non-commodity products will allow us to capture more market share in the cellular infrastructure, fiber optic, microwave & millimeter-wave communications and military markets," reckons Daly.

For Q4/2010, Hittite expects revenue of $64.5–66.5m (up 3.6% sequentially and 52% year-on-year revenue; the goal for full-year 2010 growth is 50%). Net income should be $20.2–21m, despite operating expenses rising sequentially by 4–5% due mainly to expansion activities. As it completes the expansion into its new engineering facility (bought in Q1), Hittite expects capital expenditure to rise to $5m, but it should return to the $2m level thereafter, says Boecke.

www.hittite.com

Kopin's III-V growth slows in Q3 to 4.4%

...but normal seasonal decline in Q4 not expected

For third-quarter 2010, Kopin Corp of Taunton, MA, USA has reported revenue of $31.6m, down slightly on $32m a year ago but up 4.5% on $30.2m last quarter.

Revenue for CyberDisplays was $15m, down on $17.7m a year ago but up on $14.3m last quarter. Revenue for III-V products was $16.6m, up 16% on $14.3m a year ago and up 4.4% on $15.9m last quarter (although less than last quarter's growth of 7%).

"Driven by the continued strong demand for smart phones and other advanced mobile devices, our III-V revenue has increased 50% to $47.1m through the first nine months of 2010 from $31.5m for the same period last year as a result of a combination of an expanding market and, we believe, increasing our market share at several of our power amplifier circuit partners during the year," says president & CEO Dr John C.C. Fan. "III-V continued its momentum in the third quarter... These results reflect the strength of key end-markets," he adds.

Gross margin has rebounded from 25% last quarter to 32.3%, comparable to 32.6% a year ago. R&D expense of $4.8m was roughly level with $4.9m last quarter, up from $3.5m a year ago. "We have been increasing our R&D investments for new III-V products targeting smart phones and tablet computers, and for advancing Golden-i [displays] to market," says Fan. However, excluding gains on the sale of patents and the investment in Taiwan subsidiary KTC in 2009, net income has fallen further from $3.8m a year ago and $1.9m last quarter to $1.4m.

"We have continued to broaden our III-V product portfolio with the addition of new advanced manufacturing systems and structures that further enhance device performance and improve power efficiency," Fan says. "Furthermore, during the third quarter, we received a two-year $750,000 contract through the Missile Defense Agency to develop aluminum indium nitride (AlInN)-based high-electron-mobility transistors. This award enables us to leverage our proven success in III-V materials and nanoengineering, advancing toward our long-term goal of commercializing AlInN-based electronic materials," he adds.

"III-V revenue growth continues to be strong and we do not expect the normal seasonal decline in the fourth quarter," Fan notes. "Although we expect military display revenues to remain solid in the fourth quarter, on a full-year basis these results have been affected by a weak first quarter related to delays in the procurement cycle," he adds.

Accordingly, Kopin expects to achieve the low end of its revenue guidance of $120–130m for full-year 2010. "Although we have invested $9.7m in capital equipment and repurchased $5.4m of our stock during 2010, our balance sheet has remained very strong," comments Fan. During the third quarter, cash and marketable securities fell from $115.3m to $110.5m. In addition, the firm has no long-term debt.

www.kopin.com

Skyworks' PA modules used in USA's first LTE handset

Two of Skyworks' power amplifier modules (PAMs) are enabling the first commercial long-term evolution (LTE) handset in the USA.

Launched by MetroPCS, Samsung's newest 4G mobile phone, the Craft uses the SKY77702 and SKY77703. The carrier expects to cover 19 markets by 2011 and about 110 million LTE customers in major cities such as Dallas, Los Angeles and New York. Today's 4G systems offer a comprehensive solution where data and streamed multimedia are available to consumers anytime, anywhere at higher data rates than previous-generation networks. In July, Skyworks also enabled the world's first commercial LTE device, Samsung's high-speed 4G USB modem.

"Our solutions benefit handset OEMs and smart-phone providers, as well as infrastructure suppliers and operators worldwide by improving efficiency and performance, boosting network throughput, and simplifying roaming," claims Gregory L. Waters, Skyworks' general manager of front-end solutions.

Developed for wideband LTE applications, SKY77702 and SKY77703 PAMs are fully matched 10-pad surface-mount modules (SMMs) that pack full 1850–1910MHz (SKY77702) and 1710–1785 MHz (SKY77703) bandwidth coverage into a single compact package. Both modules meet the stringent spectral linearity requirements of LTE data transmission with high power-added efficiency (PAE). A directional coupler is also integrated into the devices, eliminating the need for an external coupler.

The single GaAs MMIC contains all active circuitry in the modules, including on-board bias circuitry plus input and inter-stage matching circuits. Output match into a 50Ω load is realized off-chip within the device packages to optimize efficiency and power performance.

The modules are made with Skyworks' InGaP HBT bipolar field-effect transistor (BiFET) process, which provides for all positive voltage DC supply operation while maintaining high efficiency and good linearity, the firm claims.

www.skyworksinc.com

Skyworks' revenue exceeds revised guidance

For its fiscal 2010 (to 1 October), 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 reported revenue of $1.072bn, up 34% on fiscal 2009's $802.6m.

For fiscal fourth-quarter, revenue was a record $313.3m (80% from handsets; 20% from linear products). This is up 14% on $275.4m the prior quarter and up 37% on $228.1m a year ago (and exceeding guidance of $310m, which had been updated on 21 September from the original guidance in July of $300m).

"Our strong fourth quarter results were driven by our mobile internet and our diversified analog growth edges," says president & CEO David J. Aldrich. "Skyworks is capitalizing on consumers' insatiable demand for always-on connectivity, broadband mobility and access, as well as home automation applications."

On a non-GAAP basis, gross margin has risen from 40.9% a year ago and 43.3% last quarter to 43.8%, driven by a product mix that increasingly includes higher-margin vertical market in 3G solutions, volume ramp of new products, margin-enhancing demand-driven capital investments, continued manufacturing productivity enhancements, and yield improvements.

Operating income has risen from $42.5m a year ago (an operating margin of 18.6% of revenue) and $63.5m last quarter (a margin of 23.1%) to $81.8m (26.1%), despite operating expenses rising from $55.6m last quarter to $70.7m.

For full-year fiscal 2010, operating income was $246.3m (a margin of 23%), more than doubling from $120.9m (15.1%) in fiscal 2009.

Non-GAAP net income has risen from $41.8m a year ago and $58.7m last quarter to $78.8m. During the quarter, cash and cash equivalents rose by $69m from $390m to $459m despite $12m of depreciation and $29m in capital expenditure.

"We believe our strategy of diversifying across new vertical markets and customers while continuously improving operational execution will translate into sustainable above-market growth, greater operating leverage and increasing shareholder value," says Aldrich.

During the quarter, Skyworks ramped shipments of ZigBee-enabled solutions targeting hospitality and security applications; gained traction at Huawei and ZTE with its portfolio of high-performance broadband synthesizers spanning ultra-wide frequency ranges; secured reference design wins with Broadcom addressing HDTV, Blu-ray player, notebook, gaming console and smartphone platforms; shipped more than 4 million wireless connectivity solutions in support of the rapidly emerging tablet market; was designed into next-generation cable head-end distribution systems at Motorola; started volume production of analog components at Cisco for fiber-to-the-curb (FTTC), fiber-to-the-home (FTTH), cable set-top box and wireless video systems; and extended its smart energy presence by capturing design wins enabling LED-based streetlight monitors and controllers.

"Having completed the 6" capacity expansion in our Newbury Park fab last year, we have strategically focused our more recent CapEx investments on expanding our assembly & test capabilities in support of our improving outlook and high visibility," says VP & chief financial officer Donald W. Palette. "These back-end investments come from our 6" wafer transition and hybrid outsourcing model and are focused on equipment adds to eliminate internal bottlenecks," he adds. "We anticipate these investments to payback within the fiscal year, while expanding margins and improving our return on invested capital."

Given strong order visibility and increasing customer demand, and based on specific program ramps, for fiscal Q1/2011 Skyworks expects revenue of $330–335m (up 6% sequentially and 35–37% year-on-year). "Operationally, we expect to deliver continued gross margin expansion [to 44.5%] and operating leverage yielding a 27–28% non-GAAP operating margin [up sequentially from 26.1%, and on track for the existing medium-term operating model target]," says Palette. Skyworks also expects to pay off its $50m credit facility.

"We are entering fiscal 2011 poised to demonstrably outpace industry growth, underpinned by our design-win momentum, by a product pipeline, and by scale advantages," says Aldrich. "Skyworks is making strides towards a new mid-term operating model targeted at 30% [with gross margin of 45%]."

Skyworks expands Asia presence by opening Singapore office

The Skyworks Global Pte Ltd office has been opened in Singapore to support rising demand for solutions in the firm's linear products portfolio and to further enhance manufacturing activities in the region.

Skyworks is broadening its footprint in Asia to improve customer service and bring products closer to the customer, says VP of worldwide operations Bruce J. Freyman. "By expanding our engineering, quality and supply chain capabilities within Asia, we are better positioned to efficiently meet increasing customer demand," he adds.

The new office will support strategic sourcing, supply chain planning, logistics and engineering; provide storage for finished goods and die-bank distribution; and serve as a failure analysis laboratory to help shorten customer response time.

www.skyworksinc.com

IN BRIEF

M/A-COM appoints global distribution director

M/A-COM Tech says that Jack Kennedy is its new director of global distribution, reporting to chief strategy officer Bob Donahue and overseeing the strategic development of its global distribution channels.

"As market opportunities expand, enhancing the capabilities and efficiencies of our global distribution channels is fundamental to supporting our broad global customer base," says Donahue.

Kennedy has a long and productive history with M/A-COM Tech in roles such as strategic account lead and global account director, as well as roles in sales management and field sales engineering.

Kennedy has a B.S. from Boston University and is completing his M.S. at Northeastern University.

M/A-COM Tech has also promoted James (Jim) Dempsey to the newly created post of deputy director of distribution, assisting Kennedy in distribution channel management and providing key support in the assurance of the continuity of service between distributors, manufacturer representatives, direct sales, factory support.

With more than 25 years of experience in the RF microwave industry, Dempsey has worked in various roles for Skyworks, Alpha Industries, and Herley Micro-Dynamics. His diverse knowledge comes from working in areas such as aviation radar, military products, wireless data, and infrastructure, says M/A-COM Tech.

Dempsey obtained his associates degree in Electronic Engineering Technology from Wentworth Institute of Technology. He also has a certificate from the Greater Boston Executive Business Management Program at MIT Sloan School of Management.

M/A-COM Tech's Santa Clara Design Center expands to new facility

M/A-COM Technology Solutions Inc of Lowell, MA, USA (which supplies semiconductors, components, and subassemblies for RF, microwave and millimeter-wave applications) says that its Santa Clara Design Center has moved to a new facility (near San Jose International Airport and across the street from Santa Clara University) in order to accommodate its expanded engineering and business functions.

The design center is focused on the design and development of monolithic pHEMT integrated solutions covering 6–50GHz for commercial and military applications. M/A-COM Tech previously announced in May that Henrik Morkner had joined it as director of engineering to lead the team in Santa Clara, and the firm says that the expansion demonstrates its commitment to collaborating with its marketing teams and customers to develop devices.

The new design center occupies about 11,600ft^2 and includes a 1200ft^2 engineering lab for design and test characterization of monolithic microwave integrated circuits (MMICs), surface-mount devices (SMDs) and connectorized modules. In addition to new product development, the center provides engineering design support and product line management for the Component Product Line, which covers a wide variety of catalog and custom applications.

"This move to a new facility with state-of-the-art equipment allows M/A-COM Tech to fully utilize the talented team we have assembled in Santa Clara for new product development," says VP engineering Mike Murphy. "Under Henrik's guidance we are able to work closely with our customers to define and develop products which meet their requirements, both from a technical and commercial approach."

HMIC broadband diode switches in Surmount packages operating up to 20GHz

M/A-COM Tech has launched a family of heterolithic microwave integrated circuit (HMIC) broadband diode switches that use RoHS-compliant Surmount packages.

M/A-COM Tech's new 50MHz–20GHz HMIC broadband diode switches in Surmount packages.

The rugged, monolithic switches operate up to 26GHz, provide low insertion loss and high isolation, and deliver up to +38dBm CW power handling. The Surmount package provides a surface-mount chip-scale configuration optimized for broadband performance with minimal associated parasitics, which are usually related to hybrid MMIC designs incorporating beam lead and PIN diodes that require chip and wire assembly. The broadband switches are suited to military and test equipment applications, says M/A-COM Tech.

"We combine this innovative process [HMIC] with Surmount diode technology, which eliminates all bond-wire parasitics and enables broadband capability in a surface-mount configuration," says product manager Tim Daly.

Engineering samples and production devices are offered in tape & reel or gel packs.

www.macomtech.com

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Plessey starts development of 8" SiGe BiCMOS to expand RF capability

New process could boost operating frequency ten-fold on prior technology, to 5GHz

Plessey Semiconductors Ltd says that it has started the development of 0.35μm silicon germanium (SiGe) BiCMOS process technology on its 8-inch line at its manufacturing facility in Roborough, Plymouth, UK.

Plessey Semiconductors was created at the beginning of this year with the renaming of Plus Semi, which had acquired silicon foundry X-FAB UK Ltd (including the manufacturing facilities of two former Plessey fabs in Roborough and Swindon, UK). Bipolar production lines (using both silicon and silicon-on-insulator substrates) have since been transferred from the Swindon facility to the original Plessey CMOS fab at Roborough, operating initially as a 0.35μm foundry (with annual capacity of 30,000 8-inch wafers) supporting the former customers of X-FAB before designing and manufacturing its own bipolar and CMOS chips.

The firm now says that, as part of its strategy of developing its three core product lines of sensors, RF components and power management devices, it decided that a bespoke SiGe BiCMOS process was required.

"We have looked at SiGe bipolar and BiCMOS process technologies for some time and have developed processes for other fabs," says chief technologist Dr Peter Osborne. "Our exceptional complementary bipolar processes on SiGe, together with our 0.35μm CMOS capability, should provide a compelling platform from which Plessey can develop outstanding product lines," he adds.

Products manufactured using this process will take advantage of having a 70GHz, 2.5V breakdown voltage architecture together with a 40GHz 5V breakdown voltage architecture on the same substrate. The process will also include a range of analog and high-performance passive components including Schottky diodes, varactors, high-Q inductors and MIM capacitors.

The combination of a high-frequency capability combined with high voltage and the added component features opens up a wide range of applications, reckons Plessey Semiconductors. Potential products include: high-performance transceivers for optical communications, next-generation data converters for test & measurement systems, and high-speed amplifiers including logarithmic amplifiers; for example, a log amp design using the new SiGe technology could operate at frequencies up to 5GHz (a ten-fold increase in performance compared with a previous technology implementation).

Plessey Semiconductors plans for the SiGe BiCMOS process to be generally available by mid-2011 and for the first products to be sampled by end 2011.

www.plesseysemi.com

Plextek works with GCS and Cirtek in re-designing obsolete GaAs ICs to avoid board re-engineering

Electronics and communications design consultancy Plextek Ltd of Cambridge, UK says that it has re-designed two gallium arsenide ICs for a major US-based high-technology company after the original devices, which are used in a large number of different boards and products, became obsolete and could no longer be sourced.

Plextek says that the firm was hence able to avoid the expensive process of completely re-designing its various boards and products to accommodate a replacement IC and could instead cost-effectively source direct drop-in replacements with no change to the performance specifications.

Previously, Plextek had provided GaAs IC design services to the firm and was approached again when the new requirement arose. It says that, as a result of its detailed knowledge of the commercial GaAs industry, it was able to quickly select a suitable commercially available process, design and layout pin-compatible direct replacement ICs, and arrange packaging and test to ensure that the replacement ICs would be available in the required timescales.

In creating the re-designed devices, Plextek identified and worked closely with US pure-play foundry Global Communication Semiconductors Inc (GCS) of Torrance, CA, USA (with which it formed a strategic alliance in 2002) and Cirtek, a packaging firm based in the Philippines.

"Plextek's vast experience in IC design enables us to source and redesign obsolete ICs with minimum disruption and help companies avoid an expensive and time-consuming product redesign," says Liam Devlin, Plextek's director of RF Integration. "In this case our replacement IC was not only able to drop in to the original product without disruption, but resulted in higher isolation and lower leakage compared to the part it replaced," he adds.

www.plextek.com

Freescale samples 77GHz SiGe chipsets for automotive radar systems

Freescale Semiconductor of Austin, TX, USA, which designs and manufactures embedded semiconductors for the automotive, consumer, industrial and networking markets, is now providing samples of 77GHz silicon germanium (SiGe) integrated chipsets to select customers for use in automotive radar systems. The firm's radar solutions provide long- and mid-range functionality, allowing automotive systems to monitor the environment around the vehicle to help prevent crashes.

The automotive industry's target of zero automotive-related fatalities, along with consumer demand and government legislation, are driving the adoption of automotive safety systems, notes Freescale. Advanced driver assistance systems (ADAS), radar and camera systems are expected to become government-mandated in the future.

"77GHz is likely to be the European Union's radar band of choice in 2013, with China and the USA expected to follow," says Demetre Kondylis, VP & general manager of the Sensor & Actuator Solutions Division. "SiGe mixed-signal technology is a critical differentiator for our radar business. It gives us a distinctive advantage to offer our customers exceptional product functionality and capability, such as various modulation schemes in a standalone mode of operation, high-speed frequency ramp up, competitive power consumption and best-in-class reliability," he adds.

Freescale's Xtrinsic radar chipsets consist of a transmitter and a multi-channel receiver with an integrated phase-locked loop (PLL). The firm's 77GHz technology allows a device to switch between long- and short-range functionality simply by issuing a serial peripheral interface (SPI) command. This enables the same radar module to be used for multiple safety systems, such as adaptive cruise control (ACC), headway alert, collision warning and mitigation. Long-range radar, used for adaptive cruise control and lane departure warnings, has long and narrow coverage directly in front and back of the car. Short-range radar (for blind-spot detection, pre-crash and stop-and-go applications) monitors the car's immediate surroundings with a wide spatial view that covers shorter distances.

Freescale has been developing its radar technology for collision warning and avoidance for several years and is one of few firms developing SiGe for long-range radar. SiGe has become standard for many wireless applications as consumer demand for low-power portable products continues to increase. But recently the technology has garnered increasing interest for emerging high-frequency markets such as automotive radar.

Freescale's radar system is based on multi-channel receivers and transmitters that allow high-level integration and complex signal generation and processing. A typical RF front-end solution consists of a transmitter chip with an integrated PLL, power amplifier and local oscillator (LO) output and an on-chip ramp generator, along with multi-channel receivers providing the low-noise down-conversion of the radar signals into the intermediate frequency (IF) domain.

The chips are manufactured in the firm's 0.18μm BiCMOS technology, which allows the combination of high-speed bipolar devices with the high integration level of CMOS.

The technology suits automotive safety systems and is also applicable for aerospace, military and industrial markets. Several tier-one automotive suppliers are sampling the chipsets, and Freescale plans to have standard products available by 2012.

Freescale showcased its radar technology at the electronica 2010 trade fair in Munich, Germany on 9–12 November.

www.freescale.com/sensors

E-Band expands to 60GHz for enterprises & carrier picocell networks

E-Band Communications Corp of San Diego, CA, USA, which makes high-capacity point-to-point Gigabit Ethernet wireless transmission systems for carrier, enterprise and government networks, has launched a line of 60GHz point-to-point solutions using its exclusive monolithic microwave integrated circuit (MMIC) technology.

With license-free operation in most countries, spectrum-efficient QPSK modulation and narrow-beamwidth transmission, the E-Link Mini provides a highly secure data link suited to connecting buildings at street level and can also provide a cost-effective solution for last-mile network extension. The small high-gain flat-panel design enables the radio to be installed easily using visual alignment aid and a mounting bracket and with just one Ethernet cable that handles power and data transmission (power-over-Ethernet, or PoE) and provides a solution suiting sensitive architectural environments where zoning can preclude the installation of wireless systems with larger antennas.

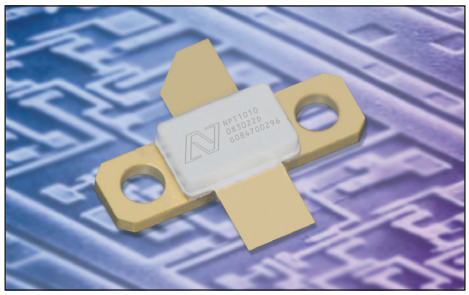
"Building on the popularity of our 70/80GHz solutions, we have added a line of products in the 60GHz frequency range," says co-founder & senior VP Saul Umbrasas. "Compared to competing 60GHz radios with 100Mbps capacity, the E-Link Mini 320 [320Mbps full duplex] provides over three times higher capacity in a much smaller package," he claims. "At just 7.2 inches square, the E-Link Mini 320 is less than half the size, weight and power consumption of our competitions' 60GHz radios, and doesn't require a separate external power supply and cable." The size, pricing and performance suits extending macrocell networks to a street-level microcellular architecture, especially in dense urban settings, he concludes.

www.e-band.com

Nitronex launches second HEMT on 2nd-gen platform

Following the launch of the 25W NPT1012 at the end of July, Nitronex Corp of Durham, NC, USA, which designs and makes gallium nitride on silicon (GaN-on-Si) RF power transistors for the defense, communications, and industrial & scientific markets, has announced production readiness of the 100W NPT1010 GaN HEMT as the second product based on its new-generation power transistor platform technology, which has been developed to meet the growing demand for wideband, high-power and robust RF power amplifiers.

The new platform is specifically designed to meet the stringent performance requirements of military communications, jammers and radars. The primary benefit of products based on the platform is very low thermal resistance, which results in higher output power and efficiency in broadband applications combined with improved ruggedness, says the firm.



Nitronex's NPT1012 GaN HEMT.

Nitronex claims that the NPT1010 has the lowest thermal resistance (1.4°C/W) of all GaN products at this power level on the market (lower than competing 28V products by 30%, normalized to power). The device achieves over 60W, more than 55% drain efficiency and over 14dB power gain in a 500–1000MHz broadband application circuit with less than 80°C rise in junction temperature.

The new platform is specifically designed to meet the stringent performance requirements of military communications, jammers and radars

"We focused our efforts on reducing thermal rise and developed a complete plan to attack all the key factors: FET design, die thickness, die attach methods and package materials," says VP of engineering Ray Crampton. "We recognized early on that the contribution of the substrate is secondary to the contribution of other factors, particularly the FET design," he adds. "By combining improvements from several areas, we achieved a 22% improvement in thermals compared to our last-generation products."

The NPT1010 is available in a ceramic air-cavity package in bolt-down and pill (solder) versions. It is lead-free and RoHS compliant, is production ready, and is available from stock to 10 weeks lead time.

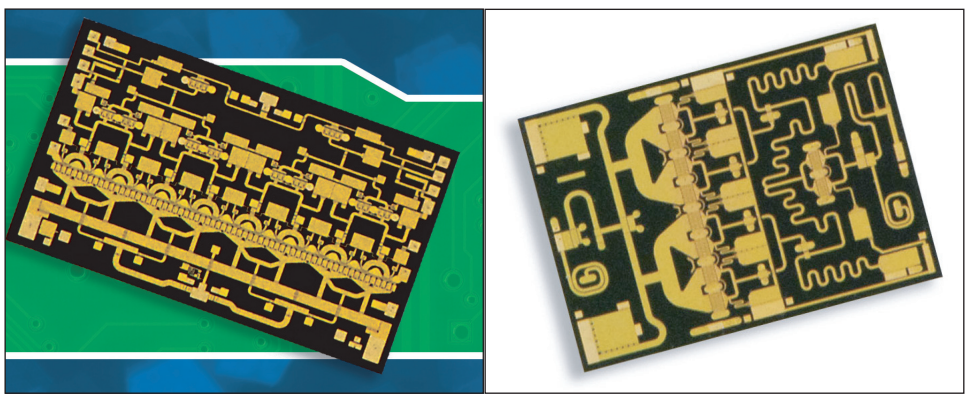
www.nitronex.com

TriQuint launches 20W and 30W GaN power amplifiers with 30% power-added efficiency

At the annual Military Communications (MILCOM 2010) conference in San Jose (31 October – 3 November), RF component maker and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA launched two gallium nitride (GaN) power amplifiers (PAs) with high power and efficiency.

Fabricated using TriQuint's production-released GaN-on-SiC process, the TGA2572 delivers 20W for Ku-band (14–16GHz) systems in defense and commercial communications applictions. "Our new TGA2572 delivers high gain as well as excellent power-added efficiency (PAE)," claims TriQuint marketing manager Grant Wilcox. Typical PAE is 30% and small-signal gain is 24dBm.

Offered in die and packaged forms, samples will be available in early 2011.



TriQuint's TGA2572 20W (left) and TGA2576 30W (right) GaN PAs.

TriQuint has also launched a 30W GaN power amplifier with high power and efficiency for counter improvized explosive device (C-IED) and other electronic weapons (EW) systems.

Fabricated using TriQuint's production-released GaN-on-SiC process, the TGA2576 delivers 30W of saturated output power in the 2.5–6GHz range. The new device typically offers PAE of 30% and small-signal gain of 25dBm.

Die-level samples were due to be available by the end of November; packaged samples are expected in early 2011.

www.triquint.com

RFMD wins $1.5m Navy contract for GaN RF power

RF Micro Devices has been awarded a $1.5m R&D contract by the US Office of Naval Research (ONR) related to gallium nitride microelectronics, including the development of materials, device fabrication and high power circuits.

The $1.5m R&D contract award expands RFMD's contract backlog over the next six quarters to about $5m. Since 2004, RFMD has been awarded more than $14.5m in R&D contracts by the US Government for development of its GaN high-power RF technology.

"GaN technology offers unprecedented performance advantages to advanced military applications, including radar, mobile communication and electronic warfare (EW) systems," says Jeff Shealy, VP & general manager of RFMD's Defense and Power business unit.

"RFMD is leveraging the world's largest compound semiconductor wafer fab and captive assembly & test facilities to deliver an industry-leading supply chain for the design, packaging and test of GaN high-power devices," claims president & CEO Bob Bruggeworth. "We utilize our scale manufacturing assets used to manufacture and ship approximately 3 million RF components per day, enhancing our competitive position in the high power amplifier (HPA) marketplace and increasing our ability to improve upon RFMD's return on invested capital (ROIC)," he adds.

RFMD says that, in addition to military systems, its GaN RF power technology delivers enhanced performance to a growing number of commercial power amplifier applications, including private mobile radio (PMR), 3G/LTE wireless infrastructure and CATV transmission networks.

www.rfmd.com

RFMD adds 75W device to GaN unmatched power transistor family

RF Micro Devices Inc of Greensboro, NC, USA has production released the RF3932, a 75W highly efficient GaN RF unmatched power transistor (UPT) that delivers what is claimed to be superior performance versus competing GaAs and silicon power technologies.

The RF3932 follows the launch in October of the 140W RF3934 (the highest output power device in the firm's UPT family). RFMD plans to release a third GaN UPT device in first-quarter 2011, significantly expanding the GaN power transistor options available to its customers.

RFMD says that its GaN unmatched power transistors support 'green' architectures that reduce energy consumption, improve thermal management, and optimize network efficiency for network operators. The RF3932 operates over a broad frequency range (DC to 3GHz) and delivers high peak efficiency of >65%. It also incorporates simple, optimized matching networks external to the package, providing wideband gain and power performance advantages in a single amplifier.

The RF3932 is packaged in a hermetic, flanged ceramic two-leaded package that leverages RFMD's heat sink and power dissipation technologies to deliver what is claimed to be excellent thermal stability and conductivity. The 75W RF3932 and the 140W RF3934 are optimal for both driver and/or output stages, depending on overall power requirements.

RFMD's GaN-based product portfolio supports diverse end-markets, says Bob Van Buskirk, president of the firm's Multi-Market Products Group (MPG). "We look forward to introducing additional GaN devices that feature superior power density, high efficiency, rugged dependability and 'green' power consumption advantages," he adds.

RFMD says that its 48V high-power-density GaN process features a combination of high RF power density and efficiency, low capacitance, and high thermal conductivity. This enables the development of compact and efficient high power amplifiers (HPAs) for a broad range of applications, including private mobile radio (PMR), 3G/4G wireless infrastructure, ISM (industrial scientific & medical), military and civilian radar, and CATV transmission networks.

EPC updates device models for E-mode GaN transistors

Efficient Power Conversion Corp (EPC) of El Segundo, CA, USA has made available on its web site updated device models for all of its enhancement-mode gallium-nitride-on-silicon (eGaN) field-effect transistors (FETs).

The updates improve the robustness of the models without changing the core equations. Performance predictions with the new models will be consistent with previous versions of EPC SPICE models.

TSPICE, PSPICE, LTSPICE and Spectre device models are provided to help designers of eGaN-based power conversion circuits and systems to understand the value of the EPC eGaN power transistor family and reduce their time-to-market with benchmark products.

EPC has also written an application note to help users to understand eGaN transistor capabilities and the applicability of the SPICE models.

http://epc-co.com

IN BRIEF

EPC eGaN products win EDN China Innovation Award

Efficient Power Conversion Corp (EPC) of El Segundo, CA, USA says its family of enhancement-mode gallium nitride on silicon (eGaN) power FETs have been awarded the 'Editor's Choice Award' in the power device and module segment of the Electronic Design News (EDN) China's 2010 Innovation Awards.

The panel of judges based the award on online voting by Chinese design engineers. "It is the best-recognized product yet to be fully adopted in target markets," says EDN China's publisher William Zhang. "We also recognize EPC's potential significant contribution to the Chinese engineering communities with its innovations to set a new course in the power technology roadmap," he adds. EPC claims it was first to introduce enhancement-mode GaN-on-Si FETs as power MOSFET replacements.

"This award substantiates that EPC's enhancement-mode GaN power transistors represent a major breakthrough in power conversion technology," claims co-founder & CEO Alex Lidow. "The award supports our belief that performance from silicon-based MOSFETs has reached the end of the road and that eGaN technology will lead the way for continued increases in performance in power transistors."

Spanning a range of 40–200V and 4–100mΩ, eGaN FETs demonstrate performance advantages over state-of-the-art silicon-based power MOSFETs. EPC says that its technology produces devices that are smaller than similar resistance silicon devices and have many times superior switching performance.

www.epc-co.com

LAST POWER project targets strategic independence for Europe in wide-bandgap semiconductors

Complete production chain planned for integration of SiC and GaN on 150mm silicon

The partners in a new publicly funded European research consortium have announced details of the multinational/multidisciplinary program 'LAST POWER' (Large Area silicon carbide Substrates and heTeroepitaxial GaN for POWER device applications).

The aim of the 42-month ENIAC (European Nanoelectronics Initiative Advisory Council) project is to provide Europe with strategic independence in wide-bandgap (WBG) semiconductors. This field is of strategic importance as it involves the development of highly energy-efficient systems for all applications that need power, from telecoms to automotive, from consumer electronics to electrical household appliances, and from industrial applications to home automation.

The consortium aims to develop European technology for the complete production chain for semiconductor devices built with both silicon carbide (SiC) and heteroepitaxial gallium nitride on silicon wafers (GaN-on-Si), which both offer higher speed, current capability, breakdown voltage and thermal capability compared with conventional silicon technologies.

"The power semiconductor market, which represents approximately 30% of the overall semiconductor market, is set to change significantly in response to the ever-increasing demand for more energy-efficient devices," says project coordinator Salvatore Coffa, group VP and R&D general manager, Industrial and Multisegment Sector, at STMicroelectronics. "This key project, which targets secure strategic independence in the emerging field of SiC and GaN technologies, will place Europe at the forefront of energy-efficient devices," he reckons.

The project's overall objective is to develop cost-effective and reliable integration of SiC and GaN semiconductors in the European power microelectronics industry, via five specific objectives:

- growth of large-area (150mm) SiC and high-quality heteroepitaxial GaN on 150mm Si wafers, beyond the current state-of-the-art for substrates, epitaxy and surface preparation;
- development of new dedicated equipment for material growth, characterization and processing;
- processing reliable and efficient SiC and GaN devices on 150mm wafers;
- demonstration of high-performance devices with properties that cannot be obtained on silicon, including a 1200V/100A SiC MOSFET, SiC JFET capable of operating up to 250ºC, and GaN HEMT devices for power switching; and
- developing advanced packages for high-temperatures devices, as well as improving device reliability.

The partners in the LAST POWER consortium are:

- STMicroelectronics S.r.l. (Italy);
- LPE S.p.A. (Italy);
- Consiglio Nazionale delle Ricerche, Istituto per la Microelettronica e Microsistemi (Italy);
- Epitaxial Technology Center S.r.l. (Italy);
- Foundation for Research & Technology-Hellas (Greece);
- NOVASiC S.A. (France);
- Consorzio Catania Ricerche (Italy);
- Institute of High Pressure Physics UNIPRESS (Poland);
- Universita della Calabria (Italy);
- SiCrystal AG (Germany);
- SEPS Technologies AB (Sweden)
- SenSiC AB (Sweden);
- Acreo AB (Sweden); and
- Aristotle University of Thessaloniki (Greece).

www.eniac-lastpower.org

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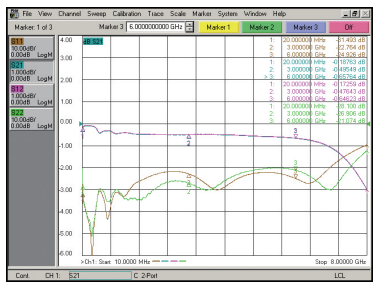
TBT-H06M20-F TBT-H06M20-F **25W / 20MHz～6GHz**

SPECIFICATION

Series		TBT			
Model		TBT-H06M20-F			
Impedance		50Ω			
Frequency Range		20MHz～6GHz			
		20～50MHz	50MHz～2GHz	2～3GHz	3～6GHz
VSWR (Return loss)		1.4 max.	1.22 max.	1.28 max.	1.4 max.
Insertion Loss		0.5dB typ.			0.7dB typ.
		0.8dB max.			1.0dB max.
Connector	RF	SMA (Female)			
	DC	Feedthru			
RF Power		25W max.			
Bias Current		3A max.			
Bias Voltage		50V max.			
Dimensions *		50 x 38 x 18 ㎜			
Weight		70g			
Temparature		0℃～ +40℃			

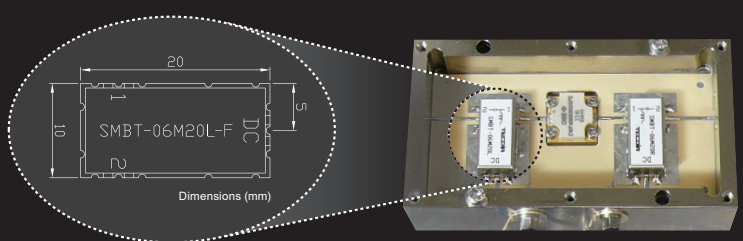
* Excluding Connectors

Typical VSWR & Insertion Loss



Surface Mount Design

20MHz～6GHz Typical Installation

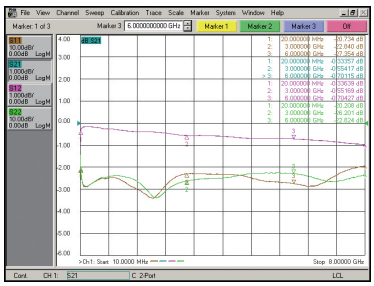


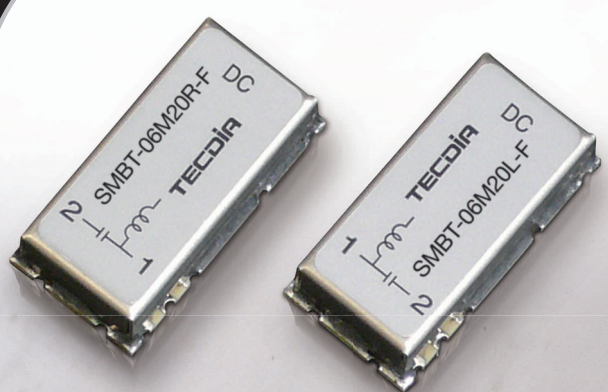
SPECIFICATION

Series	SMBT			
Model	SMBT-06M20□*-F			
Impedance	50Ω			
Frequency Range	20MHz～6GHz			
	20～50MHz	50MHz～2GHz	2～3GHz	3～6GHz
VSWR (Return loss)	1.5 max.	1.22 max.	1.28 max.	1.4 max.
Insertion Loss	0.8dB max.			1.0dB max.
RF Power	5W max.			
Bias Current	2A max.			
Bias Voltage	50V max.			
Dimensions	20 x 10 x 5 ㎜			
Weight	2g			
Temparature	-40℃～ +90℃			

*□=L or R for connection orientation

Typical VSWR & Insertion Loss





Ready-made Bias Network for GaN FET

* Left/Right Connection Available

GeneSiC samples multi-kHz, ultra-high-voltage SiC thyristors to US researchers

In what is claimed to be a first of its kind, GeneSiC Semiconductor Inc of Dulles, VA, USA has made available a family of 6.5kV SCR-mode SiC (silicon carbide) thyristors for use in power electronics for smart-grid applications.

Performance advantages of the power devices are expected to spur key innovations in utility-scale power electronics hardware to increase the accessibility and exploitation of distributed energy resources (DER). "Until now, multi-kV silicon carbide power devices were not openly available to US researchers to fully exploit the well-known advantages — namely 2–10kHz operating frequencies at 5–15kV ratings — of SiC-based power devices," says president Dr Ranbir Singh. "GeneSiC has recently completed delivery of many 6.5kV/40A, 6.5kV/60A and 6.5kV/80A thyristors to multiple customers conducting research in renewable energy, army and naval power system applications. SiC devices with these ratings are now being offered more widely."

SiC-based thyristors offer 10x higher voltage, 100x faster switching frequencies and higher-temperature operation compared with conventional silicon-based thyristors. Targeted research applications include

GeneSiC's 6.5kV/80A SiC thyristor in fully soldered module package.

general-purpose medium-voltage power conversion (MVDC), grid-tied solar inverters, wind-power inverters, pulsed power, weapon systems, ignition control, and trigger control.

Ultra-high-voltage (>10kV) SiC device technology will play a revolutionary role in the next-generation utility grid, believes GeneSiC. Thyristor-based SiC devices offer the highest on-state performance for >5kV devices, and are widely applicable to medium-voltage power conversion circuits like fault-current limiters, AC–DC converters, static VAR compensators (SVCs) and series compensators. SiC-based thyristors also offer the best chance of early adoption due to their similarities to conventional power grid elements, adds the firm. Deploying these power semiconductor technologies could provide as much as a 25–30% reduction in electricity consumption through increased efficiencies in the delivery of electrical power.

"It is anticipated that large-scale markets in solid-state electrical substations and wind turbine generators will open up after researchers in the power conversion arena will fully realize the benefits of SiC thyristors," says Singh. "These first-generation SiC thyristors utilize the lowest demonstrated on-state voltage drop and differential on-resistances ever achieved in SiC thyristors," he claims.

"We intend to release future generations of SiC thyristors optimized for gate-controlled turn-off capability and >10kV ratings," Singh says. "As we continue to develop high-temperature ultra-high-voltage packaging solutions, the present 6.5kV thyristors are packaged in modules with fully soldered contacts, limited to 150ºC junction temperatures," he adds.

GeneSiC says it is committed to developing SiC-based devices for: (a) HV–HF SiC devices for power grid, pulsed power and directed-energy weapons; and (b) high-temperature SiC power devices for aircraft actuators and oil exploration.

www.genesicsemi.com

SETI wins phase II SBIR contract for AlInN/GaN FETs

The Missile Defense Agency (MDA) has awarded Sensor Electronic Technology Inc (SETI) of Columbia, SC, USA a $750,000 Phase II Small Business Innovation Research (SBIR) contract to continue the development of AlInN/GaN heterostructures for X-band RF power amplification devices.

Although GaN-based transistors have emerged as a future technology for high-power microwave applications, technical challenges arising from the lattice mismatch between the AlGaN barrier layer and the GaN channel continue to lead to reliability issues. During Phase I of the SBIR program, SETI demonstrated the technical feasibility of its patented MEMOCVD (migration-enhanced MOCVD) technology for growing Ga-free high-quality AlInN layers, and produced AlInN/GaN hetrostructures with up to 22% indium content and achieved record sheet electron concentration in excess of $4.5x10^{13}cm^2$. Using this material structure, record HFETs were produced, with peak drain currents exceeding 2A/mm and f_T and f_{max} above 100GHz.

Phase II will scale the technology to 3" wafers with improved uniformity.

Since lattice-matched AlInN/GaN hetrostructures do not suffer from strain-related effects, significant device reliability improvements are expected. Also, due to much higher Al fractions in latticed-matched AlInN/GaN heterostructures, very high 2D electron concentration can be achieved at very small barrier thickness. This should result in very high cut-off frequencies (f_T) at very high maximum currents.

www.s-et.com

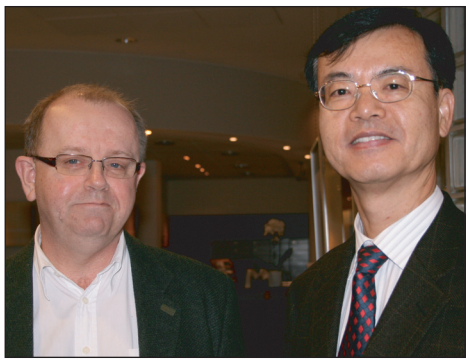
LG Innotek starts SiC project with Linkoping University

Electronic components for hybrid electric vehicles targeted

Electronic components firm LG Innotek, which is part of South Korea's LG group of companies, and materials researchers at Sweden's Linköping University (LiU) have begun a nine-year collaborative project to develop manufacturing of silicon carbide (SiC) for electronic components, starting with a kick-off project meeting in Linköping on 12 November.

LG Innotek says that investment in the high-performance electronics material SiC is a part of a new strategy for the firm. Using SiC as a substrate can boost the output of light-emitting diodes, and LED-based displays and illumination are a priority area (in which parent company LG is the second biggest manufacturer in the world). However, SiC is also of great interest in the development of components for electric vehicles and the streamlining of green energy production.

"LG Innotek representatives have visited research groups and companies around the world to find a partner for this investment," says Olle Kordina, senior lecturer and contact person for the project,



Professor Erik Janzén (left) and LG Innotek's CTO Joo-Won Lee at project kick-off meeting in Linköping.

led by professor Erik Janzén. "We've been negotiating with them since the spring, and now the project is underway."

The project is financed in part by the Republic of Korea. LiU researchers' funding includes SEK20m (€2.13m), and their role is to develop a method for epitaxial growth of high-quality SiC, for which LG will fund a new reactor. "We are the only group outside South Korea who will be working for LG on this," says Kordina. Janzén and co-workers in the Department of Physics, Chemistry and Biology have focused on SiC for many years. The results of their research have previously been commercialized by Norstel, which has a manufacturing plant in Norrköping, Sweden.

LG has its sights set on the rapidly growing hybrid electric car market. With heat-resistant SiC transistors, an electric hybrid can manage with just one cooling system, reducing weight and hence energy consumption. "Many car manufacturers are interested in silicon carbide for their future electric cars — for example, Hyundai, Toyota, Volkswagen, and BMW," says LG Innotek's chief technical officer Joo-Won Lee.

The challenge for the approximately 50 researchers in the LiU group is to further improve the surface quality of their SiC material and hence maximize performance. "We have now developed a new chemical method where we mix in chlorine gas, which increases the speed of growth by 10–20 times," says Janzén. "It will be very interesting for us to test this on a large scale."

www.lginnotek.co.kr
www.liu.se

RFHIC launches 8W, 100–960MHz TETRA GaN hybrid

RFHIC Corp of Suwon, South Korea (which makes GaN and GaAs active RF & microwave components and hybrid modules for telecom and broadcast markets) has launched a class-C GaN hybrid amplifier using devices on GaN-on-SiC substrate.

With input and output matching circuits included in the design together with bias circuits and other matching circuits, and using a ceramic substrate over a copper heat slug, the physical size of the SMD-type hybrid GaN amplifier is 15mm x 10mm x 5.4mm.

Using an input voltage of 24–34V, the amplifier provides VHF at 8W in the 130–450MHz range with an efficiency of 60%, and UHF at 6W in the 450–960MHz range with an efficiency of 50%.

Existing TETRA amplifiers (TErrestrial Trunked RAdio, formerly known as Trans European Trunked Radio) use LDMOS technology and operate from a 5–12V supply. Also, previous designs separated three to four bands of 130–220MHz, 380–400MHz, 410–470MHz, 560–580MHz and 870–933MHz, and combining losses were inevitable. Recent TETRA developments require full 100–960MHz frequency range coverage, and RFHIC says its new GaN hybrid amplifier fits this application. Better efficiency amplifiers can reduce the number of base-station installations in the field.

GaN technology enables a more efficient solution for most TETRA replacement amplifiers and new installations. RFHIC says it has developed the wideband TETRA GaN hybrid amplifier for users looking for greener solutions for their systems. One TETRA system can now cover the full 100–960MHz band with an efficiency of 50–70%. RFHIC says the use of an SMD-type package guarantees high production yield. All amplifiers are 100% tested and aged for immediate installation.

RFHIC is now working on 100W and 500W TETRA hybrid amplifiers; 20W and 40W amplifiers are already in production.

www.rfhic.com

Showa Denko and Air Water to form JV for specialty gases

Initial H_2Se plant for CIGS PVs to start up in June

Tokyo-based chemical manufacturer Showa Denko K.K. (SDK) and Osaka-based Air Water Inc (AWI), which supplies gas for industrial and medical applications, have agreed that in December they will establish a Tokyo-based joint venture for the production of specialty material gases for the electronics industry, to be marketed globally. Owned 51% by SDK and 49% by AWI, Showa Denko Air Water Co Ltd will be capitalized at ¥100m.

Demand for specialty material gases has been growing steadily, centered on Asian markets, for use in the production of solar cells, semiconductors, LCD panels and LEDs, say the firms. Due to the growing need for functional, energy-saving and compact electronic devices, manufacturers of specialty material gases are now required to develop new products and make further capital investments, they add.

SDK and AWI says that they aim to utilize their proprietary technologies to establish production at the new manufacturing joint venture and launch a wide variety of new material gases. The joint venture's will products will be sold independently by SDK and AWI through respective sales channels.

As a first step, within the premises of SDK's Tokuyama Plant in Shunan City, Yamaguchi Prefecture the JV will install a 40ton/year facility for hydrogen selenide (H_2Se), which is used to form light-absorbing films in copper indium gallium diselenide (CIGS) photovoltaic cells. H_2Se production should start in June 2011.

SDK and AWI add that they aim to quickly strengthen their joint operations, pursuing the possibility of expanding the JVs product lines and establishing plants at locations both in Japan and abroad.

www.sdk.co.jp
www.awi.co.jp/english

AXT appoints VP of sales for Asia

AXT has appointed Dr Liming Zhu as VP of sales for the Asia region. Zhu was previously VP of quality & quality systems for its manufacturing facility in Beijing. AXT says that the appointment represents an expansion of its direct, local sales presence in Asia.

"Knowledge of our products and our customers makes him a perfect fit to head up our sales efforts in this increasingly important region," says CEO Morris Young. "There is an abundance of opportunity in Asia, and having a direct, local presence underscores our commitment to this region and enhances our ability to respond quickly and effectively to customer needs," he adds. "This expansion will help drive continued market share growth in Asia."

Zhu was appointed VP of quality & quality systems early this year after serving as director of quality & quality systems since 2007. He joined AXT in 2001 and has held various positions including senior process R&D engineer, senior project manager, and product reliability manager.

AXT's revenue rises 16% to $26.8m

Gross margin leaps from 36.8% to 39.3% in Q3

For third-quarter 2010, AXT Inc of Fremont, CA, USA has reported revenue of $26.8m, up 16% on $23.2m last quarter and 60% on $16.8m a year ago.

"Solid demand in all of our key end markets coupled with great execution across our organization allowed us to deliver outstanding financial results and continued increases in our market share and customer penetration," says CEO Morris Young.

Total gallium arsenide (GaAs) substrate revenue was $19.2m, up 19% on $16.2m last quarter and 44% on $13.3m a year ago. Although up 39% on $688,000 a year ago, indium phosphide (InP) substrate revenue has fallen 13% from $1.1m last quarter to $955,000. Germanium (Ge) substrate revenue was $2.3m, up 44% on Q2's $1.6m and up 28% on $1.8m a year ago. Raw materials sales were $4.4m, up 5% on Q2's $4.2m and more than quadrupling from $1m a year ago.

"Not only did we exceed our revenue expectations, our gross margin performance was the highest it has been in many years," says Young. Gross margin has risen from 32.9% a year ago and 36.8% last quarter to 39.3%.

Compared with $3.7m a year ago and $3.6m last quarter, operating expenses have risen slightly to $3.8m. Nevertheless, income from operations has continued to rise, from $1.9m a year ago and $5m last quarter to $6.7m. Net income was $5.6m, up slightly from $5.5m last quarter and $2.1m a year ago (although, excluding a $1.2m net sales tax refund, net income last quarter was just $4.3m).

"We continue to see growing momentum in the long-term secular trends that are fueling our growth, including the adoption of smartphones and other intelligent wireless devices, the proliferation of LED applications and the expansion of PV technology," Young says. "These trends are opening up exciting opportunities for our business that we believe will extend for years to come."

For fourth-quarter 2010, AXT expects revenue to rise to $28–29m.

www.axt.com

Brewer Science opens offices in Tokyo and Seoul

Brewer Science Inc of Rolla, MO, USA says that, to better serve its Asian customers with process and material solutions for the semiconductor, MEMS, and LED industries, it has recently opened new offices in Tokyo, Japan, and Seoul, Korea, joining its existing offices in Taipei, Shanghai, and Hong Kong.

"Local customer support is a commitment of Brewer Science," says president Terry Brewer. "Working side by side with customers provides us with an opportunity to address their issues and provides them with the most effective manufacturing solution for the long term."

Brewer Science has delivered technology solutions to the microelectronics industry for 30 years, beginning with the invention of anti-reflective coatings for microlithography processes, the firm says. The firm's products include ARC anti-reflective coatings, ProTEK protective coatings, WaferBOND bonding materials, the ZoneBOND thin-wafer processing systems, OptiNDEX high-refractive-index materials, OptiStack multilayer lithography systems, and Cee benchtop processing equipment.

The new offices are located at:

- Brewer Science Japan G.K., Level 28, Shinagawa Intercity A, 2-15-1, Konan, Minato-ku, Tokyo, Japan 108-6028, Tel: +81 (0)3 6717-4378;
- Brewer Science Asia Ltd, Korea Representative Office, 30th Floor ASEM Tower, 159-1, Samsung-dong, Gangnam-Gu, Seoul, Korea 135-798, Tel: +82 2 6001 3498.

Brewer Science exhibited in the Next Generation Technology Pavilion at the SEMICON Japan 2010 trade show (1–3 December).

www.brewerscience.com

IN BRIEF

Nanometrics begins share repurchase

The board of directors of process control metrology system maker Nanometrics Inc of Milpitas, CA, USA has authorized the repurchase of up to $10m of the firm's common stock from the public market or in private purchases.

As of 2 October, Nanometrics had $64m in cash and cash equivalents and about 22.2 million shares outstanding.

In Q3/2010, Nanometrics completed its prior $4m stock repurchase program, "We have achieved five consecutive quarters of positive cash flow from operations," notes president & CEO Tim Stultz. The new program aims to offset shareholder dilution from periodic grants of incentive options and restricted stock units.

www.nanometrics.com

Dow Electronic Materials breaks ground on new Korean trimethyl gallium MOCVD precursor plant

Dow Electronic Materials of Philadelphia, PA, USA, a business unit of The Dow Chemical Company, has broken ground on its new MOCVD precursor manufacturing plant in Cheonan, Korea, about 85km south of Seoul.

Construction of the plant is part of a multi-phase plan unveiled in June to expand TMG (trimethyl gallium) production capacity to meet surging global demand from LED and related electronics markets. The plant should be operational in early 2011.

Dow Electronic Materials currently manufactures TMG and other metalorganic precursors in North Andover, MA, while packaging is performed in both North Andover and Taoyuan, Taiwan.

Capacity expansion in the USA at existing facilities is also progressing as planned, with new capacity expected by the end of 2010 and continuing through first-quarter 2011. Total additional capacity resulting from the multi-phase plan is expected to be 60 metric tons per year.

"Meeting our customers' near- and long-term needs for high-quality materials continues to be a priority for us," says Joe Reiser, Dow Electronic Materials' global business director for Metalorganic Technologies. "The construction of our new facility in Korea illustrates our commitment to investing in expansion and having supply capabilities close to our customer base in Asia."

www.dow.com

SAFC expands Taiwan plant to boost precursor capacity

LED TVs and lighting drive new facility to meet Asia demand

Following March's expansion of trimethylgallium (TMG) MOCVD precursor production at its Bromborough, UK manufacturing site, chemical manufacturer SAFC Hitech of St Louis, MO, USA (a business segment of SAFC within the Sigma-Aldrich Group) has reinforced its commitment to the Asia-Pacific electronics markets by announcing plans to build a new, dedicated facility in Kaohsiung, Taiwan for transfilling, technical service and production of LED and silicon semiconductor precursors.

Expected to be operational by late 2011, the new facility will extend the firm's ability to serve the Asian market, leveraging the knowledge and capabilities developed at its existing Kaohsiung facility.

The new investment will transition current operations into a new environment that is expected to expand SAFC Hitech's transfilling and technical service base, as well as add significant capacity for the dedicated manufacturing of precursors to support the burgeoning HB-LED market as well as atomic layer deposition (ALD) and chemical vapor deposition (CVD) precursors for the silicon semiconductor market.

Increased focus on improving efficiency and reducing energy costs through technology and design advances is driving the electronics sector to roll out more 'energy-conscious' products and systems, says SAFC Hitech. Due to the resulting exponential rise in demand for LEDs (particularly HB-LEDs used in applications such as backlighting in flat-panel TV sets and energy-efficient lighting), SAFC Hitech says that it is continuing to strengthen its position as a legacy supplier of precursors for the HB-LED market.

We are experiencing significant increases in customer and partnership activities in the Asia-Pacific region

"As mass manufacturing continues its rise, we are experiencing significant increases in customer and partnership activities in the Asia-Pacific region, which aligns nicely with our core commitment to driving global expansion in the production of precursors for the rapidly expanding HB-LED market," says SAFC Hitech president Philip Rose. "The expansion of our Kaohsiung presence is a logical next step that will help us to support these markets," he adds. "By increasing our investment in local technical service capabilities and by leveraging our proprietary technologies and capabilities, we are able to increase our transfilling, production and technical services in these key markets."

The existing SAFC Hitech Kaohsiung capabilities handle and characterize highly specialized laboratory-scale chemicals and features a dedicated customer support center. The existing site is ISO 9001 certified for quality and ISO 14001 certified for safety and environmental protocols. The facility was originally built to service semiconductor industry demands for ultra-high-quality precursors using proprietary technologies. The site also provides integrated inert-atmosphere transfilling stations, analytical instrumentation for the detection of ultra-low metallic- and oxygen-containing contaminants, and dedicated cylinder preparation and packaging areas. An extensive departmental infrastructure (health & safety, quality, shipping, sales) provides for adherence to the highest standards of performance, says SAFC Hitech.

www.safchitech.com

US firm ATMI buys minority stake in Korean metal-organic precursor supplier Lake LED Materials

Semiconductor materials firm expands into LED market

ATMI Inc of Danbury, CT, USA (which provides specialty semiconductor materials and high-purity materials handling and delivery solutions) has purchased a minority interest in Lake LED Materials of Daejeon, South Korea, a materials technology start-up focused on providing metal-organic precursors to the LED market.

ATMI aims to help to accelerate commercial LED materials introductions with select marketing and technology rights. ATMI says that the collaboration highlights its technical expertise in process materials for LED applications with its global infrastructure in conjunction with Lake LED Materials' technology. ATMI also says that the collaboration represents the first step in a multi-faceted strategy for addressing process efficiency opportunities in the LED market.

"Light-emitting diodes are the wave of the future for lighting — for TVs, personal electronics, and business and home lighting," says Dan Sharkey, ATMI's executive VP, business development. While basic LED technology has been around for decades, moving them into cost-effective mass-production requires developing the enabling materials that can be readily incorporated into high-volume production, he adds.

"Just as ATMI has created a pre-eminent position in materials with traditional semiconductor manufacturers, we believe that, working jointly with Lake LED Materials, we can establish a similar enabling materials position with leading global LED manufacturers," Sharkey continues.

"ATMI's investment in Lake LED Materials not only confirms the value of our high-efficiency production technology, but also supports further production and R&D expansions," comments Lake LED Materials' chairman, president & CEO Jin-dong Kim.

Market research firm Strategies Unlimited forecasts a $20bn overall market for high-brightness LEDs by 2014, a compound average annual growth rate (CAAGR) of more than 30% from 2009. Meanwhile, DisplaySearch believes that three of every four televisions will be LED models by 2014, doubling from 100 million units in 2012 to more than 200 million in 2014.

www.atmi.com

AkzoNobel to double TMG capacity again

Demand for LED lighting drives acceleration of plans

AkzoNobel of Amersfoort, The Netherlands says that, due to continued strong global demand for its High Purity MetalOrganics (HPMO) product range, it will again significantly expand its production capacity for trimethyl gallium (TMG) precursor material.

The HPMO business (part of AkzoNobel's Functional Chemicals business unit) is a producer of semiconductor-grade indium-, gallium-, aluminum-, zinc- and magnesium-based metalorganics used as key precursor materials in the production of LEDs and solar cells.

In June, AkzoNobel doubled TMG production capacity at its facilities in LaPorte, TX, USA. "Our customers' response to this expansion has been very positive, and their continued strong demand has already fully adsorbed the enlarged capacity," says Michiel Floor, global business manager of the HPMO product group.

To continue to meet the growing demand, especially from the LED industry, the company says that it has decided to advance its plans for expanding TMG capacity, again doubling production capacity. The increased volume will become available in February. "This makes us by any measure by far the largest producer of this product," reckons Floor.

"We continue to support the exciting growth of the LED and other compound semiconductor industries, and have firmly planned ahead for stepwise capacity additions across our High Purity Metalorganics product range, including trimethyl gallium and trimethyl indium," says Floor. "We are also the only producer that is backward integrated into the key raw material trimethyl aluminum that we produce in-house in bulk volumes," he adds (as per TMG precursor, but also for many other applications beyond semiconductor materials). Akzo will also continue to expand TMI, for which capacity has already doubled (stepwise) over the past 12 month. "We are actively working on the design of the next TMI plant," notes Floor.

"Our continued investments in the HPMO business further demonstrate AkzoNobel's commitment to the attractive and high-growth LED industry, with general lighting applications becoming reality sooner than expected," says Bob Margevich, managing director of Functional Chemicals. "This business also further supports our efforts in sustainability, by focusing on applications that drive energy efficiency and lower energy usage, such as LEDs and solar cells".

www.akzonobel.com/hpmo

IN BRIEF

IQE wins supplier award from Avago

Epiwafer foundry and substrate maker IQE plc of Cardiff, Wales, UK says that its IQE Inc operation in Bethlehem, PA, USA has been recognized as an outstanding supplier to wireless chip maker Avago Technologies.

The Outstanding Supplier Award is based on quality-related criteria for products and services.

IQE supplies Avago with specialized RF materials used in the manufacture of high-end components for handsets and other wireless applications.

"The award demonstrates IQE's commitment to supplying its customers with the best quality of products and services," comments IQE Group's CEO & president Dr Drew Nelson.

www.iqep.com
www.avagotech.com

INL orders Riber research reactor

Riber S.A. of Bezons, France, which manufactures molecular beam epitaxy (MBE) systems as well as evaporation sources and effusion cells, has sold a Compact 21 research system to the Lyon Institute of Nanotechnology (Institut des Nanotechnologies de Lyon, INL).

The new system will supplement existing Riber MBE systems at INL and contribute to expanding the its research capabilities for developing micro- and optoelectronic components, specifically the use of silicon as a 'universal' substrate. The project is being financed with funds from a State-Region planning contract.

INL is a mixed research unit, overseen by the French national center for scientific research (CNRS), Ecole Centrale de Lyon, INSA de Lyon and Université Lyon 1. Its mission is to develop research, from materials to systems, paving the way for the emergence of groundbreaking technical fields. Applications cover the main economic sectors, from the semiconductor, microelectronic and photonic industries to telecoms, energy, health, biology, industrial control, defense and the environment.

Riber says that the Compact 21 system sold to INL offers high modularity and flexibility, making it possible to deposit materials with both low and high evaporation temperatures simultaneously (which is particularly suited to growing crystalline oxides on silicon). Drawing on Riber's technical experience and INL's oxide growth expertise, the reactor is being integrated into the other Riber systems at INL, which are devoted to growing III-V semiconductor-based nanostructures.

Riber says that, as well as confirming the commercial success of the Compact 21 range (the world's best-selling MBE research system), the new order from a leading semiconductor research lab highlights Riber's expertise in nanotechnologies.

http://inl.ec-lyon.fr

SEMI Europe's Standards Awards honor Freiberger's Bindemann and Liverpool University's Williams

At the SEMICON Europa 2010 trade show in Dresden, Germany (19–21 October), industry association SEMI announced that Paul Williams of the University of Liverpool and Roland Bindemann of Freiberger Compound Materials had received International Standards awards.

Williams received a Standards Leadership Award for his dedication in leading the SEMI Standards Precursors Task Force, while Bindemann received a Standards Honor Award for his dedication to the advancement of SEMI Standards.

The SEMI International Standards Program was established in 1973 with the aim of benefiting the worldwide semiconductor, photovoltaic and emerging markets industries by helping to increase productivity and reduce costs.

Williams, formerly with precursor chemical manufacturer SAFC Hitech in Bromborough, UK but currently with the University of Liverpool, has led the SEMI Standards Precursors Task Force since 2005. SEMI says that Williams consistently built consensus while setting guidelines and seeking input from interested parties. Under his leadership, four major documents were published and four more draft documents are almost ready for balloting. The SEMI Standards Leadership Award was presented to Williams for his outstanding leadership in guiding the SEMI International Standards Program.

Since 1993, Dr Bindemann of Germany-based compound semiconductor substrate maker Freiberger Compound Materials GmbH has been involved with standardization efforts in Europe. In 2003, he was appointed as co-chair of the SEMI Europe Compound Materials Standards Committee. Now retired from Freiberger, he continues to be sponsored by the firm to support SEMI European Standardization activities. The SEMI Standards Honor Award was presented to Bindemann for his long-standing dedication to the advancement of SEMI Standards.

"Paul Williams and Roland Bindemann received these Standards awards for exceptional commitment to the advancement of SEMI International Standards," says Heinz Kundert, president of SEMI Europe of Brussels, Belgium. "SEMI is grateful for their commitment to the SEMI International Standards Program."

www.semi.org/europe

NAMBE award for Moustakas

The 2010 MBE Innovator Award, co-sponsored by epitaxial deposition and process equipment maker Veeco Instruments Inc of Plainview, NY, USA and the North American Molecular Beam Epitaxy (NAMBE) organization, was presented to professor Theodore Moustakas of Boston University's Electrical and Computer Engineering Department at this year's NAMBE Conference in Breckenridge, CO on 28 September.

Initiated eight years ago, the MBE Innovator Award (consisting of a $3000 honorarium and plaque) recognizes individuals whose innovations have significantly advanced MBE in the following categories:

- materials research;
- device development;
- device commercialization; or
- equipment development.

NAMBE selected Moustakas for his pioneering contributions in the development of MBE growth of nitride materials and the development of nitride optoelectronic devices prepared by MBE. Particular contributions include the use of MBE for the synthesis and device fabrication of LEDs, laser diodes, photodetectors, and optical modulators operating in the visible and ultraviolet range. He is the co-editor of eight books, has authored 300 papers, and has been granted 25 US patents (with several more pending). Intellectual property transpiring from his work has been licensed to a number of firms, including major manufacturers of blue LEDs and lasers.

"Veeco congratulates professor Moustakas on his great, long-standing success in the field of MBE, and furthermore we reiterate our sincere appreciation to all innovative contributors in MBE," says Jim Northup, general manager/VP, Veeco St. Paul Operations. "We support this award as a key driver in the continuing expansion of MBE technology into eligible markets."

www.veeco.com/mbe

IN BRIEF

AIST orders Riber reactor for PV R&D

Riber S.A. of Bezons, France has sold a Compact 21 MBE reactor to the photovoltaic technology R&D center at the Institute of Advanced Industrial Science and Technology (AIST) in Tsukuba.

As Japan's largest public scientific research institute, AIST is involved in nanotechnology, nanomanufacturing techniques and evaluation, and is particularly active in applied research for solar power.

The new system will strengthen AIST's fleet of equipment and help to develop high-performance structured solar cells based on InGaAs.

Riber says the system offers high modularity and flexibility, satisfying the most demanding specifications for developing III-V-based nanostructures.

www.riber.com

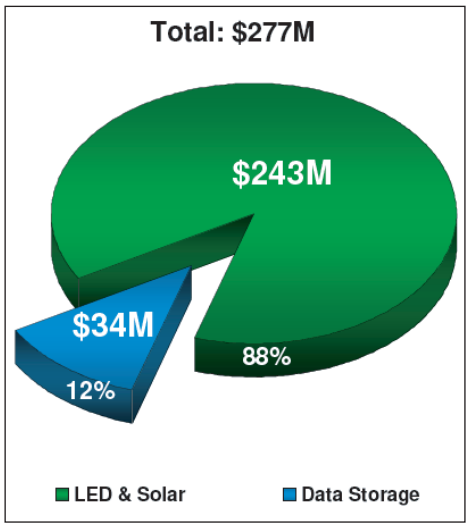
Veeco grows 25% in Q3; on track for $1bn in 2010

China MOCVD boom driving LED & Solar towards 90% of revenue

For continuing operations in third-quarter 2010 (excluding the Metrology business, sold to Bruker Corp of Billerica, MA, USA on 7 October for $229.4m in cash), epitaxial deposition and process equipment maker Veeco Instruments Inc of Plainview, NY, USA has reported record revenue of $277.1m (up 25% on $221.4m last quarter and 270% on just $74.7m a year ago).

Of this, 12.5% came from Data Storage revenue of $34.5m (down 3% on $35.7m last quarter but up 59% on $21.7m a year ago). LED & Solar comprised 87.5% of total revenue ($242.6m, up 31% on $185.6m last quarter and 350% on just $53m a year ago). Of this, MOCVD revenue was $236m (up from $175m last quarter) after Veeco shipped more than 100 MOCVD systems (up from 81 last quarter). The proportion of Veeco's total revenue coming from LED & Solar has risen from 73% in Q2/2010 (before the sale of the Metrology business) and just 54% in 2009 and 29% in 2007.

Gross margin has risen from 40.9% a year ago and 44.6% last quarter to 48.9% (exceeding the guidance of 45–46%). Compared with just breaking even a year ago, net income has almost doubled for a second consecutive quarter, from $49.9m last quarter to $91.1m.



Veeco's Q3/2010 revenue by market segment.

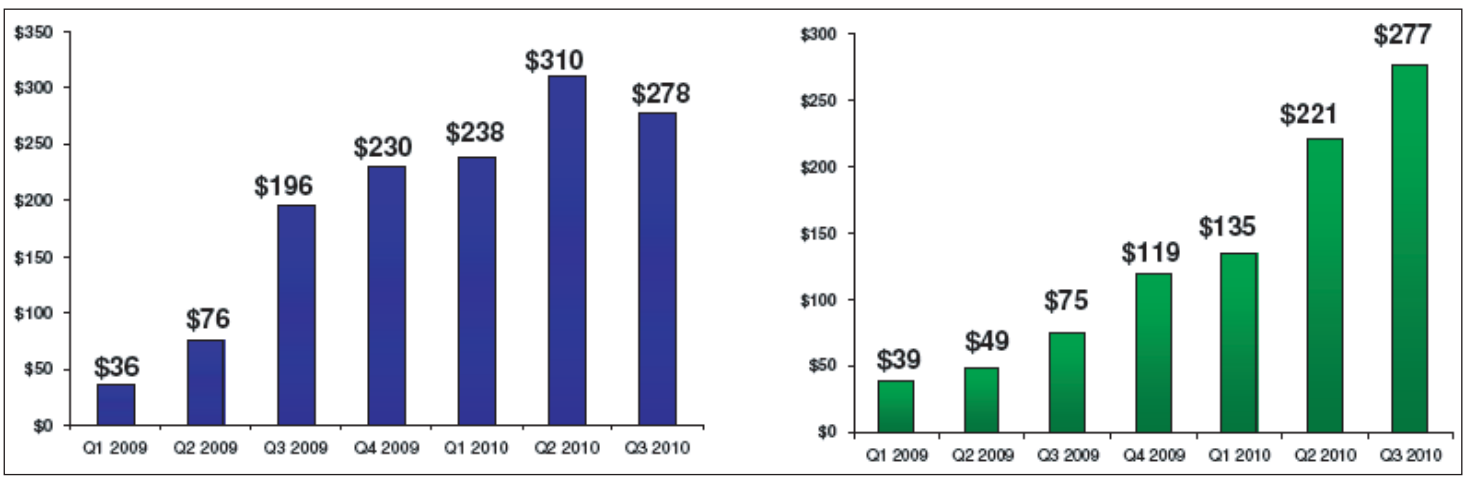
During the quarter, Veeco generated a record $79m in cash from operations, "the best financial position in our history", comments CEO John R. Peeler.

On 24 August, Veeco's board authorized the repurchase of up to $200m of its common stock through August 2011, and during the quarter the firm purchased 930,000 shares of its stock at an average price of $34 per share (for a total of about $32m). Cash and short-term investments hence grew $52m during the quarter, from $414.8m to $466.8m.

Orders were $278m (up from $196m a year ago but down 10% on $310.5m last quarter). Of this, 13% came from Data Storage ($35m, more than double $17m a year ago, but down 30% on $50m last quarter) and 87% came from LED & Solar ($243m, up 36% on $179m a year ago but down 7% from last quarter's $260m). During the quarter, order backlog fell from $597m to $569m.

"We have recently experienced rescheduling of tool shipments from the fourth quarter into the first quarter by several customers in Korea and Taiwan," says Peeler. "Due to the recent strong order rate from China, our current plan for Q4 revenue includes a significant amount of large multi-tool shipments to key Chinese customers, many of whom are currently building or expanding their facilities," he adds. During Q3, orders for MOCVD tools were placed by 15 customers, with continued strength in China (Elec-Tech, Sanan and

We have recently experienced rescheduling of tool shipments from Q4 into Q1 by several customers in Korea & Taiwan. Q4 revenue includes a significant amount of large multi-tool shipments to key Chinese customers



Trends in Veeco's quarterly bookings (left) and revenue (right), in millions of US dollars, since Q1/2009.

Tsinghua Tongfang) and further account penetration in Taiwan (Epistar, Arima, GPI and Lextar).

"While we currently expect that these tools will ship over the next few months, timing of revenue could shift into the first quarter due to customer facility readiness." For fourth-quarter 2010, Veeco expects revenue to rise to $285–320m and gross margin to rise to 50–51%.

"We continue to see high levels of quoting activity for MOCVD systems, particularly in China and Taiwan, and our Data Storage business continues to experience healthy overall market conditions," Peeler says. "Fourth-quarter orders will be equal to or better than the third quarter."

"Further strength in MOCVD bookings currently forecasted for Q4 should enable us to exit 2010 with strong backlog, positioning Veeco for excellent revenue performance in the first half of 2011," believes Peeler. "We have built our manufacturing capacity to 120 or more tools per quarter, and will head into 2011 with the ability to flex quarterly shipments up or down as required by customer demand." Veeco targets 2011 revenue of more than $1bn (compared with just $282.4m for continuing operations in 2009).

"As we look to the future, we believe there may be an opportunity to sell thousands of MOCVD systems as LEDs fully penetrate display applications and adoption accelerates for solid-state lighting in 2011 and 2012," Peeler continues. "In order to capitalize upon this opportunity, Veeco is expanding training, service and support functions in China, Taiwan and Korea, and accelerating our new product roadmap," he adds.

"In our other businesses, quoting activity is picking up for our CIGS solar deposition systems as we make progress advancing these tools' process capabilities for high-efficiency/low-cost solar cells."

www.veeco.com

Epistar orders K465i GaN MOCVD systems

Taiwan's Epistar Corp has ordered multiple Veeco TurboDisc K465i GaN MOCVD systems for high-volume LED production.

"Since we qualified Veeco's tools for production back in May, we have been extremely satisfied with their performance," says president Dr M.J. Jou. "Given the systems' ease-of-use and low cost of ownership, we now plan to include Veeco as an important supplier," he adds.

"We are excited to continue to establish this strong relationship with Epistar in 2010, and pleased to support their current and future MOCVD requirements," says Bill Miller Ph.D., executive VP, Compound Semiconductor and head of Veeco's MOCVD operations.

Veeco delivers GEN10 MBE system to University of New Mexico's Center for High Technology Materials

Epitaxial deposition and process equipment maker Veeco Instruments Inc of Plainview, NY, USA says that it recently delivered a GEN10 automated MBE system to the University of New Mexico (UNM) Center for High Technology Materials (CHTM).

The GEN10 was purchased through an instrumentation grant by the US Air Force Office of Scientific Research awarded to Dr Sanjay Krishna, UNM CHTM associate director and professor of Electrical and Computer Engineering. Krishna's group consists of research professors, postdoctoral fellows, graduate students and undergraduates who are investigating next-generation infrared detectors. The system is also accessible for use by the other researchers at the center, department, school and university, and is available for industry to assemble specialized prototypes.

The system will also benefit small businesses by supplying wafers to them. For example, Krishna has a start-up company that will use the grown samples in an infrared camera that will permit early detection of melanomas on the skin using extremely small temperature variations.

Biological sciences, in addition to energy harvesting, is the newest focus for researchers at CHTM since its inception 25 years ago, with an historical concentration in electrical and optical semiconductor research.

The new automated R&D MBE system is the first system of this kind available for use in a university setting in the USA, says Krishna. "We chose the Veeco GEN10 because of its state-of-the-art design that allows researchers to grow complex crystals with better quality control than has been possible in the past," he adds.

"In addition, its flexible footprint design provides for efficient use of multiple growth modules for projects of interest by our various groups."

With a focus on maximum efficiency and the need for the independent growth of multiple incompatible materials in a single system architecture, Veeco says that it is seeing an increase in interest in its enabling cluster tool systems. In particular, the GEN10 for R&D is the most recent introduction to the company's cluster tool product line, built upon nine years of cumulative knowledge within various production environments.

Veeco says that orders over the last year position the GEN10 reactor into all major application segemens for MBE, including those related to III-Vs, oxides and nitrides.

www.veeco.com/mbe

Aixtron reports revenue up 11% in Q3 to record €212.7m

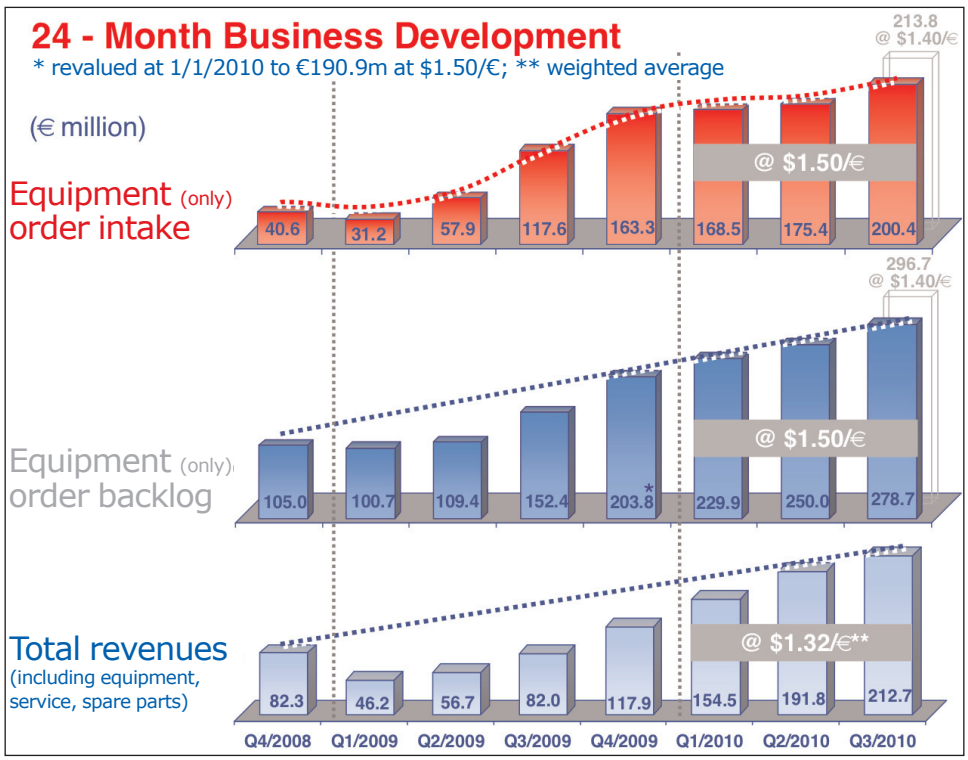
EBIT margin guidance for 2010 raised further to 35%

Supported by ongoing high system demand, mainly fuelled by high-brightness LED backlighting and lighting applications (and positively influenced by the stronger US dollar), deposition equipment maker Aixtron AG of Aachen-Herzogenrath, Germany says that in third-quarter 2010 it saw a continuation from in recent quarters of its positive growth trend in orders, revenue (the sixth consecutive quarter of growth) and profitability (the fifth consecutive quarter of improvement).

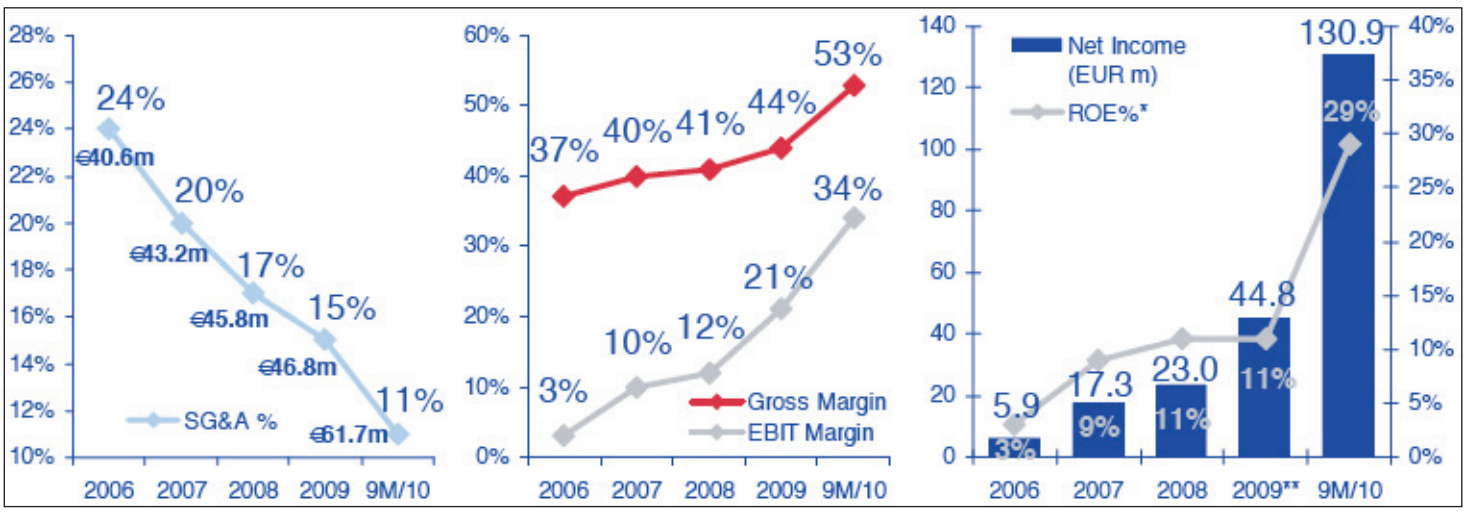
Revenues was €212.7m (up 11% on Q2's €191.8m and up 159% on €82m a year ago). This took revenue for the first nine months of 2010 to €559.1m (more than tripling from €184.9m year-on-year). Of this, 93% came from Asia and just 4% from the USA and 3% from Europe (up from 80%, 5% and 15% for the first nine months of 2009, driven by revenue 254% growth for Asia). By application, 93% of revenue was for LEDs and just 2% for telecoms/datacoms, 1% for silicon, and 4% for displays/other.

Although up from 42% a year ago, gross margin has fallen from 55% in Q2 to 52% in Q3, due mainly to the product and final acceptance mix in the quarter. However, despite some offsetting effects on operating margin from currency hedging and translation expenses, the operating result has risen from €60.6m in Q2 to €82.6m, resulting in EBIT (earnings before interest and taxes) margin rising from just 20% a year ago and 32% in Q2 to 39%. Net income has risen by almost five-fold from €11.6m a year ago (a margin of just 14% of sales) and by 34% from €42.3m in Q2 (22% margin) to €56.8m (27% margin). Cash and cash equivalents (including cash deposits) have increased from €301.2m to €444.6m over the first nine months of 2010.

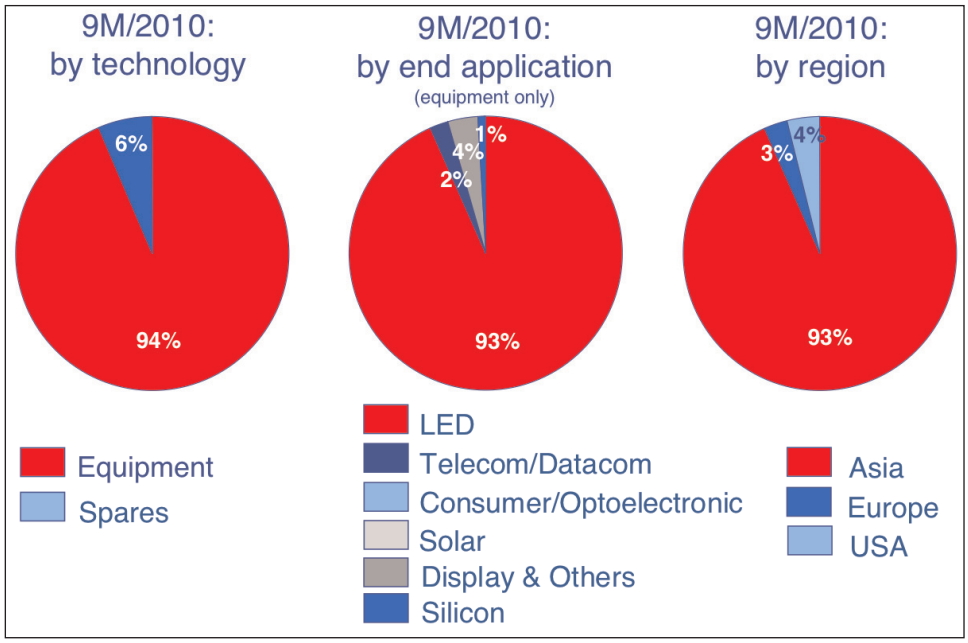
"We have once more delivered on what we said we would deliver, namely a very strong set of results with excellent operational leverage," says president & CEO Paul Hyland. "It is a significant moment, when



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



Aixtron's cost structure, profit margins, and return on equity for the first nine months of 2010 vs the last four full years.



Aixtron's revenue for the first nine months of 2010, showing the dominance of the LED sector and the Asia region (up from 82% of revenue in 2009).

we can report an EBIT figure for the first nine months of the year [€189.6m] that is higher than the revenue figure for the same period in the prior year [€184.9]," he adds.

Equipment orders have continued the strong demand trend predicted previously, from €168.5m in Q1 to €175.4m in Q2 and now €200.4m in Q3 (up 14% on Q2 and up 70% on 117.6m a year ago). "We continue to see healthy demand in the current quarter, mainly for LED backlighting and increasingly for LED lighting manufacturing systems, which, in my opinion, looking ahead at the next 2–3 years, underlines the very positive outlook for the industry," says Hyland. In Q3/2010 Aixtron announced a multi-system order from China-based Neo-Neon International Ltd (which specializes in LED-based light replacement products). New-generation MOCVD system orders for LED manufacturing were also received from China's Sanan Optoelectronics and Taiwan's Epistar and Tekcore. In total, more than 30% of LED production systems ordered in Q3 were for Aixtron's new-generation G5 and CRIUS II systems (launched in Q1/2010), which have the potential to more than double productivity over previous-generation systems.

Order backlog has hence risen from €152.4m a year ago and €250m in Q2 to €278.7m. Of this, Aixtron expects about €180m to be converted into revenue by the end of 2010, supplemented by a further €11m from spares and services.

Reflecting the positive business outlook for the rest of the year, Aixtron has reiterated its full-year revenue guidance of €750m (which, at the end of July, was raised from late April's guidance of €650–700m and mid-March's guidance of €600–650m). At today's exchange rate, this is more than $1bn. Aixtron has now also raised its guidance for EBIT margin again, to about 35% (from guidance in late July of 33%, in late April of 30%, and in mid-March of 25%).

"With the opening of our new R&D center this month [an investment of about €15m by the end of 2010], we plan to even further strengthen our ability to offer the most competitive and compelling technology and value propositions," concludes Hyland. Total staffing has risen from 649 a year ago to 766 but, of the 117 rise, 52 were in R&D.

Aixtron plans to complete the roll-out of its group-wide SAP Enterprise Software System by year end.

www.aixtron.com

IN BRIEF

Jiangxi Changda adds Aixtron MOCVD reactors to boost GaN HB-LED epi capacity

Deposition equipment maker Aixtron AG of Aachen-Herzogenrath, Germany has announced an order for two AIX 2800G4 HT 2-inch metal-organic chemical vapor deposition (MOCVD) systems from Jiangxi Changda, a new customer in the Jiangxi province of southern China. The new GaN high-brightness light-emitting diode (HB-LED) growth reactors have been installed and commissioned by the local Aixtron support team.

"We need them to comply with our planned capacity increase as we manufacture more LEDs to meet the strongly growing demand," says Jiangxi Changda executive VP Dr Lu Bo. "The Aixtron systems match our specification for process flexibility, thickness uniformity, doping, and composition. We had a swift and efficient installation thanks to the Aixtron close local support and service," he adds.

"This is an important sale for Aixtron for several reasons: Jiangxi Changda is a subsidiary of Lattice Power Corp in Nanchang, Jiangxi Province, which is one of our long-time customers and one of the first in China," says Dr Christian Geng, VP Greater China & general manager Aixtron Taiwan.

"This company relies on several Aixtron MOCVD systems to develop and manufacture HB-LEDs for full-color displays," he adds. "Lattice Power is also scaling up its R&D for the production of HB GaN LEDs on silicon substrate for even more cost-efficient devices," Geng notes.

www.aixtron.com

Korea's Semi Materials enters LED lighting market with five Aixtron MOCVD systems

Aixtron AG of Aachen-Herzogenrath, Germany says that, in second-quarter 2010, Semi Materials Co Ltd of Seoul, South Korea ordered five AIX 2800G4 HT MOCVD systems in a 11x4"-wafer configuration. Delivered in fourth-quarter 2010 and commissioned by Aixtron's local support team in a dedicated facility at Semi Materials' production plant in Gyeongsan, the systems will be used to produce GaN-based ultra-high-brightness (UHB) LEDs for lighting applications.

Founded in 2000, Semi Materials is engaged in developing photovoltaic materials and products.

However, the firm's latest order marks its first steps into the LED lighting market, in which it says it intends to become a world leader in the manufacture of LED-based lighting materials and components.

"Our company has embarked on an exciting new venture to enter the business of developing and manufacturing high-brightness LEDs for general lighting applications," says Semi Materials' CEO Kun Park. "The reactors will form a centrepiece of the new operation, which we recently contracted in a $450m memorandum of understanding with Kyungbuk province."

www.semimaterials.com

Changelight orders Aixtron MOCVD reactors for AlGaInP ROY LED expansion

Aixtron has announced a new order for MOCVD reactors from Changelight Co Ltd of Xiamen, China, comprising several AIX 2600G3 IC systems in a 49x2"-wafer configuration as well as a double-digit number of AIX 2800G4-R systems in 60x2"-wafer configuration. After delivery between fourth-quarter 2010 and second-quarter of 2011, the Aixtron China support team will install and commission the new reactors in Changelight's epitaxy facility at its mainland China production plant, after which they will be used for red-orange-yellow (ROY) high-brightness LED production.

"Since 2006, we have been exclusively working with Aixtron," says Changelight's general manager professor Xiang Wu Wang. "Consequently, it was a straightforward decision choosing their systems when assessing the best solution to carry out our planned increase in production capacity," he adds. "This time it will be the combination of the AIX 2800G4-R and AIX 2600G3 IC systems. These will give us good economics through very low source material cost overhead. The G4 systems will provide the desired high throughput for our ROY LED requirements."

Changelight's quaternary alloy AlGaInP LED epitaxial wafers and chips are said to be comparable to the best from the leading domestic manufacturers in terms of scale, output and sales, with wide applications in digital, dot matrix, full-color screen displays as well as traffic lights.

"Changelight plans to reach the number-one position amongst mainland China GaAs LED companies, and longer-term we want to achieve success in overseas markets," states Wang. "The new reactors, coupled with the high-quality Aixtron support service, will ensure that we reach our targets according to plan," he reckons.

www.changelight.com.cn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HBTs
pHEMTs
BiFET/BiHEMTs
Multi-junction CPV Cells

Arradiance ships first benchtop GEMStar ALD system to Oregon State University

Arradiance Inc of Sudbury, MA, USA has shipped its first GEMStar atomic layer deposition (ALD) system to the School of Electrical Engineering and Computer Science at Oregon State University (OSU).

Founded in 2003 with expertise in charged particle detection and amplification, Arradiance uses its proprietary ALD materials and equipment to produce high-gain, low-noise micro-channel amplifiers, offering electron amplification devices that can replace the legacy traditional lead-glass/hydrogen firing process (developed in the 1960s) that is used for all micro-channel plate (MCP) applications.

"From our work with sensitive, high-aspect-ratio microchannel structures, we became acutely aware of the need for a system which could repeatably and uniformly deposit complex nanolaminate films efficiently," explains chief operating officer David Beaulieu. "We also realized that, in order to meet the needs of the research community, the tool needed to be small but powerful and to be flexible enough to handle the wide range of applications, substrates and materials commonly found in lab environments," he adds.

With its capability to process wafers of up to 6" diameter using up to eight precursors, Arradiance says that GEMStar has the flexibility to deposit atomically thin layers of material on virtually any substrate and was designed with the most challenging high-aspect-ratio and through-pore deposition applications in mind.

"The GEMStar has everything our lab environment should need in an ALD tool," believes OSU professor Dr John F. Conley. "It is small, flexible and can handle up to 6" wafers. We also like the 1" height of the chamber that accommodates small, three-dimensional objects and the port we can use for in-situ metrology. The design appears to be rugged and easy to service," he adds.

"Our unique experience in materials science, charged-particle physics and systems design have been combined to make a truly robust research system," says Arradiance's CEO Ken Stenton. "Because of the importance of materials research in emerging growth industries such as biomedical, solar, space science, environmental and semiconductor, we saw the need for a research tool with production performance and reliability," he adds.

www.arradiance.com

Tegal returns to profit and revenue growth after shedding thin-film etch & PVD

For fiscal second-quarter 2011 (to end-September 2010), plasma etch and deposition system maker Tegal Corp of Petaluma, CA, USA has reported revenue of $3.2m, up from $3.1m a year ago and just $0.3m last quarter.

This follows March's sale of its legacy thin-film etch and physical vapor deposition (PVD) product lines to OEM Group Inc of Gilbert, AZ, USA for up to $3m. Tegal continues to sell and support its full range of deep reactive ion etch (DRIE) systems acquired from Alcatel Micro Machining Systems (AMMS) in September 2008, which are used for etching silicon and dielectric films in the micro-electro-mechanical systems (MEMS), bio-tech, power IC, optoelectronic, and 3D-IC (interconnect) sectors.

"We expected our results this quarter to improve as we shipped two new systems to two new customers and a process module to an existing customer," says president & CEO Thomas Mika.

Operating expenses have been cut from $2.7m a year ago to $1.6m, largely due to R&D expenses being more than halved from $1.17m to $0.54m and sales & marketing expenses being slashed from $0.67m to $0.15m. This has contributed to the firm recording a net income of $0.1m ($0.02 per share), compared with a net loss of $1.7m ($0.20 per share) a year ago and $2.5m ($0.29 per share) last quarter.

We are in the process of restructuring the company to its present mission, which is focused on deep silicon etch for MEMS and TSV applications

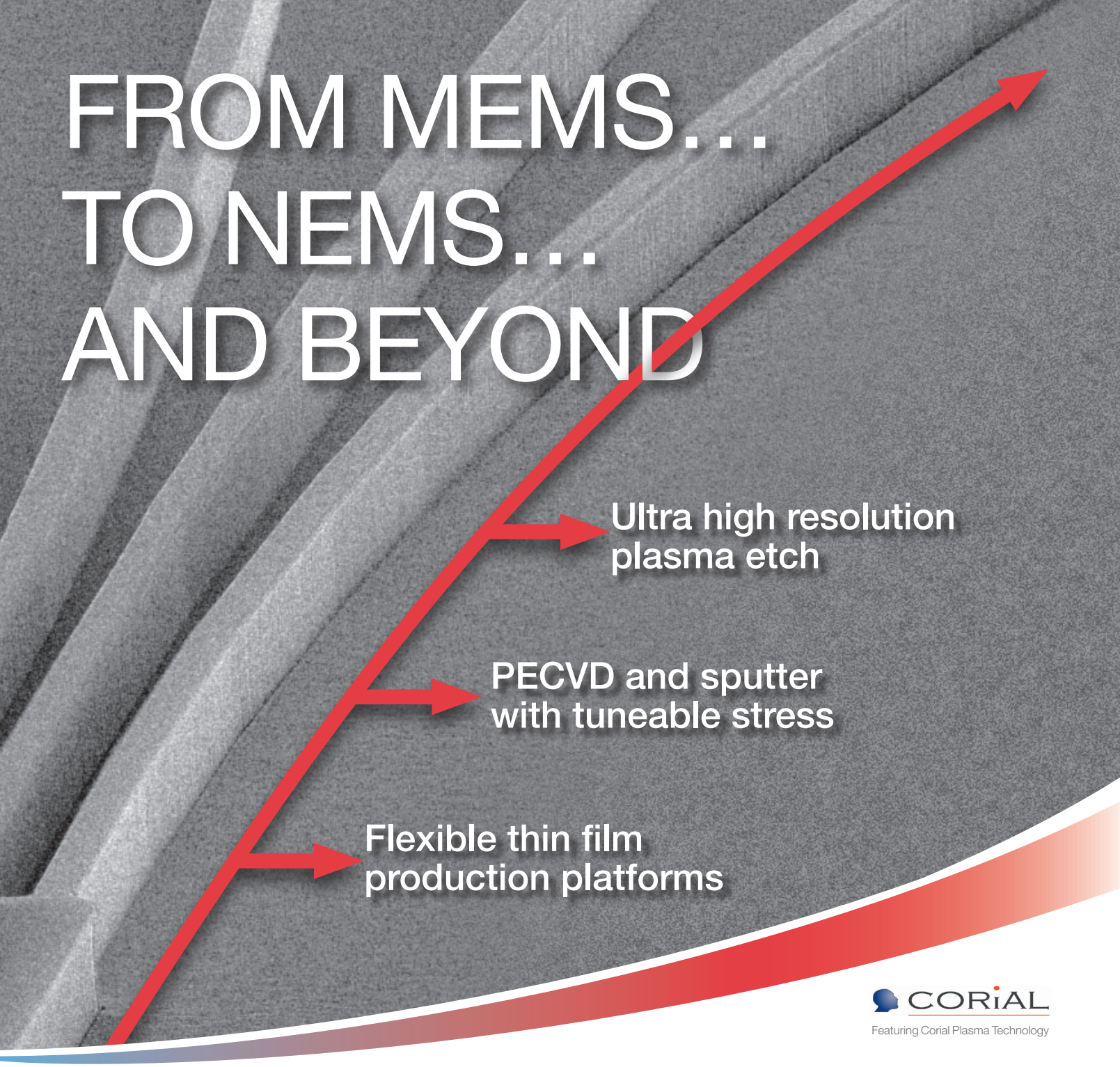
Nevertheless, during the quarter, cash balance fell further, from $6.2m to $4.4m. At the end of Q2, systems backlog was about $1m.

In July, Mika said that results of the restructuring will not be fully realized until the December quarter, following closure of its manufacturing facility in Petaluma.

"We are in the process of restructuring the company to its present mission, which is focused on deep silicon etch for MEMS and TSV (through-silicon via) applications," says Mika. "We are actively seeking business partners that can take full advantage of our leading technical position in these markets, and we are evaluating several strategic alternatives for the company, including possible business combinations in these markets and in related, higher-growth markets," he adds.

www.Tegal.com

FROM MEMS... TO NEMS... AND BEYOND



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SPTS opens San Jose facility as it celebrates anniversary

Annual revenue on course to triple

SPP Process Technology Systems Ltd (SPTS) of Newport, Wales UK, the plasma etch & deposition equipment subsidiary of Japan's Sumitomo Precision Products Co Ltd (SPP), has celebrated one year since it began operations in November 2009, while opening its new office in San Jose, CA, USA.

Consisting of a manufacturing space of about 28,000ft^2 plus 17,000ft^2 in warehouse space, the new facility will be home to its Thermal Products Division (relocated from Scotts Valley, CA) as well as its sales and support headquarters for North America, with more than 80 staff serving the firm's global customer base.

In October 2009, SPP acquired the assets of Aviza Technology Inc (including the Newport-based Single-Wafer process equipment subsidiary Aviza Technology Ltd and Aviza's Scotts Valley-based Thermal Products business). SPP subsequently integrated these with its plasma etch & deposition equipment subsidiary Surface Technology Systems (STS) into the newly formed SPTS. "November marks a year since the formation of SPTS," says its president & CEO William Johnson.

The company has since grown 50% faster than the estimated 130% growth of the global wafer fabrication equipment segment during the past year. The firm's Single Wafer and Thermal Products divisions derive about 80% of current business from four major market segments: advanced packaging including through-silicon via (TSV) and wafer-level packaging, compound semiconductor including high-speed electronics and LEDs, power semiconductors, and micro-electro-mechanical systems (MEMS).

"We've had great support from our customers in the past 12 months, and moving the North America headquarters and the Thermal Products Division back to the heart of Silicon Valley demonstrates our commitment to serving their needs," says Johnson.

SPTS president Bill Johnson at the San Jose opening ceremony.

"With less than two months left in 2010, we are on course to triple our revenue compared to the combined pre-acquisition entities in 2009," says Johnson. "To attain this growth in 12 months while simultaneously completing the company and product integration is a tremendous achievement," he adds, highlighting a company record of more than 40 new customer or technology wins in 2010.

"SPTS grew one-and-a-half times faster than the next vendor in our peer group," says Susumu Kaminaga, chairman of SPTS and president of SPP, who also hails new penetration in the firm's chosen market segments. "Our goal is to continue that growth with the Thermal Products Division and the Single Wafer Division based in the UK as we leverage our market synergies," adds Johnson.

Building on current growth momentum, SPTS looks to future technology investments by committing to joint ventures and technology partnerships. In August, it announced a AUS$5.2m investment in BluGlass Ltd of Silverwater, Australia, with which it is forming a joint venture. Spun off from the III-nitride department of Macquarie University in 2005, BluGlass has developed a low-temperature process using remote-plasma chemical vapor deposition (RPCVD) to grow materials including gallium nitride (GaN) and indium gallium nitride (InGaN), potentially offering cost, throughput and efficiency advantages for the production of LEDs. In addition, in October SPTS announced an agreement to develop 300mm (TSV) 3D-IC processes at CEA-Leti's 300mm facility in Grenoble, France. SPTS, which claims to be an early proponent and market leader in TSV equipment development, will team its process expertise in etch and deposition technologies with Leti's device know-how to optimize an integrated process flow.

SPTS concludes that, with a surge in all its served market segments, it expects order intake to remain strong through the remainder of 2010 and into 2011.

www.spp-pts.com

Ostendo orders Oxford Instruments deposition and etch systems

UK-based equipment maker Oxford Instruments has received a multi-system order for its PlasmaPro System100 PECVD deposition and PlasmaPro System100 ICP etch tools from Ostendo Technologies Inc of Carlsbad, CA, USA. The multi-wafer batch tools will be used by Ostendo in developing next-generation solid-state lighting based display technologies and products for commercial and consumer markets.

"Our objective is to achieve efficiencies and cost effectiveness at the material, device and system levels. We chose Oxford Instruments' leading-edge tools as they offer high throughput and excellent uniformity in addition to multi-batch capability," says Ostendo's CEO Dr Hussein El-Ghoroury. "Ostendo's enabling technologies support products that are disruptive in their individual marketplaces, and this will be achieved more effectively with the addition of our Oxford Instruments tools," he adds.

"This latest order from Ostendo reinforces our relationship with this important and innovative SSL display technology provider," comments Stuart Mitchell, VP Oxford Instruments America Inc.

Earlier this year, subsidiary Oxford Instruments—TDI announced the availability of a semi-polar ($11\bar{2}2$) gallium nitride (GaN) layer on sapphire substrate wafers using Ostendo's proprietary design and TDI's proprietary hydride vapor phase epitaxy (HVPE) technology. The firms says that their joint development provides the opportunity to high-brightness light-emitting diode (HB-LED) and laser diode developers to increase optical efficiency significantly compared with structures grown on c-plane GaN substrates.

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

IN BRIEF

ClassOne joins Fab Owners Association

ClassOne Equipment of Atlanta, GA, USA has become an associate member of the Fab Owners Association (FOA) of Cupertino, CA.

FOA is an international, non-profit, mutual benefit corporation composed of semiconductor and MEMS manufacturers, and suppliers. Founded in 2004, it provides a forum for executives to discuss and act on common manufacturing issues.

ClassOne supplies refurbished wafer fabrication and metrology equipment to the semiconductor, nanotechnology and MEMS industries. Focus areas include: Suss and EVG mask aligners, Semitool wet process equipment, Hitachi SEMs, and KLA-Tencor wafer metrology tools.

www.waferfabs.org
www.classoneequipment.com

USHIO launches first 6" full-field projection exposure system for LED chip making

USHIO America, Inc of Cypress, CA, USA (a subsidiary of USHIO Inc of Tokyo, Japan that provides specialty and general illumination lighting solutions) has started marketing in the USA what it claims is the world's first 6" full-field projection exposure system for manufacturing LED chips.

Designed specifically for LED manufacturing, the system is intended to greatly reduce the initial cost compared with using a semiconductor stepper system for manufacturing LEDs.

In LED manufacturing, exposure equipment has been used to form electrodes, electrical circuitry, and passivation layers on the sapphire substrate, in the same manner as for semiconductor device making. In general, stepper systems (step & repeat projection exposure systems) or contact exposure systems used for manufacturing semiconductors have also been used for 2-inch or 4-inch sapphire wafers.

As the applications of LEDs have increased, demand has risen dramatically while the price has fallen significantly, says USHIO. To meet growing demand, LED chip makers have increased wafer sizes from 2-inch or 4-inch wafers to 6-inch wafers in order to enhance productivity and reduce manufacturing cost (through increasing the number of chips produced from each wafer).

However, the increase in wafer size has caused problems such as warpage or distortion of wafers that cannot be eliminated by conventional stepper or contact exposure systems, lowering the yield due to deposition errors. In addition, conventional exposure systems require changes in system settings and the replacement of parts for wafer size conversion. This can cause additional cost and downtime, so it has been a challenge in technology and cost to enhance productivity by increasing wafer size, comments USHIO.

USHIO hence developed the new UX4-LEDs system, which is based on the same platform as USHIO's field-proven UX series full-field projection exposure systems (for semiconductors, flat-panel displays, PCBs and MEMS), of which it has installed over 1000 units worldwide. However, compared with the conventional UX series, the UX4-LEDs' footprint is reduced by at least 50% (to 3m^2 or less).

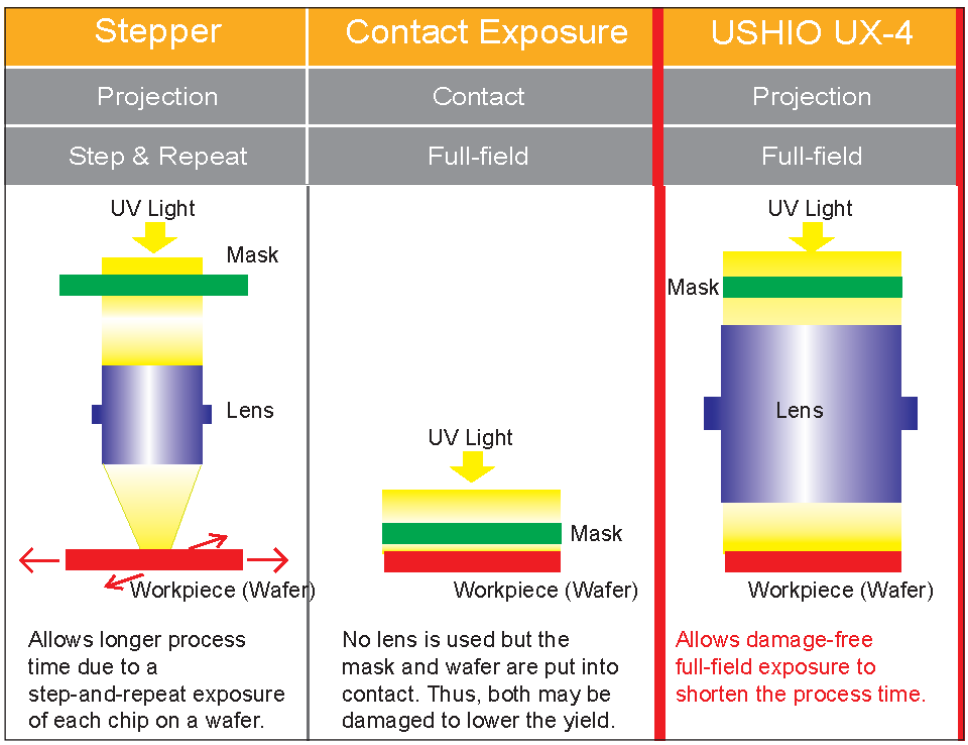
The UX4-LEDs allows full-field exposure of 6" wafers. USHIO developed the projection lens and the alignment and wafer transfer mechanism so that it was optimized for manufacturing LEDs. This allows an enhancement in the detection accuracy of alignment marks with low visibility (such as those for transparent electrodes) to achieve high overlay accuracy. The system also has an original wafer chucking method for eliminating warpage or distortion of wafers, and a projection lens with a deep depth of focus to minimize variation in line width. The system requires no contact between mask and wafer, avoiding damage to both and preventing defects in circuit patterns. It also requires neither the mask replacement nor the cleaning that can cause system downtime. Throughput is boosted by 300% compared with conventional stepper systems.

Also, use of a modular structure for major system components allows easy specification changes or upgrade and easy maintenance. In particular, a flexible system design allows automatic wafer size conversion, enabling an increase in wafer size without changing system settings or replacing parts, and hence requiring no downtime.

"It will allow major LED manufacturers to dramatically increase their mass-production capacity while lowering their manufacturing cost," says USHIO America's president & CEO Kenji Hamashima about the UX4-LEDs. Running cost is 80% less than conventional stepper systems, lowering cost of ownership.

"We expect to ship the first unit within this year, since several major LED manufacturers have already been evaluating this system for mass-production," Hamashima adds.

www.ushio.com



RASIRC wins TechAmerica award

RASIRC of San Diego, CA, USA has been selected as a winner in the Semiconductors, Industrial and Analytical Instrumentation category of the 2010 TechAmerica High Tech Awards. RASIRC's ultra-high-purity steam generation and delivery technology was recognized for its innovation and market potential.

"We have developed the first commercially accepted steam purification technology, which is used to improve solar cell efficiency, semiconductor line width shrinks, and carbon nanotube structures," says president Jeffrey Spiegelman. "Our steamers, humidifiers and humidification systems incorporate patented processes for water vapor control, delivery and purification. With triple-digit CAGR over the last five years, we believe the market has spoken positively about our products."

"The strength of applications TechAmerica received this year made for a solid competition, and selecting winners was no small feat," says TechAmerica San Diego's executive director Kevin Carroll. "RASIRC is being honored in the Semiconductors, Industrial and Analytical Instrumentation category not only for its innovative contributions, but because we believe its steam purification technology exemplifies key development in the technology industry," he adds.

Spiegelman with RASIRC's TechAmerica High Tech Award.

RASIRC's technology delivers ultra-high-purity water vapor to manufacturing processes at a wide range of flow rates from micrograms to kilograms per minute. Steam is created from de-ionized water, which eliminates explosive and expensive hydrogen and oxygen, delivering high-purity water vapor at a lower cost than other technologies presently in use, says the firm.

www.rasirc.com

Ultratech opens Singapore HQ

Lithography and laser-processing system maker Ultratech Inc of San Jose, CA, USA has announced the opening of its new Singapore International Operations headquarters, located at #02-01, 1 Kaki Bukit View, Techview, Singapore 415941.

Aiming to better serve its large customer base in Asia, the Ultratech Singapore operations will include engineering and manufacturing for its lithography systems and other related products, which include lithography steppers for advanced packaging (bump packaging of ICs) and high-brightness LEDs (HB-LEDs), and modules for the laser spike anneal systems (LSA). Ultratech's international sales and service operations will also be headquartered in the Singapore facility. Laser processing systems will continue to be manufactured at the firm's facility in San Jose.

The grand opening event for the Singapore operations will be held on 6 December, with manufacturing of lithography systems planned to begin in late 2010 and the first tool shipments to customers scheduled for first-quarter 2011.

"Our corporate objective has been, and continues to be, to provide our customers with leading-edge technology at the lowest cost-of-ownership for high-volume manufacturing," says Ultratech's chairman & CEO Arthur W. Zafiropoulo. "With many of our customers located in the Pacific Rim... the new Singapore facility will help Ultratech achieve our commitment to meet our international customers' needs."

www.ultratech.com

IN BRIEF

Cascade hires Mahon as VP of operations

Cascade Microtech of Beaverton, OR, USA, which provides production test products including probe cards and test sockets for wafers, ICs, packages, circuit boards and modules as well as MEMS and LED devices, has appointed Steve Mahon as VP of operations.

Mahon joins Cascade after more than 16 years at RF component maker and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, where he was hired as the director of process engineering and for the last five years has been general manager of military bulk acoustic wave (BAW) and surface acoustic wave (SAW) products as well as BAW production. He began his career at Hewlett Packard as a process development engineer, and then moved to Electronic Decisions Inc of Illinois where he served as wafer fabrication manager. Mahon has a BSEE from the University of Illinois at Urbana-Champaign, and an MSEE from Stanford University.

"Steve is a critical strategic addition to our management team at this time in our corporate evolution," says president & CEO Michael Burger. "He brings a strong background in operations management, with over 30 years of experience in a broad array of positions in micro-fabrication operations, engineering management and semiconductor process engineering. He will be a great asset as we continue to pursue not only aggressive operating efficiencies, but as we develop a product roadmap that delivers continued value for our customers," he adds.

"My role will be to help Cascade Microtech find ways to work more effectively and efficiently throughout the organization, with the ultimate goal of enabling Cascade Microtech's growth," says Mahon.

www.cascademicrotech.com

Jordan Valley appoints KLA founder Levy as chairman

X-ray and vacuum ultraviolet (VUV) metrology tool maker Jordan Valley Semiconductors Ltd (JVS) of Migdal Haemek Israel has named Ken Levy as chairman of its board of directors, replacing Kalman Kaufman (who has been chairman for the last three years, and remains a member of the board). "I look forward to continuing to work with Ken, a seasoned business executive and visionary technologist," comments Kaufman.

Levy has been an entrepreneur and corporate executive for over 35 years. He founded KLA Instruments in 1976, serving as CEO and then chairman until 2006. On retiring, he was named chairman emeritus. During his tenure, KLA-Tencor went from a development-stage firm to sales of over $2bn and a market capitalization in excess $10bn. It is now one of the five largest companies in the semiconductor capital equipment industry.

Levy has also received awards including the 'SEMMY' Semiconductor Equipment and Materials Institute award in the area of wafer fabrication, and the SEMI Lifetime Achievement award. He has been inducted into the Silicon Valley Hall of Fame, and was elected as a member of the National Academy of Engineering.

"Jordan Valley, led by the leadership of founder & CEO Isaac Mazor, presented impressive and unique progress in 2010," says Avi Fischer, deputy chairman of IDB Group (the largest shareholder, through Clal Industries and Elron). "We thought that at this time the company could benefit from the skills and expertise of one of the most experienced, talented and highly regarded managers in the industry," he adds.

"Jordan Valley's products are enabling x-ray systems to move onto high-volume production applications," says Levy. "Their systems will enable the semiconductors industry to control its most advanced processes. I expect the company to continue to innovate and expand its business opportunities," he adds.

"His experience and knowledge in the semiconductors capital equipment business will be a valuable asset to Jordan valley," remarks Mazor about Levy. "The next few years will prove to be a period of increased market penetration and high growth for Jordan Valley following it's outstanding growth in 2010," he believes. "As a chairman of the board, Ken will play a key role in driving the company's strategy."

Over the past 25 years, Levy has been active in helping to build Israeli hi-tech firms. In addition to investing in technology firms, he spearheaded the establishment of KLA-Tencor Israel and served on boards of firms including Saifun, Aprion, Scitex Digital, PowerDsine, Genoa and DigiFlex. For his contributions to Israeli industry, he won the 'State of Israel Jubilee Award' by Prime Minister Netanyahu.

www.jvsemi.com

SÜSS MicroTec and Fraunhofer IST launch aligner technology for selective surface treatment

Equipment and process solutions provider SÜSS MicroTec AG of Garching, Munich, Germany, and Braunschweig-based Fraunhofer for Surface Engineering and Thin Films (IST) have announced the launch of SELECT, a bond aligner and mask aligner technology that selectively activates parts of a wafer surface through plasma treatment.

Local treatment of the surface prior to wafer processing can replace standard process steps and reduce the overall cost per wafer. Selective plasma activation can be applied to a variety of MEMS (micro-electro-mechanical system), optical and solar applications using direct wafer bonding or surface modification for the creation of micro mirror arrays, micro valves, sensors or micro fluidic channels. The SELECT toolkit is an upgrade option for SÜSS MicroTec's MA/BA8 Gen3 manual mask and bond aligner.

Fraunhofer IST's patent-pending technology is based on atmospheric pressure plasma selectively modifying the molecular level surface. Conventional surface treatment of complete wafers without selection can damage the functionality of micro components or electronics. With selective treatment it is possible to protect those sensitive areas by activating only specific parts of the wafer. Selective plasma activation is used with planar wafers as well as with wafers with topography, where plasma activation is provided in the cavities or on the elevated structures.

"While selective plasma treatment in wafer bonding applications significantly reduces the post-bond anneal temperature from 1000°C down to 200°C, it also protects sensitive devices," says Fraunhofer IST's director professor Günter Bräuer. The technology therefore increases the process window for direct bonding. "With SÜSS MicroTec's SELECT toolkit applied in both direct bonding as well as other wafer processing applications, a ground-breaking new approach seems possible for device processing in the semiconductor industry," he reckons.

"The treatment of selected parts of wafers reduces the costs of producing a device through streamlining processes and increasing throughput at the same time," explains SÜSS MicroTec's president & CEO Frank Averdung. "The new technology has the potential to completely change the cost-of-ownership model for a large variety of applications."

www.suss.com

AZZURRO closes €14.5m funding round

High-volume GaN-on-Si epiwafer foundry to be built in Dresden

AZZURRO Semiconductors AG of Magdeburg, Germany has closed a €14.5m ($19.3m) round of financing from existing investors Cedrus Private Equity and IBG Innovationsfonds as well as new investors Wellington Partners, Good Energies and Emerald Technology Ventures (whose Christian Reitberger, Frank Siebke and Markus Moor, respectively, join the firm's supervisory board).

AZZURRO uses MOCVD to make gallium nitride epiwafers on large-diameter (150mm) silicon wafers for low-cost high-brightness LEDs and high-power electronics. The new funding will finance its first production site, to be built up in Dresden within the next two years.

High-power electronics such as power supplies, solar inverters or power converters for hybrid and electric vehicles typically use conventional silicon or expensive silicon carbide devices. In contrast, GaN-on-Si has unique advantages of high efficiency and low cost at high voltages and currents.

Previously, GaN-on-Si has not been available on large-sized wafers and has not been widely adopted. However, AZZURRO says it has closed this gap by providing thick high-quality GaN epilayers on standard silicon wafers with a diameter of 150mm (and soon 200mm).

The LED industry has adopted GaN but relies on small sapphire-based substrates that have supply and cost constraints, says AZZURRO. The firm says it offers a platform technology for LED makers to process wafers in standard silicon fabs with high productivity. Compared with conventional technology, substantial cost savings can be achieved while maintaining the same performance, it is claimed.

"The AZZURRO team has worked hard for the last seven years to bring the core technology platform to commercialization readiness," says CEO Erwin Wolf. The basic technology was invented by professor Alois Krost and Dr Armin Dadgar at the Otto-von-Guericke University Magdeburg from 1999 to 2006 and exclusively transferred to the firm. "We have received highly encouraging feedback from our customers and are now building up more capacity to fully support our customers' ramp-up plans," says Wolf.

"The time has come to build a high-volume GaN epiwafer foundry to enable industry-wide adoption," says Wellington general partner Reitberger. "AZZURRO will bring the industry the long-anticipated arrival of GaN-on-Si and the benefits of economies of scale," he adds.

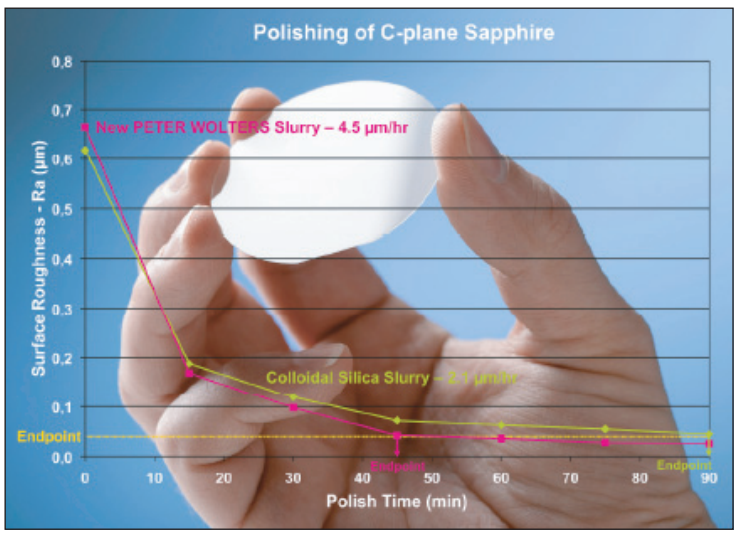
www.azzurro-semiconductors.com

Peter Wolters' new slurry halves polishing time for c-plane sapphire substrates

Peter Wolters GmbH of Rendsburg, Germany is introducing a new polishing slurry for the LED market that has demonstrated a 50% reduction in the time required to complete final polishing of c-plane sapphire for flip-chip or through-substrate LEDs (see figure).

The development uses a combination of chemical and abrasive technologies to cut the cost of ownership or the manufacturing cost for LEDs when manufactured on c-plane sapphire. "As demonstrated by our testing, the time required to achieve a comparable final surface finish has been reduced by half in substrates of identical incoming quality," says David Suica, president of subsidiary Peter Wolters of America, the Peter Wolters Competence Center for Sapphire Polishing.

The quality and clarity of the final polished surface is comparable with the use of colloidal silica (which is commonly utilized in the final polishing step), adds the firm.



New slurry reaches surface roughness endpoint in half the time compared to standard colloidal silica slurry.

Peter Wolters says that the slurry product is completely mixed and tested by its in-house team of scientists and engineers to maintain high levels of consistency and quality.

The pre-mixed slurry is shipped in a concentrated form, which can be thinned easily to the appropriate point-of-use consistency by adding deionized (DI) water. Handling and storage of the custom slurry does not require any exceptional processes or procedures beyond what is typical to common colloidal silica.

www.peter-wolters.com

SEI unveils first 6" GaN substrates for white LEDs

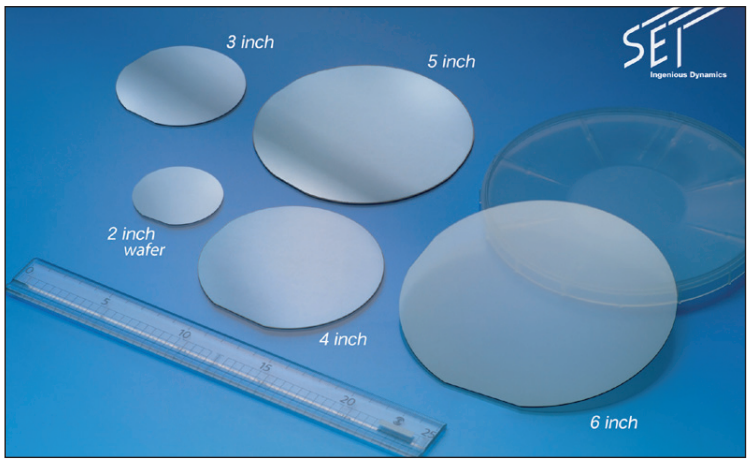
Volume production of c-plane GaN planned

Japan's Sumitomo Electric Industries Ltd (SEI) has developed what it claims are the first 6-inch diameter gallium nitride (GaN) substrates to be used for white light-emitting diodes.

Previously, Sumitomo Electric was first to produce 2"-diameter GaN substrates for blue-violet lasers, which enabled production of the first Blu-ray DVD players.

The white LED market has been growing rapidly using 2–4" sapphire substrates. As an alternative to sapphire, Sumitomo Electric began large-scale production of 2" GaN substrates designed for use in white LEDs. It has also been developing larger-diameter GaN substrates.

SEI says that GaN substrates allow better thermal dispersion and other properties that can enable LED makers to reduce chip sizes and increase output power. It also



SEI's 2–6"-diameter GaN substrates.

believes that GaN substrates will be used for power devices because of their excellent thermal conductivity and electric responsiveness as well as the breakdown voltage of devices made using these materials.

The front face of the new 6" GaN substrates is a polarized c-plane, which is the plane that is generally used for white LEDs and blue-violet or blue lasers (although the polarization decreases light-emitting efficiency in the green region, compared with non-polar or semi-polar GaN orientations).

SEI says that it has ongoing development efforts to bring its 6" GaN substrate into large-scale production, and it expects that the material will find wide-spread use for both white LEDs and power devices.

http://global-sei.com

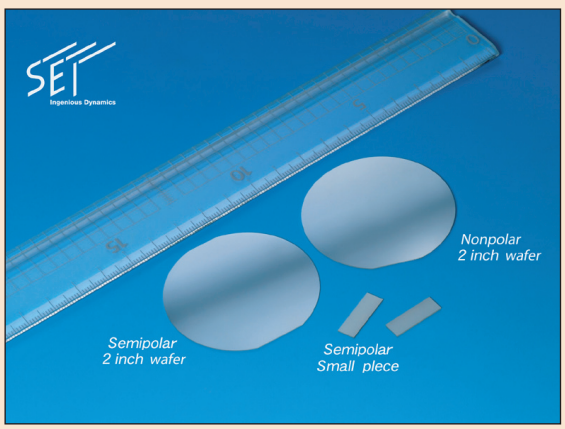
SEI announces first 2" semipolar/nonpolar GaN

Volume production with dislocation density comparable to c-plane

Sumitomo Electric Industries says that it has developed production technology enabling large-scale production of 2" diameter semi-polar/nonpolar GaN substrates for green semiconductor lasers.

For white LEDs and blue-violet or blue semiconductor laser diodes, the c-plane crystal face of a GaN substrate is generally used. However, with positively charged gallium (Ga) and negatively charged (N) atoms oriented alternately, the c-plane exhibits strong polarization, which decreases light-emitting efficiency in the green region.

Following its development of green semiconductor lasers in 2009, Sumitomo Electric has been developing manufacturing technology for semipolar and nonpolar GaN substrates (rather than polar c-plane GaN), which can improve the performance of green lasers



SEI's 2" semipolar and nonpolar GaN.

and white LEDs. These efforts have resulted in the development of manufacturing technologies that inhibit piezoelectric effects on polarized substrates, improving device luminous efficiency.

In general, semipolar and non-polar GaN substrates are manufactured by vertically or diagonally slicing GaN crystals along the crystallographic c-plane. However, this method results in relatively small crystals (rectangular crystals with dimensions on the order of several millimeters). The size of these materials has been a major obstacle to increasing the production scale of higher-efficiency LED devices, says the firm.

To overcome this limitation, Sumitomo Electric has hence developed HVPE (hydride vapor phase epitaxy) manufacturing technology for large-scale production of 2" substrates. The firm says that the substrates produced using this technique exhibit a dislocation density on the order of 10^5, which is comparable to that of the c-plane substrates currently in use.

Rubicon's sales grow more-than-expected 30% in Q3

For third-quarter 2010, Rubicon Technology Inc of Bensenville, IL, USA, which makes monocrystalline sapphire substrates and products for the LED, RFIC, semiconductor and optical industries, has reported record revenue of $20.5m, up 30% on Q2's $15.8m and up 260% on $5.7m a year ago (and above the expected $19.5m). Growth was due largely to increased pricing for sapphire substrates.

"Demand from the LED market remained strong in the quarter as our customers continued to add capacity in response to the projected rapid growth in the LED industry," says president & CEO Raja Parvez. Strong interest in polished 6" wafers also continued. "With the increased polishing capacity we are bringing on-line, we expect the 6" polished wafer product to become an increasingly large percentage of our total revenues," says Parvez.

Gross margin has risen from 46% in Q2 to 54%. Operating margin reached 40%. Compared to a net loss of $2m a year ago, net income more than doubled from Q2's $3.8m to $8.3m. Diluted earnings per share nearly doubled from Q2's record of $0.18 to $0.35 (exceeding the expected $0.28).

After generating $4.4m in cash from operating activities, cash and cash equivalents fell from $21m to $12m, due to spending $15.2m on property and equipment.

"While we have seen some softening in demand in certain geographies associated with higher TV panel inventories, overall demand remains strong and we expect prices for our sapphire products to increase in the fourth quarter by at least 15% on average sequentially," says chief financial officer William Weissman. "We also anticipate beginning to add capacity in both crystal growth and polishing in the quarter."

Rubicon recently opened both its new crystal growth facility in Batavia, IL and its new polishing facility in Penang, Malaysia. The new crystal growth facility will produce larger crystals, allowing more flexibility in addressing the growing demand for larger-diameter sapphire substrates. The new polishing plant will be responsible for the more labor-intensive crystal fabrication processes and will allow the firm to significantly expand capacity for large-diameter wafer polishing.

"These two new facilities give us a significant advantage," believes Parvez. "This combination of high-volume, high-quality, large-diameter crystal growth and polishing capability makes us unique in the marketplace today, and positions us very well to maintain our leadership position for years to come."

For Q4/2010, Rubicon expects revenue to grow 27% sequentially to $25–27m. Gross margin should rise to the high 50% range, and operating margin to the mid 40% range. Diluted earnings per share should rise further to $0.47–0.49.

First boule produced from Batavia 6-inch sapphire plant

Rubicon has produced the first boule from its new 135,000ft^2 sapphire crystal manufacturing plant in Batavia, IL (in the Chicago Metropolitan area near Rubicon's Franklin Park and Bensonville facilities). The large-diameter 6" sapphire will be exported to Rubicon's new plant in Malaysia for cutting and polishing into finished wafers.

The new facility was established to meet increasing demand from Asian manufacturers of LEDs used in LED-based consumer electronics (including HDTVs, smartphones and laptops) and general lighting products (such as LED light bulbs). "Demand for high-quality sapphire substrates is high as industries ranging from consumer electronics to general and architectural lighting have tapped LEDs as a light source for their next-generation products," says president & CEO Raja Parvez. Rubicon's capacity to deliver high-yield, large-diameter sapphire wafers will help to satisfy the large volumes of sapphire needed to meet growing demand for LEDs, he adds. "This is especially important as the demand for LED-based light bulbs grows with worldwide consumer adoption."

President & CEO Raja Parvez (left) and CFO William Weissman (right) with the Batavia plant's first boule.

Market research firm iSuppli expects the LED market to nearly double to almost $14.3bn by 2013, driven by the penetration of LEDs into the general illumination market. In particular, government regulators worldwide looking to save energy are driving the move to LED light bulbs. LEDs are emerging as a replacement for incandescent bulbs due to their durability, energy efficiency, enhanced aesthetics, and low-voltage operation versus less clean options such as compact fluorescent bulbs that contain mercury, Rubicon adds.

Rubicon claims that its ability to cost-effectively produce low-defect, large-diameter sapphire wafers is critical to making the production of high-quality, affordable LED-based products. The transition to large-diameter wafers has already begun: earlier this year, the firm said that it had entered into a $71m agreement to supply 6" polished substrates to a major LED chip maker.

www.rubicon-es2.com

SETI's UVTOP DUV LEDs pass environmental robustness tests to complete space qualification

Deep ultraviolet (UV) LED maker Sensor Electronic Technology Inc (SETI) of Columbia, SC, USA, together with Stanford University and National Security Technologies (NSTec) of Livermore, CA, has demonstrated what is claimed to be unprecedented environmental robustness and radiation hardness of its UVTOP deep ultraviolet LEDs.

Deep UV LEDs with peak emission wavelength of 255nm have passed stringent space qualifications for large temperature variations and mechanical shocks, with 27 cycles of 100K temperature cycles and 14g rms random mechanical vibrations. The forward voltage, emission spectra, and optical output power exhibited no significant changes after these harsh environmental tests.

The UVTOP LEDs have been successfully tested against the requirements for deep space exploration such as the Europa Jupiter System Mission (EJSM), where they will be subject not only to severe thermal and mechanical shocks but also high levels of radiation. Under irradiation up to $2x10^{12}$ protons/cm^2, the LEDs demonstrated extreme radiation hardness. UV LEDs have so far have exhibited high operational lifetimes in excess of 26,000 hours in nitrogen atmosphere and 25,000 hours in vacuum, without significant power drop or spectral shift.

SETI says that the extreme testing demonstrates that the optical, electrical and mechanical robustness of the UVTOP LEDs is suitable for many space and terrestrial applications where conventional UV light sources are too fragile.

In addition, solar-blind P-i-N photodiodes with a peak responsivity matching the UVTOP LEDs at 255nm were also manufactured by SETI and tested to the same stringent space qualifications. These detectors also exhibited extreme radiation hardness and retained 50% responsivity up to a fluence of $3x10^{12}$ protons/cm^2, says the firm.

www.s-et.com

Osram's TOPLED LEDs used in horticultural lighting

Osram Opto Semiconductors GmbH of Regensburg, Germany says that millions of its TOPLED LEDs are being used by Tampere-based agricultural lighting specialist Netled Oy in a horticultural lighting system in Honkajoki, Finland.

Designed and installed in a curtain structure of 10 strips each measuring 25m in length, the LED lighting replaces high-pressure sodium (HPS) lamps that are traditionally deployed in greenhouses. By creating the right wavelengths and intensity, the lighting installations are expected to achieve energy savings of up to 60%, says Osram Opto.

HPS lamps are widely used in horticulture to create the right environment for plants to grow in the dark season. A typical 1 hectare greenhouse using HPS lamps consumes about 10,000MW-hrs of electricity per year. "Based on some research, we found that only 7% of the light created by HPS lamps is absorbed by the plants. Much of the energy is wasted by inefficiencies," says Netled's Niko Kivioja. "By converting into LED lighting, energy saving can be achieved immediately," he adds. "In the case of lettuce grown in a greenhouse, energy consumption can even be reduced by 20–30%."

The patent-pending curtain structure also reduces light pollution in the skyline, which is an issue in high-density population areas in northern territories and Asia.

In addition, according to recent studies, certain wavelengths and color temperatures can make the fruit quantity, weight or biomass grow more quickly. By using more pre-defined light, for example in growing tomatoes, the joules spent per kilogram of vegetables can be reduced. With cucumbers, the yield can be increased by more than 20%, the vegetable quality is improved, and the production season can be lengthened.

The cost of electricity in Finland is rising by more than 15% annually, which will have an enormous effect on the food industry in the years to come, reckons Kivioja. Netled hence aims to provide affordable solutions to decrease lighting costs for horticultural production, he adds.

Cultivation in greenhouses is becoming more significant, says Osram Opto. Through greenhouse-based farming, profitable and high-demand plants have become more cultivated. However, the total area of greenhouses in Scandinavia is 1400ha, which is less than the 2000ha in Canada and 2100ha in Japan. Furthermore, there is huge market potential for LED lighting in the Nordic countries, central Europe, and in Canada due to the significant period of darkness, the firm adds.

"The LED installation in Honkajoki has important implications for greenhouse farming in Scandinavia," says Kai-Chung Cheng, marketing director of Osram Opto Semiconductors Asia Ltd. "It also proves that the features of LEDs such as small form factor, high efficiency and long life-span provide flexibility for lighting designers to make their ideas into reality," he adds.

The project has been initiated by Netled in terms of research and promotion and Amity in terms of design and development, while the lighting system was manufactured by BCM in Malaysia.

www.netled.fi
www.osram-os.com

USDA awards $4.88m grant to study LED lighting of crops

A USDA grant will help Cary Mitchell study LED lighting use in greenhouses. (Purdue Agricultural Communication photo/Tom Campbell).

At the end of October, US Department of Agriculture (USDA) officials, including Deputy Secretary Kathleen Merrigan, toured Purdue University greenhouses equipped with prototype LED lights in order to preview work that will come from its new $4.88m grant for the four-year project 'Developing LED Lighting Technology and Practices for Sustainable Specialty-Crop Production', which aims to increase greenhouse yields and decrease producers' energy costs.

The USDA Specialty Crops Research Initiative Award will include $2.44m from the USDA and an equal amount of in-kind contributions of equipment and services from industry partners. Researchers at Purdue will collaborate with Rutgers University, the University of Arizona, Michigan State University and Orbital Technologies Corp of Madison, WI, USA.

"The high-intensity discharge lamps used today are inefficient. When you have acres and acres of greenhouses with these lamps in them, it really adds up," said project director Cary Mitchell, a professor of horticulture at Purdue. "With LED lighting, we should be able to do as well or better with much less energy," he adds.

"The specialty crop industry plays an enormously important part in American agriculture and is valued at approximately $50bn every year," Merrigan said. "These projects will be key to providing specialty crop producers with the information and tools they need to successfully grow, process, and market safe and high-quality products."

Mitchell's work will include testing LED lighting on high-wire tomatoes, which can grow taller than 20 feet so that traditional overhead lighting doesn't reach the lower parts of many plants. Mitchell believes that using LED lights on the sides of plants will increase photosynthesis and flowering, improving yield.

Assistant professor of horticulture Roberto Lopez will work with about 20 species of bedding plants to test the ability of LED lighting to lower the cost of establishing new plants from cuttings and seeds. Low winter light means growers currently have to use more expensive overhead lighting to establish new plants. John Burr, a lecturer in Purdue's Krannert School of Management, will evaluate the costs and benefits associated with LED lighting.

A.J Both at Rutgers will be responsible for developing best practices and standards for testing commercial LED lighting. Chieri Kubota at the University of Arizona will test the optimal wavelengths and colors for LED lighting to establish vegetable transplants. Erik Runkle at Michigan State will test flower initiation of ornamental crops with different colors of LEDs, as well as performing project outreach.

The researchers are partnering with Robert Morrow and C. Michael Bourget of Orbital Technologies, which will build the LED lights.

Later phases of the research will include evaluating LED lighting in commercial settings and developing improved LED lights that match the needs determined from those tests.

www.purdue.edu

Osram's four-chip OSTAR Lighting Plus offers powerful, efficient and surface-mountable lamp replacement

Osram Opto Semiconductors GmbH of Regensburg, Germany says that, due to its high brightness and color stability, its new OSTAR Lighting Plus LED can be used without any problems in retrofits for incandescent lamps or halogen lamps. Containing four chips fabricated in UX:3 chip technology and emitting either cold-white or warm-white light, the new LED provides a large amount of light from a small area and improves efficiency compared with its predecessors.

Brightness is 425lm (5700–6500K) or 365lm (2700–4000K) at an operating current of 350mA, corresponding to typical efficiency of about 100lm/W or 80lm/W, respectively. "OSTAR Lighting Plus is also very efficient at higher currents and offers high light output thanks to the extremely uniform flux distribution over the entire chip surface," says Andreas Vogler, marketing manager General Illumination (SSL). The greater brightness level per chip area suits applications where space is tight, such as LED luminaires and retrofits, he adds. Homogenous white light is ensured by an ANSI-compatible binning system with finely graded classes. The LED is also easy to handle due to its compatibility with surface-mount technology (SMT), says the firm.

Osram's new OSTAR Lighting PlusLED.

With a power draw of less than 5W, the 365lm output of the warm-white OSTAR Lighting Plus is much brighter than a 25W incandescent lamp, which manages just 220lm. Energy savings of more than 80% can therefore be made despite a luminous flux that is 65% higher. Only four OSTAR Lighting Plus units are therefore needed to replace a frosted 100W incandescent lamp. Also, the color rendering index (CRI) is 80.

Applications for the new power LED cover interior lighting for shops, offices and homes, including many applications that require strong directional light from a small unit, such as spotlighting. The small dimensions of OSTAR Lighting Plus also suit applications that are currently being served mostly by halogen lamps.

OSTAR Lighting Plus was premiered at November's electronica 2010 trade fair in Munich, Germany and will be available on the market at the start of 2011.

www.osram-os.com

OSLON SSL 150 LED's 150° beam angle boosts luminaire efficiency

At November's electronica show in Munich, Osram Opto Semiconductors launched its OSLON SSL 150 LED.

While adding to its OSLON SSL product family (which has a beam angle of 80°), the 150 has a beam angle of 150°, enabling luminaires to be simpler and more efficient. Retrofit and downlight designs can benefit from the even light distribution, allowing designers to better manage light in external reflectors, the firm says. Also, the OSLON's small footprint can simplify the design of lamps and luminaires and facilitate low-profile designs.

The new LED's wide beam characteristic enables the light to be used in reflector systems with much lower light losses, so LED lamps and luminaires designed with OSLON SSL 150 are more efficient.

"With its low-profile and very compact design [measuring 3mm x 3mm], the new OSLON SSL 150 can be closely clustered without creating shadow effects," says Martin Wittmann, marketing manager Solid State Lighting. "In reflector applications for example, the luminaire efficiency can be increased by more than 5%. The reflectors can also be low-profile and the luminaire itself needs only a shallow mounting depth," he adds. "Thanks to these properties the LED offers flexible design options for high-performance lighting solutions."

The OSLON SSL 150 also suits other applications such as diffused lighting in suspended ceilings and wide-area backlighting with no obvious spots of light. Additionally, uniform illumination of the diffuser is possible in retrofits that aim to simulate incandescent or halogen light.

Color mixing is also easier. If OSLON SSL LEDs in different colors are used in a cluster, then the colors can be mixed at the reflector level, which is much less complex than mixing colors with secondary lenses.

The LED is based on a 1mm^2 chip, providing a typical brightness of 92lm at 3000K at an operating current of 350mA and 156lm at 700mA. It is available in all white tones (2700–6500K) and in different colors.

Osram's new TOPLED Compact 4520 LED produces bright high-current pulsed light for super flat displays

Osram Opto Semiconductors GmbH of Regensburg, Germany says that its new TOPLED Compact 4520 enables super flat displays due to being one of the smallest LEDs for screen backlighting, and is the first LEDs for this application to have a UX:3 chip. It is therefore suitable for pulse mode, can be loaded with a very high current, and can help to produce sharp pictures.

The trend toward flatter displays calls for very slim backlighting systems and high quality of light, says Osram Opto. Correspondingly, since it is flat encapsulated, does not have a lens (like the other members of the TOPLED family), and uses the tried and tested TOPLED package (which measures 4.5mm x 2.0mm x 0.8mm), the Compact 4520 light source suits

Osram's TOPLED Compact 4520.

single- or double-sided injection into light guides up to 2mm. It also covers a color space of more than 100% sRGB. Due to its UX:3 chip, which offers high linearity between current and brightness, with a brightness of 35lm (at 150mA) and an efficiency of 72lm/W, it is brighter in high-current pulse mode than any LEDs based on other chip technologies, the firm claims.

"The TOPLED Compact 4520 has been designed specifically for super flat displays," says Winfried Schwedler, marketing manager Backlighting. "Its extreme brightness and high-current pulse mode help produce razor sharp high-contrast images with no wipe effects," she claims. Pulse mode provides greater contrast on dark images by darkening or dimming individual segments of the image. It also prevents wipe effects on fast-moving images. To achieve this, parts of the backlighting are briefly switched off. This takes place so quickly that the human eye cannot detect the dark phases. The overall result is a bright image with consistent color quality, says Osram Opto.

www.osram-os.com

Stack chip technology doubles output of infrared Power TOPLEDs

Osram Opto Semiconductors says its new Power TOPLED SFH4250S emits almost double the infrared light compared to its standard SFH4250 component.

The new IR-LED achieves a radiant intensity of typically 22mW/sr and a total flux of 70mW in continuous operation at a drive current of 70mA, allowing the design of very compact lighting units. Also, in existing designs the effective range can be increased. Applications that can benefit include 3D TVs.

Osram attributes the increase in performance to its stack technology for thin-film chips (introduced last year to large-scale 1mm^2 chips), which features a serial connection of two p-n junctions rather than one p-n junction, almost doubling performance. The technology has been applied to chips with an edge length of 300µm for the SFH4250S.

"With this combination of well-proven chip design and standard packages, our customers can make use of our enlarged portfolio of

Infrared Power TOPLED SFH4250S.

powerful IR emitters without having to change their design," notes Harald Feltges, marketing manager for Infrared Components. The new Stack Power TOPLED allows pulsed operation up to 1A pulse current, reaching 220mW/sr radiant intensity and 700mW total radiant flux.

"Applications in which compact lighting units illuminate large areas with infrared light benefit from this new component," says Feltges. A typical example is 3D TV: synchronization of shutter glasses with the TV picture is achieved by powerful IR emitters which illuminate the area in front of the TV up to a distance of 7m. "The new Stack Power TOPLED almost halves the number of required IR-LEDs per set, or it improves the range of existing designs, respectively," he adds.

With a wavelength of 850nm, the emitted light of the SFH4250S is not visible to the naked eye, neither does it interfere with the remote control, which works at about 950nm. Many computer games make use of the 3D technology too, benefiting from the new IR emitters. The increased IR power also generates advantages in vehicle safety systems, mainly in seat occupancy detection systems for airbag activation and driver monitoring systems to enable fatigue detection (Drowsy Driver System).

Osram Opto says that the stack technology for thin-film chips has been tested in many applications, from vehicle night-vision systems to sensors in mobile end-user devices, which benefit in particular from the efficiency of stack chips.

Osram Opto's LEDs light up Asian Games

Osram Opto Semiconductors GmbH of Regensburg, Germany says that its OSLON SSL LEDs illuminated the exterior of the venue for the Asian Games, held in a newly constructed stadium in Haixinsha Square in Guangzhou, China (12–27 November).

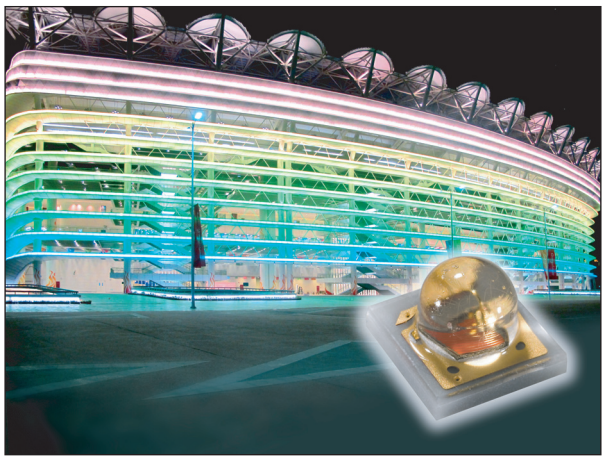
The games involve 11,700 athletes from 45 nations competing in 42 sports. The LEDs were used to produce a variety of colors, highlighting the gill-like side openings of the half-stadium, flanked by the city's UFO-like opera house and the latticed Guangzhou TV Tower.

The OSLON SSL series is a family of compact and symmetrical LEDs with an efficiency of up to 84lm/W (typical) at an operating current of 350mA and a viewing angle of 80° or 150°, and are particularly suited to architectural lighting.

OSLON SSL amber/green/blue LEDs and warm-white LEDs were used in separate flood lights to provide the different combinations of colors for the architectural lighting. Each floodlight was equipped with four independent sections of display pixels and color adjustments. Together with a real-time video control system, different colors were able to be created to work with the requirements of the various opening ceremony programs.

About 200,000 LEDs were used in 3200 floodlights in the project. To achieve the effect and efficiency required, several design options were explored. "We finally opted for a bi-directional asymmetric lens design and DMX online system which can make the whole lighting system easier to use and to create dynamic lighting effects," says Jiansheng Chen, general manager of Guangzhou Joinmax Display Technology Ltd, which installed the floodlights.

Currently, architectural lighting is the biggest application segment of solid-state lighting, accounting for 33.7% of the market, and revenue will rise at a compound annual growth rate (CAGR) of 16% by 2014, according to market research firm Strategies Unlimited.



Architectural lighting for Asia Games stadium.

Also, Osram Opto's Golden DRAGON Plus LEDs are installed in the street & parking lamps of the Haixinsha People square in Lin Jiang Road in the Zhujiang New City Central Business District (CBD) of Guangzhou, where the Asian Games were unveiled. The LED lamps provide a uniformly illuminated environment for pedestrians and for drivers in the parking lot.

Haixinsha is the largest public plaza in Guangzhou, measuring 170,000m^2. Osram Opto says that the Golden Dragon Plus LEDs were chosen for their large viewing angle of 170º and high luminous flux of 116lm at a color temperature of 6000K for an operating current of 350mA (and up to 273lm for 1000mA), enabling uniform and high-efficiency lighting over such an expansive area. Also, Golden DRAGON Plus LEDs are designed specifically for general illumination applications. The long lifetime of 50,000 hours suits outdoor lighting, as they require very low maintenance and thus cause minimal disruption to traffic.

The LED lamps were installed by Guangdong Zhonglong Communications Technology Ltd. Already, last year, Zhonglong installed LED street lamps using Golden DRAGON Oval Plus LEDs in Zhujiang New City CBD. That was following by several other projects. "As the opening and the closing ceremonies will take place in Haixinsha Square area and thousands of visitors will witness the benefits of LEDs in general illumination, we hope this will drive the adoption of LEDs in other applications," says Guangdong Zhonglong Communications Technology's general manager Chen Ben.

"We understand the importance of uniform lighting in street lamps and therefore have developed products which can meet this requirement," says Kai-Chong Cheng, marketing director of Osram Opto Semiconductors Asia Ltd. "Our ThinGaN chip technology not only enables products with long lifetime but also small form factor and low energy consumption, making LED becomes a viable and cost-effective light source for outdoor applications," he adds.

Golden DRAGON Plus LEDs illuminating square for opening ceremony.

Since the launch of the '10 Cities, 10,000 LED Lamps' program in China, local governments are mow using LEDs in new roads. Among them, the Guangdong provincial government has started its '10,000 LED lamps in 1000km' project.

www.osram-os.com

Seoul Semiconductor and Vertex partner to invest in LED tech firms

South Korean LED manufacturer Seoul Semiconductor Corp has announced an agreement with Singapore-based venture capital firm Vertex Venture Management to jointly seek and invest in companies with advanced capabilities in LED technology development.

As a subsidiary of Vertex Venture Holdings (owned by Temasek Holdings), Vertex Venture Management is engaged in company investments and fund commitments throughout Asia and the USA. Seoul Semiconductor aims to leverage its expertise in LED technologies to seek out high-potential companies and combine them with the capabilities of Vertex in sourcing and administering investment capital to achieve synergies for effective investment and returns.

In addition, with subsequent expansion of investment opportunities, both firms may establish a dedicated fund to nurture the R&D efforts of technology companies that can drive future innovation in LEDs and related industries.

"There are various LED-related new technologies and application companies engaged in R&D that have synergies with such new technologies... We want to support these efforts," says Brian Wilcox, Seoul Semiconductor's VP of North American sales. "All such firms are invited to sign-up on the Investment Application section of our website," he adds.

"LED is an eco-friendly light source with significant growth potential in the middle- to long-term, and we intend to identify and invest into many more companies with strong technology potential," says Vertex's chief investment officer Joo Hock Chua.

www.vertexmgt.com
www.seoulsemicon.com

Seoul Semiconductor's LEDs light up stage at Asian Games opening ceremonies

Seoul Semiconductor says that its Z-Power Series LEDs were installed as stage lighting at the opening ceremonies of the Asian Games.

The Guangzhou Games committee selected local SSC partner GOLDEN SEA Professional Equipment Ltd to provide the Z-power LED Series-embedded lighting solution that illuminated the on-stage performances. SSC says that the contract marks its continued growth in mainland China, one of the world's fastest-growing LED lighting markets.

The Z-Power Series RGB LED chosen by GOLDEN SEA generates pure white light with a color rendering index (CRI) of 80, says the firm. It also outputs 100 lumens per Watt at a drive current of 350mA, which is claimed to be the industry's highest luminous efficacy with just a single die.

"The Asian Games is one of the largest events in China this year, and I am sure our partnership with Seoul Semiconductor was instrumental in enabling us to secure this monumental win," says Golden Sea's president Zhang Wei Kai. "We are looking forward to tightening our relationship in the future," he adds.

IN BRIEF

LLFY gains Optical Selection Tool

Osram Opto Semiconductors' partner network LED Light for you (LLFY), which focuses on LEDs and their applications, is now offering a new service in the form of an Optical Selection Tool: a database containing 350 different lens types from seven of the world's largest lens manufacturers. The new tool provides comprehensive information (available for download) so that the correct lenses can be selected for each particular application.

For LED lighting, depending on the application, lenses can focus light in the desired direction or create a precise spread of light, e.g. in street lighting. Integrated lenses are one way of achieving an appropriate emission characteristic, but secondary lenses offer greater flexibility because they can be adapted to suit the application.

The 'LED Light for you' network now aims to make it easier to find the right lens for a specific luminaire design. The Optical Selection Tool provides a large database containing information needed to select the right lens (e.g. which lenses are suitable for which LEDs, how many LEDs can be placed behind external optics, and the materials, diameters and beam angles of the lenses). Some network partners offer additional simulation data for the lens characteristics on the LLFY website. Links to the manufacturers are also provided so that further details can be obtained.

"This tool gives luminaire designers a broad information base that is easy to use and will help you quickly find the right lens for your application," says Sebastian Lyschick (responsible for the LLFY network at Osram Opto).

www.ledlightforyou.com/Optical-Selection-Tool

Epistar achieves record 162lm/W cool-white LED

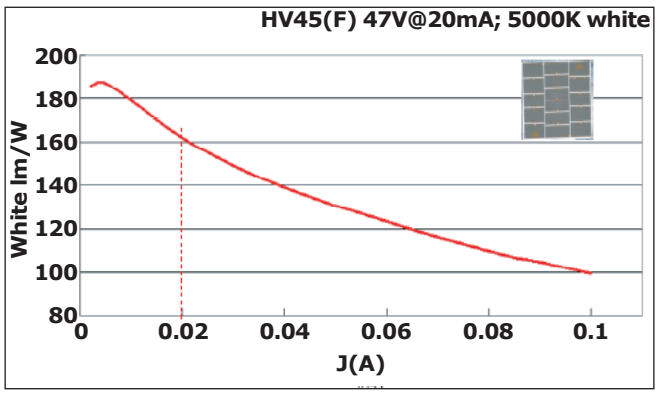
45mil InGaN HV-LED chip operated at drive current of 20mA

Taiwan's largest LED chipmaker Epistar Corp of Hsin-chu Science-based Industrial Park says that it has developed a high-voltage (HV) chip that enables record luminous efficacy of 162 lumens per watt for a cool-white LED.

Epistar Lab achieved the record efficiency with a large-chip 45mil indium gallium nitride HV-LED with a cool-white color temperature of 5000K operated at a drive current of 20mA.

The firm recently started shipping HV-LEDs with efficiency of 110lm/W, and just in late August it unveiled white HV-LED operation with efficacy of 135lm/W at a power of 1W and a color temperature of 5000K.

Epistar says that, compared with traditional LEDs, the HV-LED offers less power consumption and higher wall-plug efficiency because of its high-voltage monolithically integrated DC multi-array chip design, which improves current spreading. Also, flexibility in voltage and current adjustment can simplify the LED package and circuit design, enhancing overall efficiency, the firm claims. Due to enabling power saving, Epistar expects the new HV-LED to be used in general lighting applications. Mass production of the 162lm/W HVLED is expected to start in second-quarter 2011.



Record 162lm/W at 5000K achieved by 45mil HV-LED chip operated at a drive current of 20mA.

According to a report in Digitimes, Epistar also expects the efficacy of its warm-white LEDs to reach 130–150lm/W by the end of 2010 (after achieving 110lm/W warm-white LEDs in October 2009). LED lighting products accounted for about 20% of Epistar's revenue in third-quarter 2010, and it expects this to reach 30% in 2011 as LED lighting becomes its main focus as luminous efficacy continues to improve and prices drop.

www.epistar.com.tw
www.digitimes.com

Neo-Neon shrinks LED epitaxy expansion from 50 to 30 MOCVD reactors

Fears of oversupply of LEDs for LCD TVs prompted by panel makers' in-house expansion

Due to fears of an oversupply of LED chips used in LCD TV backlight units (BLUs), Neo-Neon Holdings Ltd, a vertically integrated LED lighting maker listed on the Hong Kong stock exchange, is downsizing its LED epiwafer capacity expansion by reducing the installation of additional MOCVD systems from its originally planned 50 by the end of 2011 to 30, according to the firm's Taiwan general manager Cheng Chien-wen reported in Digitimes.

Neo-Neon has three LED epiwafer fabs: two in Jiangmen, southern China, and the other in Yangzhou, eastern China. One in Jiangmen currently has 14–15 MOCVD reactors, giving a monthly capacity 30,000 2-inch epiwafers, with a total output of 300 million LED chips for lamps, 1 million high-power LED chips, and 70 million SMD LED chips, Cheng indicates.

Neo-Neon's Yangzhou fab will install five reactors in December and start production in January–February, while the other factory in Jiangmen will install 5–10 reactors by the end of 2011.

The possible oversupply of LED chips used in backlight units is because TFT-LCD panel makers have been expanding capacity for LED chips among subsidiaries to increase in-house supply

The three fabs will hence have up to 30 MOCVD reactors by the end of 2011, according to Cheng.

The possible oversupply of LED chips used in backlight units is because TFT-LCD panel makers have been expanding capacity for LED chips among subsidiaries to increase in-house supply, Cheng points out.

Digitimes also reports that Taiwan-based LED chip makers Tekcore Co Ltd and FOREPI (Formosa Epitaxy Inc) have both also recently delayed installing additional MOCVD reactors for the time being.

www.neo-neon.com
www.digitimes.com/news/a20101124PD209.html

Rensselaer Smart Lighting Engineering Research Center deploys first LED bulbs on its campus

The new Smart Lighting Engineering Research Center (ERC) at Rensselaer Polytechnic Institute (RPI) of Troy, NY, USA has transformed a key building on RPI's campus into a test bed for high-efficiency lighting.

Led by director Robert Karlicek, the Smart Lighting ERC worked with campus officials to replace some of the conventional incandescent bulbs in overhead lights with LED bulbs in the nine-story George M. Low Center for Industrial Innovation (CII). The initial batch of 119 replaced bulbs is expected to pay for itself via energy and labor cost savings within 12–16 months. Following the payback period, the bulbs are forecast to result in annual savings of $5608.

Karlicek says that, along with a significant reduction in energy consumption and lower maintenance costs, the new LED bulbs produce better, brighter light.

"Initially, we're trying to show the campus community how easy it is to make a very noticeable difference in terms of sustainability and reduced energy consumption," says Karlicek. "We hope this is just the first step. If we replaced all of the old bulbs in the CII with LEDs, the annual savings could increase by a factor of five," he adds.

Most of the incandescent bulbs replaced were 50W, with an expected lifetime of 2500 hours. The new screw-in LED bulbs use just 8W of electricity, but produce as much light as a 65W incandescent bulb. Also, the LED bulbs have an expected lifetime of 50,000 hours (20 times longer), so the LED bulbs will need to be replaced about every six years (rather than every four months for incandescents). Along with buying fewer bulbs, there should be a significant drop in the amount of time required by staff members to replace light bulbs.

Though the LED bulbs represent a larger up-front investment (costing $60 each versus $4.50 each for conventional bulbs) the long-term savings over the lifetime of the bulbs are apparent, Karlicek says. Another advantage is that LED bulbs don't contain the mercury that is present in competing compact fluorescent lamp (CFL) technology.

"The LED bulbs that were installed are a great showcase for sustainability, but they're not 'smart' technology. When we talk about 'smart lighting', we're looking forward to a new wave of solid-state lighting with applications that will transform the way society uses light," Karlicek notes. "The vision for smart lighting that we're working to realize is a holistic integration of advanced light sources, sensors, and adaptive control architectures that take full advantage of the amazing capabilities of light," he adds. "The smart lighting we're developing will be able to talk with networked electronics and sensors within a space, and automatically adjust the lighting parameters to provide the ideal illumination required for the task at hand."

Applications for smart lighting span the entire spectrum of technology, from illumination of homes and offices to breakthroughs in biotechnology, transportation and light-based wireless communication, Karlicek says.

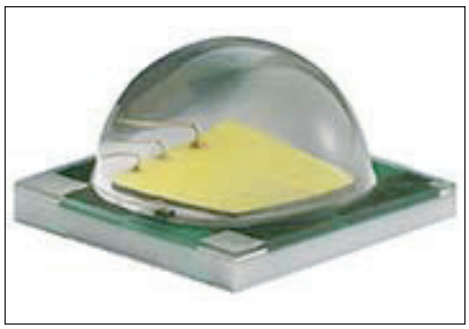
The Smart Lighting ERC is funded by the National Science Foundation (NSF), industry, and New York state, and led by RPI with core partners Boston University and the University of New Mexico. Center outreach partners are Howard University, Morgan State University, and the Rose-Hulman Institute of Technology.

http://smartlighting.rpi.edu

Cree launches single-die XLamp XM-L lighting-class LEDs delivering 1000lm at efficacy of 100lm/W

Cree Inc of Durham, NC, USA has announced the commercial availability of what it claims is the industry's brightest, highest-performance lighting-class LEDs. Designed for very-high-lumen applications such as high-bay or roadway lighting, the XLamp XM-L LED has gone from concept to commercial availability in less than eight months.

Cool-white (6500K) XLamp XM-L LEDs deliver 1000lm with 100lm/W efficacy at 3A. In a compact 5mm x 5mm footprint, XM-L LEDs offer the combination of very high efficacy at very high drive currents, delivering light output and efficacy of 160lm/W at 350mA and up to 315lm and 150lm/W at 700mA, providing a 20% efficiency gain from Cree's existing XLamp XP-G LEDs.



Cree's XLamp XM-L LED.

"An LED with this level of light output and this level of efficacy can accelerate the development of high-output commercial lighting products and could enable applications we haven't even thought of yet," reckons John Edmond, director of advanced optoelectronics.

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

IN BRIEF

XP-E and XP-C Color LED output boosted

Cree has announced commercial availability of new levels of performance for its XLamp XP-E and XP-C Color LEDs.

XP-E Color LEDs are available delivering minimum light output of 500mW for royal blue, 39.8lm for blue, 107lm for green, 73.9lm for red-orange, and 62.0lm for red, all at a drive current of 350mA.

XP-C Color LEDs are now available delivering minimum light output of 350mW for royal blue, 23.5lm for blue, 62lm for red-orange and 51.7lm for red, all at 350mA.

"Cree is extending our leadership with industry-best light output across the color spectrum in a common, small footprint," says Paul Thieken, director of marketing, LED components. "These economical, high-performance options can provide designers additional flexibility for a broad set of applications including architectural, emergency vehicle, transportation and decorative lighting, all while leveraging the reliability of the XP package," he adds.

Cree adds XP-G and XP-E warm-white LEDs offering high efficacy and CRI

Cree has added 80, 85 and 90 color rendering index (CRI) options to its XLamp XP-G and XP-E warm-white LEDs. Many lighting applications (such as retail, medical and architectural) require high color accuracy to properly render object colors, the firm notes.

With previous-generation high-CRI white LEDs, increasing color quality meant decreasing efficacy. But, due to the new high-CRI XP-G and XP-E, luminaire and fixture designers can have both, Cree claims.

"High CRI is a must for certain applications that require a high quality of light — but at the same time, we cannot forget about the system efficacy," says Massimo Santinon, i-Led brand manager for Italian lighting firm Linea Light s.r.l. "The new XLamp XP-E and XP-G with high CRI are the perfect combination we were waiting for that will allow us to address new markets," he adds.

"Lighting applications require specific performance characteristics, and Cree's XLamp LED family delivers products optimized for these individual applications," says Paul Thieken, Cree's director of marketing, LED components.

"Our high-CRI XLamp LEDs can deliver light quality comparable to halogen with better efficacy than fluorescents. And Cree's lighting-class LEDs are proven to be one of the world's most-efficient light sources, which can enable more economical designs and applications," he claims.

The new high-CRI XP-G is available with luminous flux of up to 107lm at a drive current of 350mA in warm white (3000 K), providing efficacy of 102lm/W and enabling LED lamp designers to create systems which are 70% more efficient than a traditional halogen PAR38 lamp and which deliver similar high color rendering, it is reckoned.

The high-CRI XP-G and XP-E LEDs are similar to standard XP-G and XP-E LEDs and may work in existing systems without any redesign. As with the standard XP-G and XP-E, the new LEDs have LM-80 data approved by ENERGY STAR, are UL-recognized components under UL 8750 (E326295), and feature what is claimed to be excellent thermal-management properties.

www.cree.com
www.linealight.com/i-led

Cree's 120V LMR4 LED module achieves Title 24 compliance; warranty extended to 5 years

Cree Inc of Durham, NC, USA says that its 120V LMR4 LED module has achieved California Title 24 registration, helping OEM lighting manufacturers to meet California's energy-efficiency standards and to quickly enter the LED lighting market with fixtures based on Cree's TrueWhite Technology or EasyWhite solution. Cree is also extending the warranty on its LMR4 LED module family to five years to further accelerate the LED Lighting Revolution.

"California leads the nation in promoting sustainable, energy-efficient building codes, and the growth of solid-state lighting is critical to achieving energy-saving goals and policy objectives," says Michael Siminovitch, director of the California Lighting Technology Center (CLTC) at the University of California, Davis. "Cree has been a leader in the LED lighting industry, and further advances to its technologies will allow lighting manufacturers to address the energy-efficiency needs of California consumers," he adds.

"Lighting manufacturers have already demonstrated the ease of developing LED fixtures based on the Cree LMR4 module," says Tom Roberts, Cree's director of marketing, LED modules. "Based on our continued testing and customer design successes, Cree is extending the LMR4 warranty from three years to five. We believe this provides even greater confidence in the business case for high-quality LED lighting."

Cree's LMR4 LED module, available with either TrueWhite Technology or the EasyWhite solution, integrates driver electronics, optics and primary thermal management. Both versions deliver 700 lumens, are designed to last 35,000 hours and consume just 12W of power. Fixture manufacturers have the option to include a specially designed heat sink to accommodate specific high-heat applications such as downlights for insulated ceilings.

The 120V LMR4 LED module is UL-recognized, and the 230V LMR4 module complies with multiple international standards. Fixture makers seeking ENERGY STAR qualification will have access to specifications and performance data, including LM-80 reports, which can speed regulatory approvals.

IN BRIEF

Cree appoints board member with consumer product expertise

Cree says that Robert Tillman (former Lowe's Companies chairman & CEO) has been elected to its board of directors, and to the board's Compensation Committee.

"He brings substantial leadership experience as a CEO in a major publicly traded company in the retail distribution industry," says Cree chairman & CEO Chuck Swoboda. "His knowledge, operational expertise and insight into consumer products should be very valuable to our board as we work to accelerate the LED lighting revolution."

Tillman served as chairman of Lowe's Companies Inc from 1998 to 2005, as its president & CEO from 1996 to 2005, and as a member of its board of directors from 1994 to 2005. After retiring from Lowe's in 2005, he served as a member of the board of directors of Bank of America Corp from 2005 to 2009 and also as a member of its Executive and Asset Quality Committees.

www.cree.com

Intematix launches green aluminate and red nitride phosphor materials for white LEDs

Intematix Corp of Fremont, CA, USA, which makes customizable, patented phosphors for LED applications, has added two new phosphor families to their product line, creating what it claims is the broadest portfolio of LED phosphors on the market. The new phosphors are green aluminate and red nitride materials, which enable high-quality white illumination when applied to blue LEDs.

"These latest innovations from Intematix enable the widest color gamut for TVs and displays, as well as the perfect warm light for your home," says CEO Mark Swoboda (former CEO of LED maker Bridgelux of Livermore, CA, who joined Intematix in August).

Intematix claims the new phosphor families meet the challenging material requirements for display backlighting and general lighting applications by offering an improved color spectrum and superior color rendering to LED lamps compared with current solutions. Both phosphor families advance the performance of existing lighting systems, improving color quality, thermal stability and lifetime reliability.

To develop the green aluminate and red nitride phosphors, Intematix applied its proprietary C-MAT Synthesis accelerated materials discovery and development process. The firm says that, by testing millions of combinations at once, it can develop materials for LED performance with optimized particle morphology and high quantum efficiency.

www.intematix.com

Verticle launches hexagonal LED chip

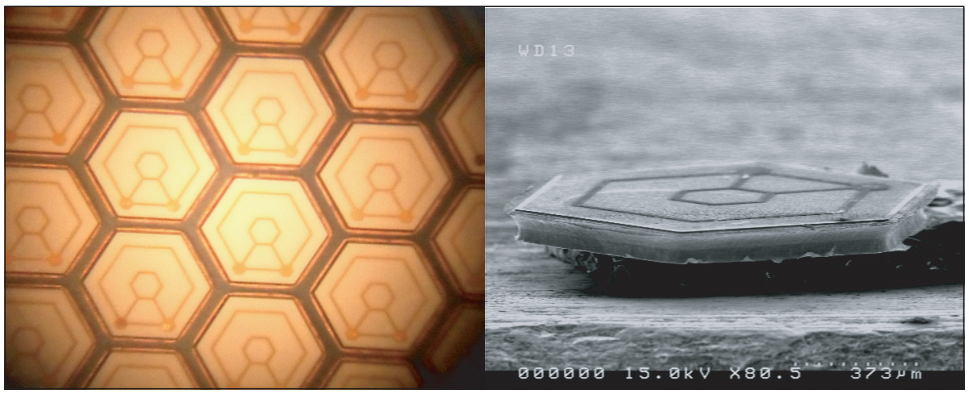
Chemical chip separation technique enables more chips per wafer

Verticle Inc of Dublin, CA, USA, which designs and manufactures vertical-type LED chips for backlight unit (BLU) and solid-state lighting applications via its production facilities and R&D center in Korea, has announced what it claims is the first hexagonal-shaped LED chip.

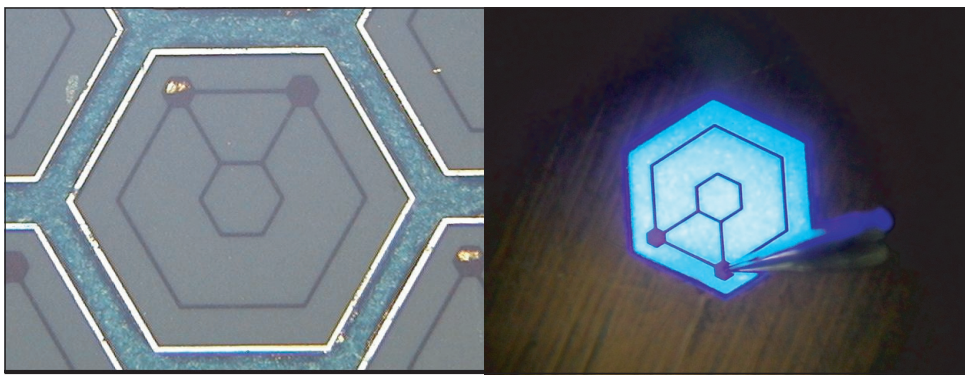
The Honeycomb LED Chip is a vertically structured InGaN-based blue LED chip developed especially for high-power applications. CEO Dr Mike (M.C.) Yoo reckons that, compared with conventional square- or rectangular-type LEDs, a hexagonal LED chip yields multiple benefits regarding cost, light output efficiency, and beam profile:

- Since a hexagon is the most closely packed structure within a circular wafer, chip count per wafer is greater, yielding 15% more hexagonal chips than square or rectangular chips of equivalent size.
- A hexagonal chip aids current spreading, resulting in higher light output than conventional chips.
- Light output after packaging is enhanced. The Honeycomb chip produces a beam profile that is much closer to the circular shape of the circular lens used in optic design. In contrast, the beam profile of the typical square or rectangular chip, when combined with a circular lens, is normally distorted.

Although the advantages of a hexagonal chip over conventional chips are widely known, they have not been realized in production up to now, claims Verticle. The main reason is the difficulty in chip separation using conventional scribing or dicing. However, a chemical chip separation technique invented by Verticle makes the chip separation step much easier and quicker than conventional chip separation techniques, it is claimed. The chip singulation technique can chemically etch the street line, to easily produce chips of any shape. Moreover, Verticle says that, with this technique, it can handle multiple wafers in one batch, resulting in chip separation throughputs that are 500 times greater than for conventional chip separation methods.



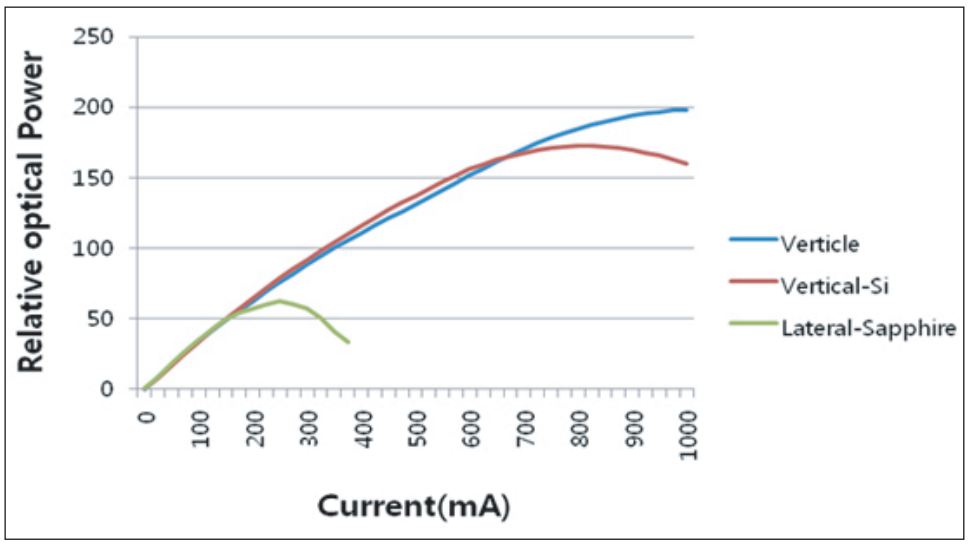
Honeycomb chips before separation (left) and SEM image of separated honeycomb chip (right).



Separated honeycomb chip by chemical chip separation technique (left) and blue light emission from separated honeycomb chip (right).

In addition, a patented copper (Cu) substrate with high thermal and electrical conductivity allows applications that require thermal benefits with light color consistency and better life-time and reliability, the firm adds.

www.verticleinc.com



Light output vs current injection (L–I) for Verticle's power chip with copper (blue) and silicon (red) substrates compared with lateral LED on sapphire.

IN BRIEF

Luminus awarded 50th US patent for 'big-chip' LEDs

The US Patent and Trademark Office (USPTO) has awarded Luminus Devices its 50th patent.

Luminus says that, having pioneered 'big-chip' LED technology, it has aggressively filed intellectual property (IP) for protection of big-chip LED devices, packages and systems. It has also been granted 13 non-US issued patents in China, Korea and Taiwan, extending big-chip LED protection into those countries.

"The rapid allowance of our patents is a testament to the novelty of our approach in the solid-state lighting industry," reckons founder & chief technology officer Alexei Erchak. "We have more than 100 additional patents pending in the US and in other countries that further extend our coverage," he adds.

Luminus also has a track record of granting licenses to other LED firms, starting with Japan's Nichia Corp in January 2009, then Taiwan's Formosa Epitaxy this March and Epistar in August.

"The innovative technologies developed at Luminus can help advance the entire solid-state industry at a more rapid pace," believes Erchak. "We therefore welcome licensing opportunities that complement our core manufacturing business while simultaneously helping other LED companies benefit from our technology," he adds. "As the industry begins to become more and more interested in the value of big-chip LEDs, we are seeing companies respect our IP position and many licensing opportunities continue to develop."

PhlatLight LEDs are used in display applications by some of the largest electronics and lighting firms, such as Acer, Guth, LG, Philips Lighting and Samsung.

Luminus' LEDs power brightest spot lights from Strong Entertainment

Luminus Devices Inc of Billerica, MA, USA, which develops and manufactures large-chip PhlatLight (photonic lattice) LEDs for illumination applications, says that its CBT-90 white LEDs are powering Strong Entertainment Lighting's Solutions 650 and 900 spot lights, for use in light the world's largest skyscrapers and towers, as well as antennas, amphitheaters and artwork displays. The Solutions 650 and 900 lights have a total light output of 20,000 lumens and a lifespan of 50,000 hours.

The Solutions 650 and 900 lights are suited to indoor and outdoor environments where high brightness and performance is required. The Solutions 650 uses a proprietary optics system, giving a narrow 3º beam of light with a reach of more than 1500 feet. The Solutions 900 is a full-color-mixing fixture employing an array of PhlatLight LEDs and is claimed to be 4–5 times brighter than anything currently on the market.

"Our new Solutions products represent a unique application of LED technology that wouldn't be possible without the Luminus CBT-90," says Strong Entertainment Lighting's VP of lighting Paul Rabinovitz. "Together, Luminus Devices and Strong are developing next-generation narrow-beam LED-based light fixtures with very long throws previously achievable only by using the highest-performance lamps," he adds.

Strong's Solutions 650 spot light.

"CBT-90 white LEDs provide lighting fixture manufacturers such as Strong Lighting with ultra-bright, white light with superior optical coupling and beam control, enabling more efficient next-generation lighting applications," says Don McDaniel, Luminus Devices' director, global entertainment. "Big-chip LEDs offer superior brightness over competitive products and can last the lifetime of the luminaire, eliminating the frequent lamp replacement of traditional spot lights."

The Solutions 650 and 900 series lights powered by CBT-90 PhlatLight LEDs were displayed at the LDI 2010 show in Las Vegas (22–24 October).

http://lighting.ballantyne-omaha.com
www.ldishow.com
www.luminus.com

Massachusetts Congresswoman visits Luminus to tour manufacturing facilities

On 15 October, 5th Massachusetts Congressional District Congresswoman Niki Tsongas met Luminus' president & CEO Keith T.S. Ward and other members of the executive management team, toured the firm's manufacturing facility and participated in a question & answer session with staff.

"For our company to sustain growth in the coming months it is important that Congresswoman Tsongas and other elected state and federal officials understand the significance of our business and how our products are used by many of the largest lighting and electronics companies in both the commercial and residential lighting industry," stated Ward.

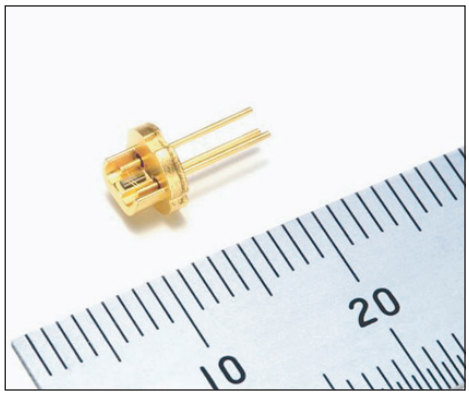
www.youtube.com/watch?v=cTn_KcxR8B4

Mitsubishi samples record 1W red laser for pico projectors

Tokyo-based Mitsubishi Electric Corp says that on 18 November it will begin sample shipments of its new ML501P73 red laser diode (LD), which has what is reckoned to be record pulsed output power of 1W for the 638nm wavelength band, suiting pico projectors and other portable display systems that require a high-brightness red light source.

Pico projectors have attracted much attention because they can be embedded in or connected to mobile systems such as cellular phones and laptop computers. Laser diodes are widely used as the light source because they can project a wider range of colors compared with lamp-based projectors. Compared with LEDs, laser diodes deliver higher output while consuming less power, extending battery life. They also enable focus-free operation, because optical systems with great depth of field can be used with laser beams.

After only in January 2009 launching a 638nm laser with what was



Mitsubishi Electric's 1W ML501P73 638nm red laser diode.

then record output of 110mW (operating in continuous-wave mode), the firm boosted output to 300mW in July 2009 then 500mW in January 2010, helping it to achieve luminosity of up to 60lm compared with just 10lm in LED-based projectors.

However, at high temperatures, the output power of red LDs with wavelengths shorter than 640nm was insufficient for high-brightness projector applications. Mitsubishi Electric says that it has now used its capabilities in applying window mirror structures and epitaxial growth technology to develop output power of 1W at the 638nm lasing wavelength, doubling luminosity to more than 120lm for pico projectors.

Supplied in a standard 5.6mm-diameter CAN package, the ML501P73 can be operated over a temperature range of –5ºC to +40ºC while emitting at an output power 0.5W in continuous wave (cw) mode and 1W in pulsed mode at a duty ratio of less than 33% and a frequency of 50Hz or higher. At a CW output of 500mW at 25ºC, operating current is 660mA and operating voltage is 2.2V. The threshold current is 170mA.

In addition, at a case temperature of 25ºC, the new laser has an what is claimed to be an industry-leading electrical conversion ratio of 32% at 1W (compared with 32% for the 500mW-output laser), helping to reduce power consumption in pico projectors.

www.mitsubishielectric.com

PhlatLight LEDs illuminate Madison Square Garden

Luminus Devices Inc of Billerica, MA, USA, which develops and makes big-chip PhlatLight (photonic lattice) LEDs for illumination applications, says that its CBM-380-RGBW PhlatLight LEDs have been used inside Vari*Lite's VLX Wash Luminaires lighting the stage for Arcade Fire's recent live HD webcast concert from Madison Square Garden (MSG) in New York City.

The Canadian rock band enlisted the assistance of lighting designer Susanne Sasic, who used 40 VLX Wash Luminaries to light the band. During the live streaming show from MSG, Sasic had to not only provide lighting for concert-goers but also for fans tuning into the webcast.

"During the concert, the VLX's were my main lights on the band. The true white from the Luminus LEDs inside the VLX Wash Luminaires

Vari*Lite's VLX Wash Luminaire

were extremely successful for the band member skin tones," says Sasic. "VLX Wash Luminaires have no match today and their brightness and intense range of color are incredible," she adds.

The heart of the Vari*Lite VLX Wash Luminaire is seven replaceable custom PhlatLight CBM-380-RGBW LEDs. The system has been optimized to deliver a total light output of 14,000 white lumens with an LED lifetime of at least 10,000 hours at maximum output.

"Wash Luminaires popularity with lighting designers is a testament to punch and color uniformity previously available only from discharge lamp fixtures," says Don McDaniel, Luminus' director, global entertainment.

"I had seen the VLX Wash during a private demo, so I knew that it would be a perfect fit for this tour because of its power, deep range of color, and the true white from the Luminus LEDs," Sasic says. "I have used automated LED lighting previously as decorative elements, but never as a main lighting source."

www.vari-lite.com
www.luminus.com

Microvision integrates direct green lasers into pico projector prototypes

Price, size, power, performance to outdo frequency-doubled lasers

Microvision Inc of Redmond, WA, USA, which provides ultra-miniature projection display technology, has integrated 'direct green' laser samples from two leading manufacturers into pico projector benchtop prototypes for what it claims is the first time, representing the first step toward the commercialization of PicoP display engines using direct green lasers.

"We are very pleased with the performance of these early direct green laser prototypes," says Sid Madhavan, VP R&D and applications. "These encouraging results give us confidence that direct green laser diodes will be capable of meeting the performance requirements for integration into our PicoP display platform," he adds. PicoP display engines that use a direct green laser are expected to offer significant commercial advantages in price, size, power, and performance.

Microvision's PicoP platform is designed to enable next-generation display and imaging products for pico projectors, vehicle displays and wearable displays that interface with mobile devices. The projection display engine uses laser light sources that can create vivid images with high contrast and brightness.

However, to create a full-color image, Microvision's existing pico projection engine uses red and blue laser diodes together with a frequency-doubled 'synthetic' green laser (where the wavelength of light from an infrared laser is reduced, being re-emitted as green light). This conversion process creates a complex system of multiple components held to tight tolerances, making manufacturing more challenging.

Direct green lasers can produce green light natively, enabling their design and manufacturing processes to be simplified in a manner similar to red and blue diode lasers, facilitating lower cost and rapid scalability to commercial quantities, says Microvision.

The firm adds that the combination of smaller size, lower power, and lower cost make direct green lasers an attractive alternative to synthetic green lasers for its mobile display technology.

Also, historically, the availability of synthetic green lasers has been constrained due to their complexity and the existence of only two manufacturers. Today, there are at least five firms worldwide that have announced they are developing direct green lasers for commercial launch between late 2011 and mid 2012. Analyst firm Yole Développement forecasts that the direct green laser market will reach about $500m by 2016, representing more than 45 million devices.

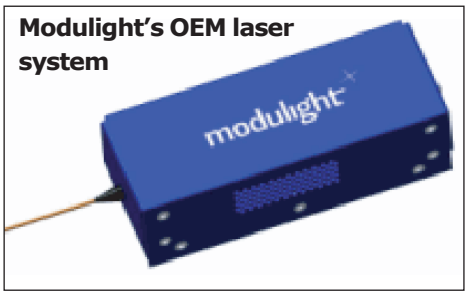
www.microvision.com

Modulight launches 635–1550nm OEM laser systems for medical & industrial applications

Laser manufacturer Modulight Inc of Tampere, Finland has launched a set of OEM laser systems for medical and industrial applications. The sub-systems produce up to 1.5W optical power and cover most conventional wavelengths between 635nm and 1550nm.

The standard configuration is based on Modulight's Butterfly module line-up options and includes an integrated laser driver, controller, cooling, and external modulation interface. Customizable options include, but are not limited to, wavelength, power and output specification, control interface, form factor, and various operating parameters.

Modulight's OEM laser system



Currently the following wavelengths and maximum powers are offered with standard configurations: 635nm, 500mW; 650/665nm, 750mW; 808nm, 1.5W; 940/980nm, 1.5W; and 1470/1550nm, 500mW. Other wavelengths are available as per request.

"By presenting a standard OEM system-level platform for single-emitter lasers, our customers benefit from existing versatile design, in-house customization capability from chip to system level, and very large wavelength range from 630nm to 1650nm," says Sampsa Kuusiluoma, product line manager for Integrated Laser Solutions. "We have supplied a number of custom OEM systems already for a few years, but we believe that a standard solution will enable larger customer base within equipment manufacturer market," he adds. "The OEM systems have been designed to enable simple integration interface both mechanically and electrically."

www.modulight.com

Source Photonics sold to Francisco Partners for $146m

Parent firm MRV focusing on optical networking equipment

MRV Communications Inc has agreed to sell its optical communications component manufacturing subsidiary Source Photonics Inc of Chatsworth, CA, USA to global technology-focused private equity fund Francisco Partners for $146m ($113m in cash and $33m in assumed debt and deductions). Payment will be made in installments within 60 days of closing.

Source Photonics designs and manufactures products including passive optical network (PON) subsystems, optical transceivers used in the enterprise, access and metropolitan market segments, and optical subsystems used in fiber-to-the-premise (FTTP) deployments (for telecom service providers to deliver high-bandwidth video, voice and data services).

"This transaction illustrates our strategic shift away from fiber-optic components and our increased emphasis on providing optical networking products, services and solutions," says MRV's CEO Dilip Singh. "Moreover, this transaction will help stabilize revenue and operating income, allowing us to concentrate on maintaining steady cash flows from our core business units and growing the business to meet customer demand," he adds. "Source Photonics will continue normal operations while benefiting from Francisco's expertise in the technology and telecommunications industries," Singh concludes.

"Source Photonics provides a powerful value proposition to its Tier 1 customers with its substantial China cost base, advanced technical capabilities, and high-growth business model," says Source Photonics' CEO Near Margalit. "Francisco Partners' experience in the optical component space and in growing technology companies will help accelerate the next phase of Source's growth, and we consider the investment a strong validation of our business strategy," he adds.

"Francisco Partners has been engaged in the optical component space for many years," says Keith Geeslin, a partner at Francisco Partners. "Source is a truly differentiated platform for growth and profitability in the optical component space, and look forward to partnering with the management team to grow Source into one of the top global vendors for optical components."

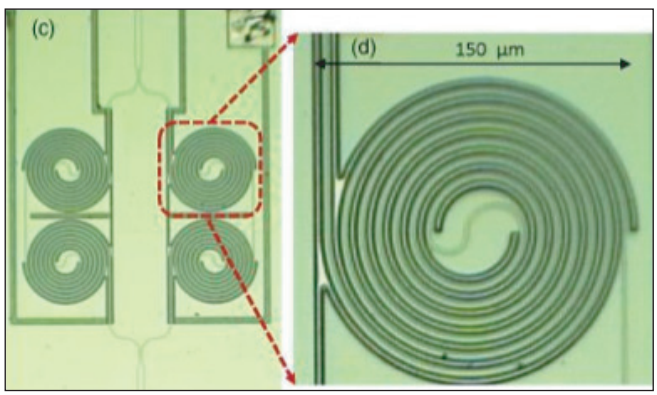
www.sourcephotonics.com

Kotura demonstrates record 0.6mW broadband 2x2 silicon photonics switch with 6ns speed

60nm bandwidth could cover entire C-band range

Kotura Inc of Monterey Park, CA, USA, which has been designing and manufacturing application-specific silicon photonics components for the communications, computing, sensing and detection markets for more than four years, has demonstrated an ultra-fast, submilliwatt, broadband 2x2 optical switch (Po Dong et al, Optics Express, 2010, Vol. 18, Issue 24, p25225). With switching speeds of 6ns and power consumption of only 0.6mW, the 60nm bandwidth means that the device could more than cover the entire C-band range.

"We are putting all the building blocks in place for optical interconnects," reports chief technology officer Mehdi Asghari. "We previously demonstrated high-speed, low-power modulators, high-speed detectors with record performance, and low-loss wavelength division multiplexers and de-multiplexers.



A 2x2 switch with spiral shape arms. Arm length is 4mm and the minimum bending radius is 5μm.

With our new 2x2 switch we will be able to support more complex silicon photonic circuits and enable more flexible interconnecting architectures," he adds. "The switching power of 0.6mW achieved by this free-carrier current injection device represents, to our knowledge, a world record and the speed of 6ns is amongst the fastest ever reported."

"Because the device is broad band, it is very generic," says president & chief operating officer Jean-Louis Malinge. "The ultra low power of the switch enables us to integrate large numbers of our 2x2 switch modules to create complex switch fabrics."

The low-power high-speed switch was developed as part of the US Defense Advanced Research Project Agency's Ultra-performance Nano-photonic Intrachip Communications (UNIC) program in conjunction with Oracle Corp, under the leadership of DARPA program manager Dr Jagdeep Shah.

www.kotura.com

www.opticsinfobase.org/abstract.cfm?URI=oe-18-24-25225

HELIOS European silicon photonics project demos 10Gb/s modulator

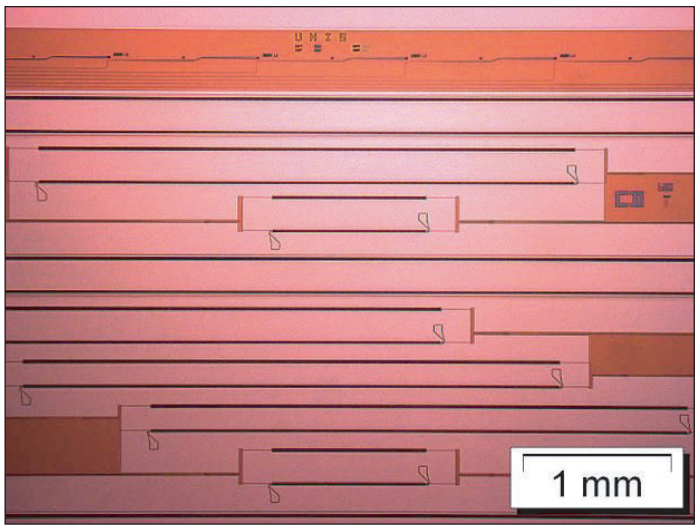
Characterization of 40Gb/s modulator expected next year

Grenoble-based CEA-Leti (the French government's Laboratory for Electronics & Information Technology), which coordinates the pan-European consortium HELIOS (pHotonics ELectronics functional Integration on CMOS) to accelerate commercialization of silicon photonics, says that project partners have demonstrated a 10Gb/s silicon modulator using a process that is compatible with complementary metal-oxide semiconductor (CMOS) processing, in addition to the project's CMOS-compatible laser.

Silicon photonics is an emerging technology for overcoming electrical connections' limits in processing increasingly data-rich content and reducing the cost of photonic systems by integrating optical and electronic functions on the same chip. The technology may enable low-cost solutions for a range of applications such as optical communications, chip-to-chip and rack-to-rack connections, data-center cables, optical signal processing, optical sensing, and biological applications.

Launched by the European Commission in May 2008 within the Information and Communication Technologies (ICT) theme of its 7th Framework Program (FP7), the €8.5m, four-year project is designed to drive European R&D in CMOS photonics and to pave the way for industrial development. Specifically, it aims to develop microelectronics fabrication processes for integrating compound semiconductor-based photonics with CMOS silicon circuits and to make the technology available to a wide variety of users.

Project partners include CNRS, Alcatel Thales III-V lab, Thales, University of Paris-Sud, 3S Photonics and Photline Technologies in France; IMEC in Belgium; Phoenix BV in The Netherlands; IHP and the University of Berlin in Germany; Austriamicrosystems AG and the University of Vienna in Austria; IMM and the University of Trento in Italy; the University of Valencia, the University of Barcelona and DAS Photonics in Spain; and the University of Surrey in the UK. The overall project cost is €12m.



CMOS-compatible 10Gb/s modulator.

Now in its second year, the project is now developing building blocks and processes to accelerate the adoption of silicon photonics. The laser was fabricated by first bonding the III-V material indium phosphide (InP) on top of a CMOS wafer and then processing it using the same equipment as in microelectronics production.

The capability of manufacturing optical components within the CMOS-processing infrastructure is key to realizing the potential of silicon photonics

The 10Gb/s silicon modulator has an extinction ratio of 7dB. A 40Gb/s version has already been designed by the consortium and being fabricated. The first characterization results are expected next year.

"The capability of manufacturing optical components within the CMOS-processing infrastructure is key to realizing the potential of silicon photonics," says HELIOS coordinator Laurent Fulbert, photonics programs manager at Leti. "HELIOS partners are focused on bringing this technology to foundries and component manufacturers for high-volume applications," he adds.

In addition to the laser and silicon modulator, building blocks under development by HELIOS partners include a light modulator, passive waveguides and photodetectors.

Other recent results of the project include:

- demonstration of high-responsivity (0.8–1A/W), low-dark-current and high-bandwidth photodiodes (up to 130GHz);
- efficient passive waveguides (mux/demux, polarization diversity circuit, fiber coupling, rib/strip transition);
- establishment of a photonics design flow; and
- investigation of novel concepts for light emission and modulation.

Most of the results of the project's second year were presented at the 7th IEEE International Conference on Group IV Photonics (GFP 2010) in Beijing, China (1–3 September).

HELIOS has also developed a free, 21-hour training course addressing all aspects of silicon photonics, available on the website.

www.helios-project.eu

Luxtera's 25Gbps silicon photonics transceivers showcased at SC10's disruptive technologies exhibit

Luxtera Inc of Carlsbad, CA, USA has announced the demonstration of 25Gbps receiver technology in its CMOS-based silicon photonics platform.

The firm says that, leveraging the benefits of silicon photonics to overcome the barriers of current-generation parallel and serial 10Gbps solutions, it can now fully support what are claimed to be unmatched levels of optical interconnect bandwidth while offering extended reach at low cost. The technology, combined with Luxtera's recently announced 25Gbps transmitters, enables the development of products for parallel 100Gbps InfiniBand and Ethernet, as well as for serial 32G Fibre Channel applications. Recognizing its potential impact in the high-performance computing (HPC) market, Luxtera was selected to showcase its transceivers as part of the disruptive technologies exhibit at this year's SuperComputing event (SC10) in New Orleans (13–19 November).

"Processor computing capabilities are continuously increasing, putting pressure on the interconnect," says Shai Rephaeli, VP of interconnect products at Mellanox Technologies of Sunnyvale, CA, USA and Yokneam, Israel. "Cost-effective, high-throughput interconnect solutions are required to support large-scale computing systems. Breakthroughs in interconnect technologies such as Luxtera's high-speed transceivers will help enable economic solutions for these next-generation 100Gbps InfiniBand and Ethernet networks."

Silicon photonics uses CMOS processes to deliver on-chip waveguide level modulation and photodetection. Unlike traditional directly modulated transceivers, lasers in silicon photonics applications are always on, acting as a continuous supply of photons to the chip. In addition, light from a single laser is used to power multiple optical transmitters on a chip, eliminating the need for multiple lasers and reducing transceiver cost. This allows Luxtera to reuse the same laser used in current production 10Gbps transceivers to power next-generation higher-speed products, eliminating the need for the development of higher-speed light sources. When combined with single-mode fiber and waveguide photodetector receivers, this offers practically unlimited reach and performance at 25Gbps, the firm claims.

"Our large-scale data center spans thousands of square feet spread over multiple computer room floors in two buildings a mile apart," says Bob Ciotti, supercomputing system lead at NASA's advanced supercomputing facility. "Our largest system currently has over 40 miles of InfiniBand cables, most of it parallel 10Gbps optical links. As we expand and transition to faster systems, we will require thousands of even faster optical transceivers that are cost effective, low power and can operate reliably from 10m to 2km," he adds.

Initial products will be delivered in 4x25G configurations, with potential platform extensions to highly parallel interconnects

"Our 25Gbps silicon proven transceiver technology will enable data centers to keep pace with growing bandwidth demands, providing end-users with enhanced connectivity; all at a cost per gigabit lower than the current generation of interconnects," reckons Luxtera's VP of engineering Peter De Dobbelaere. "Selection to showcase in this year's SC10 disruptive technologies exhibit further underscores the technology's potential to disrupt the HPC landscape," he adds.

"A technology is considered disruptive if it is so much better than current practice that it is poised to displace the incumbent technology and becomes the standard practice for future technologies," says John Shalf of SC10. "We selected Luxtera's optical transceiver for the SC10 disruptive technologies exhibit because it represents a dramatic shift from conventional practice for these devices. To date, optical transceivers have relied on directly modulating the laser source, turning the entire laser on and off as fast as possible," he adds. "Luxtera's device uses silicon photonics technology to modulate the light directly rather than the laser source. This not only enables a path to scaling to even higher signaling rates, it can also greatly reduce the cost of optical devices in the future. Given these capabilities, it is poised to drastically change optical transceiver technology across the industry."

Also, for the third consecutive year, Luxtera's Blazar 40Gbps active optical cables (AOCs) will provide connectivity for the SC10 SCinet InfiniBand network, built for HPC demonstrations. Selected for its extended reach and reliability, Blazar can support up to 4000m and offers what is claimed to be the industry's lowest power consumption of 20mW per Gigabit.

Luxtera showcased its 25Gbps transceiver technology in the disruptive technology booth (15–18 November). Its commercially shipping products, Blazar and OptoPHY (optics on motherboard transceivers) were also featured in Luxtera's booth.

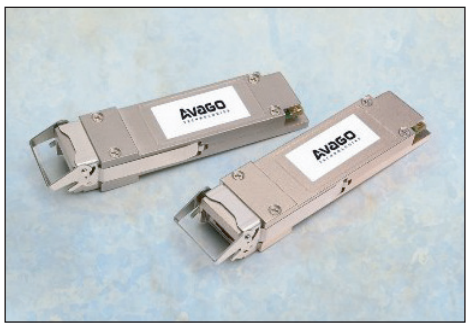
Commercial products based on 25Gbps transceiver technology availability will coincide with the market's introduction of 100Gbps EDR InfiniBand and 100G Ethernet Systems. Initial products will be delivered in 4x25G configurations, with potential platform extensions to highly parallel interconnects such as 12x and 16x.

www.luxtera.com

Avago launches first optical module to enable multimode 40G Ethernet uplink applications

Avago Technologies has announced the availability of the AFBR-79E4Z four-channel parallel optic QSFP+ transceiver module for 40 Gigabit Ethernet, enabling data communication and interconnect applications that integrate four independent 10Gbps data lanes in each direction to provide 40Gbps aggregate bandwidth. The pluggable modules also provide an alternative to copper interconnects for switch and router connections, data aggregation systems and backplane applications.

The proliferation of videos and multimedia files in business environments is placing a premium on bandwidth and density in data centers and high-performance computing applications, says Avago. Copper interconnects present significant challenges to achieving 40Gbps bandwidth performance, and their power and size requirements are inefficient for higher-bandwidth applications. System designers are hence making the transition to optical interconnects, which can handle much higher bandwidths for longer-reach lengths, consume less power, improve electromagnetic noise resistance, and provide more flexible cable management than copper-based solutions.



Avago's AFBR-79E4Z transceiver.

The AFBR-79E4Z QSFP+ modules are fully compliant to the IEEE 802.3ba 40GBASE SR4 specification, and support the IBTA 4 x 10G QDR for Infiniband applications. They provide designers with maximum flexibility to support installations of varying cable links or for difficult cable plant installations, says Avago. With data rates of 10Gbps for up to 100m using OM3 fiber or 150m using OM4 fiber, the modules operate over multimode fiber systems using a nominal wavelength of 850nm. Their electrical interface uses a 38 contact edge type connector, while the optical interface uses either an 8- or 12-fiber MTP (MPO) connector. A 21mm horizontal port pitch provides high port density. Maximum power consumption is less than 1.5W, while the case temperature operating range is 0–70°C.

The AFBR-79E4Z modules provide what is claimed to be superior electro-optical noise immunity, enabling the optimal jitter performance required for high-speed computing, server clustering, Infiniband and Ethernet switching, and core routers. The transceivers are also hot pluggable for ease of installation and servicing, and are backward compatible with 5 and 2.5Gbps per channel applications.

In addition to the AFBR-79E4Z transceiver, the AFBR-79E4Z-D variant features full real-time digital diagnostic monitoring. The AFBR-79E4Z is priced at $550 and the AFBR-79E4Z-D at $600, each in 10-piece quantities.

At the Super Computing 2010 (SC10) conference (16–19 November), Avago demonstrated its QSFP+ transceiver technology for 40 Gigabit Ethernet applications connected to an Infiniband switch using its new CXP form-factor technology.

www.avagotech.com

Avago mini-SFP+ transceiver boosts port density by 30% over SFP+

At the Super Computing 2010 (SC10) conference (16–19 November), Avago Technologies announced a new form factor for fiber-optic transceivers that enables increased port density in Ethernet and storage equipment.

The new mini-SFP+ (mSFP+) pluggable modules enable 30% greater port density over industry-standard SFP+ transceivers, while delivering the same data-transmission performance for next-generation 10Gbps Ethernet equipment designs and 8Gbps Fibre Channel for storage applications.

The mSFP+ transceivers incorporate Avago's 850nm vertical-cavity surface-emitting laser (VCSEL) and PIN detector technology and comply with the IEEE 802.3ae 10GBASE-SR standard's optical interface specification. The devices are designed for low power consumption, with typical dissipation of 0.6W. Avago has teamed with multiple cage and cable suppliers to provide a complete 10Gbps Ethernet mSFP+ solution.

At SC10, Avago is exhibiting a high-density DCX Backbone modular switch from Brocade featuring the mSFP+ technology, in addition to demonstrating other high-speed optical fiber solutions.

"Avago is the market leader in 8 and 10Gbps SFP+ transceivers, and our new mini-SFP+ devices integrate our proven technology in an innovative form factor that helps our world-class networking customers such as Brocade to deliver higher-density networking equipment," says Tina Ohlhaver, marketing manager for fiber optic products. "Avago optical transceivers offer unparalleled reliability, with not a single VCSEL failure in the millions of 8 and 10Gbps modules we have shipped to date."

Avago debuts first fully compliant CXP transceiver

120Gbps transceiver provides optimal cable management flexibility

At the Super Computing 2010 conference (SC10) in New Orleans (16–19 November), Avago Technologies demonstrated what is claimed to be the industry's first CXP parallel optic transceiver solution that is fully compliant to industry standards.

The new 12-channel CXP transceivers support lane rates of up to 10Gbps for an aggregate bandwidth of up to 120Gbps. The hot-pluggable modules feature an industry-compliant MTP multi-fiber push on (MPO) receptacle for removable fiber cable connectors. Avago says that this allows flexible cable management at installation, simplifying design and lowering cost for high-performance computing, switch fabric and other short-range data and communication interconnect applications.

The transceivers are compliant to both IBTA MSA specifications for CXP QDRx12 and IEEE 100GBASE-SR10 specifications. The modules combine the firm's 850nm vertical-cavity surface-emitting laser (VCSEL) technology, PIN array technology, and integrated laser driver and receiver IC technology to provide robust electrical and optical performance at high data rates.

Programmable equalization and de-emphasis for each of the modules' lanes optimize the signal integrity performance for an edge-mount solution and long PCB trace lengths. With what is claimed to be superior jitter performance, the modules provide 10Gbps performance per lane for up to 100m using OM3 fiber or 150m using OM4 fiber.

The new 12-channel CXP transceivers support lane rates of up to 10Gbps for an aggregate bandwidth of up to 120Gbps ...this allows flexible cable management

"Our CXP transceiver works with separate cabling to offer a pay-as-you-go fiber-optic solution with lower total cost of ownership and easier installation," says Tina Ohlhaver, Avago Technologies' marketing manager for fiber-optic products.

"Avago has over a decade of experience in developing 12-channel parallel optic solutions, and we are leveraging this expertise and investment in building-block technologies to support our customers with both standards-based and custom proprietary solutions," she adds.

At Super Computing 2010, Avago is demonstrating its CXP form-factor technology in an Infiniband switch connected to its QSFP+ transceiver technology for 40 Gigabit Ethernet applications, in addition to demonstrating other high-speed fiber-optic communications solutions.

www.avagotech.com

Avago launches 120Gbps high-density parallel optical interconnects

At the Super Computing 2010 (SC10) conference (16–19 November), Avago Technologies has launched a high-bandwidth, high-density parallel optic solution for short-range data and communication interconnect applications.

The new 12-channel embedded MiniPOD parallel optics transmitter and receiver modules support lane rates of up to 10Gbps for an aggregate bandwidth of up to 120Gbps. The small-footprint modules feature a low-cost, removable fiber cable connection and a pluggable electrical connection that provide flexible cable management at installation, simplifying design and lowering cost for switching and supercomputing applications.

The modules combine Avago's 850nm vertical-cavity surface-emitting laser (VCSEL) technology, PIN array technology, and integrated laser driver and receiver IC technology to provide robust electrical and optical performance at these high data rates. Using separate transmitter and receiver modules provides design flexibility and lowers the total solution cost for the optical interconnect, says Avago. Incorporating programmable equalization and de-emphasis into the modules' compact 22mm x 18.5mm form factor allow system designers to optimize dense board layouts with superior signal integrity and system margin, the firm adds.

The modules combine Avago's 850nm VCSEL technology, PIN array technology, and integrated laser driver and receiver IC technology to provide robust electrical and optical performance

"Our new MiniPOD 120 Gigabit optical interconnects offer a powerful combination of density, speed, performance and design flexibility," says Tina Ohlhaver, marketing manager for fiber optic products. "Avago offers the market's broadest range of high-density, high-bandwidth parallel optical interconnects, which allows us to meet unique customer layout and density needs," she claims.

Avago exhibited high-density board layouts using its MicroPOD and MiniPOD technology at SC10.

Finisar's quarterly revenue up 16% to record $240.9m

Operating margin hits revised target sooner than expected

For its fiscal second-quarter 2011 (to end-October 2010), fiber-optic communications component and subsystem maker Finisar Corp of Sunnyvale, CA, USA has reported another revenue record for continuing operations of $240.9m, up 15.9% on $207.9m last quarter and up 65.3% on $145.7m a year ago (and above September's guidance of $215–230m).

"The market environment continued to be very strong for Finisar, driven by increased demand for a broad range of LAN/SAN and metro/telecom products," says CEO Eitan Gertel. "The company continued to gain market share, including in the WSS/ROADM line-card segment," he adds.

Of the $33m increase in revenue from last quarter, sales fell $0.7m (15.6%) for products for analog and cable TV applications, but rose $12.1m (15.4%) for less than 10Gbps products, $13.3m (14.1%) for 10Gbps or faster products, and $8.3m (27.3%) for reconfigurable optical add-drop multiplexer (ROADM)-related products, including wavelength selective switches (WSS).

On a non-GAAP basis, gross margin has risen further, to 35.5% from 35.2% last quarter (due mainly to a favorable shift in product mix) and 29.6% a year ago (due to a reduction in manufacturing unit costs from higher shipment volumes).

Operating expenses as a percent of revenue have been cut from 23.5% a year ago and 21.3% last quarter to 18.5%, due mainly to revenue growing faster than expenses. Non-GAAP operating income has risen from $8.9m (6.1% of revenue) a year ago and $29m (14% of revenue) last quarter to a record $40.9m (17% of revenue, exceeding September's guidance of 14–15%).

The company continued to gain market share, including in the WSS/ROADM line-card segment

"We reached our previously announced target for non-GAAP operating margin of 17%, upwardly revised just last quarter, substantially earlier than we had predicted," says executive chairman Jerry Rawls. "Achieving this level of operating margin was driven by our strong revenue growth combined with minimal increases in operating expenses," he adds. "We achieved new company records for quarterly revenues, operating income and net income."

Non-GAAP net income has risen from $7.5m a year ago and $25.8m last quarter to $38.3m. Non-GAAP EBITDA rose to $49.5m, up from $37.3m last quarter and more than triple the $16m a year ago.

After working capital adjustments and capital expenditure ($13.4m, up from $12.1m last quarter and $7.6m a year ago), cash generated totaled $18m.

During the quarter the firm received $11.3m in cash (net of related legal fees) under a settlement and cross-license agreement with Source Photonics Inc, resolving a lawsuit claiming infringement of Finisar patents. Finisar also paid $29.6m in cash to retire convertible subordinated notes that matured on 15 October and made scheduled principal payments of an additional $1m on its Malaysian debt. Finally, the firm used $5.9m in cash to make a strategic minority investment in a small optoelectronics company. In total, cash and cash equivalents fell during the quarter from $192.2m to $184.9m.

For its fiscal third-quarter 2011 (to end January), Finisar expects revenue to rise to $247–262m (including revenue for WSS/ROADM line-cards growing another 20–30% sequentially). Non-GAAP operating margin should be at least 17%.

Finisar demonstrates first InfiniBand FDR active optical cable for high-performance computing and 16x Fibre Channel applications

At the annual SuperComputing (SC10) conference on high-performance computing, networking, storage and analysis in New Orleans (15–18 November) Finisar demonstrated the industry's first InfiniBand FDR active optical cable. The high-speed Quadwire FDR cable transmitted 56Gb/s data across four lanes of traffic at 14Gb/s each.

As the operating speed of supercomputing clusters continues to accelerate, the high-performance computing (HPC) and data-center markets demand higher-speed interconnections to support the increasing bandwidth needs, says Finisar. Its FDR active optical cables use 14Gb/s VCSEL technology to provide the next level of data throughput in the form of a compact, lightweight and flexible optical cable suitable to support those very high-density deployments.

"This product leverages our expertise in optics technology to provide a timely solution to the bandwidth and link distance requirements which cannot be supported by copper cables," says Christian Urricariet, director of marketing for high-speed optics.

At SC10, Finisar also displayed its complete family of active cables, including Laserwire for 10GbE, Quadwire for 40GbE and InfiniBand QDR, and C.wire for 100GbE and InfiniBand QDR.

www.finisar.com

Advanced Photonix reports quarterly revenue up 29% year-on-year

Guidance for full-year sales growth raised from 20% to 25%

For its fiscal second-quarter 2011 (to 2 July 2010), Advanced Photonix Inc of Ann Arbor, MI, USA (which designs and makes silicon, InP- and GaAs-based APD, PIN, and FILTRODE photodetectors, high-speed optical receivers, and terahertz instrumentation) has reported revenue of $7m, up 11% on $6.3m last quarter and up 29% on $5.4m a year ago. Revenue was down in only one of the firm's five markets.

"The second quarter continued to fuel our strong return to growth," says chairman & CEO Richard (Rick) Kurtz. "Year-to-date results are ahead of the raised guidance we gave in August of 20% year-over-year growth," he adds.

Although down on 47% last quarter, gross margin of 42% is still up on 38% a year ago. On a non-GAAP basis, net profit was $209,000, more than doubling from just $97,000 last quarter and compared to a net loss of $452,000 a year ago. EBITDA (earnings before interest, taxes, depreciation, and amortization) was $455,000, up from $387,000 last quarter and compared to negative $220,000 a year ago (an improvement of $675,000).

"We expect a strong second half of the year based on: the increase in demand for our HSOR [high-speed optical receiver] products; a rebounding of our Optosolutions product platform; and the increased interest in our terahertz product platform, as demonstrated by the recently announced contracts to assist the Department of Homeland Security with the detection of concealed threats through the utilization of the technology in our T-Ray 4000," says Kurtz. "Based on the performance of the first half and the outlook for the second half we are raising our annual guidance to the low end of a 25% increase in sales for the year."

We are raising our annual guidance to the low end of a 25% increase in sales for the year

● Advanced Photonix has also filed with the Securities and Exchange Commission (SEC) a shelf registration statement that will allow it to sell up to $7m of various securities. The terms of any future sale or issuance of securities under the registration statement will be set forth in a prospectus supplement to be filed with the SEC.

Picometrix wins $5.3m order for 100G high-speed optical receivers

Advanced Photonix Inc says that a leading OEM telecom systems provider has selected its subsidiary Picometrix LLC to supply its CR-100A 100Gb/s high-speed optical receiver (HSOR) for long-haul communications.

The annual commitment is estimated at more than $5.3m, with volume shipments beginning in the firm's fiscal fourth-quarter 2011 (starting January). Along with the commitment for the 100Gb/s HSOR (which is a new design), the systems provider also renewed its commitment to purchase $1.7m of the firm's existing 40Gb/s design (to be delivered over the next calendar year), raising its total spend in 2011 to $7m.

"This agreement with a major tier-1 telecom OEM, a leader in 100Gb/s deployment, is only one of several design wins with tier-1 and tier-2 OEMs that we are pursuing," says Robin (Rob) Risser, general manager of Picometrix and chief financial officer of API. "We anticipate additional design wins in both 100Gb/s and 40Gb/s DP-QPSK products will move to volume production status during 2011, and look forward to a long and rewarding relationship with this key customer in particular."

Additional design wins in both 100Gb/s and 40Gb/s DP-QPSK products will move to volume production status during 2011

Picometrix offers a complete line of 100Gb/s and 40Gb/s HSOR solutions for both client-side and line-side modulation formats, including NRZ, RZ, DPSK, DQPSK, ODB and DP-QPSK and DP-BPSK. The new design wins are for 100Gb/s long-haul communications in dense wavelength division multiplexing (DWDM) systems that use DP-QPSK and DP-BPSK modulation.

The CR-100A 100Gb/s optical receiver (launched in March and shipping since June) uses the firm's patented photodiode arrays, a complete optical front-end including 90º optical mixer, and high-speed linear amplifiers. It comes in the industry-standard CCRx multi-source agreement (MSA) form factor, is consistent with the Optical Internetworking Forum's Implementation Agreement for coherent receivers, and supports data rates up to 128Gb/s. The receiver operates over the entire extended C- and L-band wavelengths and can be configured with or without an internal polarization beam splitter.

www.advancedphotonix.com

GigOptix's 15% growth to record revenue in Q3 yields first non-GAAP profit

Growth of 7–10% in Q4 to be driven by 40G and 100G products

For third-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, has reported another revenue record of $7.2m. This is up 130% on $3.1m a year ago and 15% on $6.3m last quarter (the fourth consecutive quarter of both double-digit growth and growth of more than $1m on the prior quarter). It also exceeds July's guidance of $6.6–6.8m.

"Achievement of record revenue during the third quarter and for the first nine months of the year represents our continued execution on our business initiatives," comments chief financial officer Ron Shelton.

"Our results were driven by continued momentum and market share gains as we capitalized on our leadership position in 40G and 100G optical products," reckons chairman & CEO Dr Avi Katz. Revenue from 40G and 100G products grew more than 65% sequentially. In particular, during the quarter, GigOptix started volume shipments of drivers for both 100G coherent and 40G RZ-DQPSK systems (two of the fastest-growing optical segments). The firm also expanded its 100G portfolio to surface-mounted devices (SMDs) and began sampling a quad 7.5Vpp DWDM driver for 100G DP-QPSK applications.

"Most notable, during the third quarter we introduced our 40G and 100G Bundled Solutions, which we believe sets another industry first by providing a complete solution set comprised of a TIA and a TFPS [thin-film polymer on silicon] Mach–Zehnder modulator (MZM) with a matched driver for an optical application," says Katz. "Our goal is to simplify our customers' supply chain and development efforts by offering a one-stop-shop for all of their 40G and 100G requirements, including drivers, receivers and modulators, which will also enhance inter-operability quality and performance," he adds. "These products are not currently available from any other single supplier."

Shortly after the close of the third quarter, GigOptix began shipping the industry's first production samples of its TFPS MZM to tier-1 telecom customers. "This proprietary technology enables electro-optical polymer MZMs that establish new performance thresholds in our industry in terms of small size and low power," says Katz. "Our high-bandwidth TFPS MZM is optimized for the stringent telecom thermal and optical stability requirements demanded by our customers and we believe greatly strengthens our comprehensive Bundled Solutions of 40G and 100G drivers and receiver TIAs."

Also during the quarter, GigOptix launched a family of ultra-low-power multi-rate SMART optical sub-assemblies (OSAs) targeting short-reach datacom applications, demonstrated at the European Conference and Exhibition on Optical Communications (ECOC 2010) in late September. The SMART receive OSA (ROSA) and SMART transmit OSA (TOSA) are based on a new generation of GigOptix' VCSEL driver and TIA/limiting amplifier chips that combine RF analog circuit techniques that reduce power consumption with mixed-signal circuits to enable a fully digitally controlled TOSA and ROSA. "Given their ultra-low power dissipation and ease of design, we believe there is significant opportunity for our SMART TOSA and SMART ROSA products not only in the traditional datacom market but also in consumer, industrial and avionics markets," says Katz.

"Our expanded product offerings position GigOptix as the only pure-play provider of electronic devices for high-speed fiber-optical communications covering all applications (drivers, amplifiers and modulators), all speeds (from 1–120G), and all distances — from very short reach (VSR) to ultra long haul (ULH)," believes Katz.

On a non-GAAP basis, gross margin has fallen from 62% a year ago and 58% last quarter to 55% in Q3. However, although up on $3m a year ago, operating expenses have been cut by 12% from $4.7m last quarter to $4.1m.

Compared to net loss of $0.7m a year ago and $0.4m last quarter, GigOptix achieved its first non-GAAP net profit, of $0.3m. The firm also achieved its second consecutive quarter of positive adjusted EBITDA, up from $0.2m last quarter to $0.9m (12% of revenue), compared to a loss of $0.6m a year ago.

During the quarter, cash and investments rose from $0.8m to $4.9m, including $3.9m in net proceeds from a public offering of shares completed in July.

"The third quarter represents our 13th quarter of consistent execution since the inception of the company in July 2007, and we are proud of our continuing ability to exceed our original GigOptix growth plan," says Katz.

For fourth-quarter 2010, GigOptix expects revenue to grow sequentially by 7–10%, driven by continued demand for its existing product lines as well as increasing traction of products for the 40G and 100G markets. "Furthermore, we expect to grow non-GAAP profitability and adjusted EBITDA as we move closer towards achieving GAAP profitability," concludes Shelton.

"Going forward, we will focus on expanding our customer base and enhancing our product portfolio by achieving a higher level of integration with our Bundled Solutions, as well as continuing to pioneer even higher communication speeds up to 1Tbps over the next five years," reckons Katz.

www.GigOptix.com

GigOptix opens support & sales offices in China

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 opened two new offices in the Greater China region, in Wuhan and Shenzhen, responsible for sales promotion, customer service, and technical support in China.

Since the firm's inception, GigOptix has operated in China through local representative Pangaea (HK) Ltd, enabling it to develop close partnerships with local industry leaders. Activities in China include partnering with local manufacturers to develop products targeted specifically for Chinese end-users.

"The new offices located at Luoyu Road, East Lake Hi-Tech Development Zone, Wuhan and Shennan Road, Futian District, Shenzhen demonstrate GigOptix' commitment to not only its Wuhan and Shenzhen customers but also the broader China market," says Jay de la Barre, VP of global sales. "Our staff is composed of well-respected professionals with proven field experience, as well as extensive experience in telecom and datacom applications, support and service. The establishment of these new offices further confirms GigOptix' commitment to developing a strong presence in the Chinese market," de la Barre adds.

China's optical networking market is growing rapidly, and is expected to represent a total addressable market (TAM) of $3bn by 2015... We are increasing our local presence to better support our customers at their point of use

"China is strategically important to GigOptix. The expansion of our team in China is an important milestone in our continued commitment to building a strong presence in Asia and improving our service to customers," says chairman & CEO Dr Avi Katz. China's optical networking market is growing rapidly, and is expected to represent a total addressable market (TAM) of $3bn by 2015, according to telecom market research firm Ovum. "With this in mind, and more importantly with our continuously growing business in China, we are increasing our local presence to better support our customers at their point of use, and capitalize on this attractive and rapidly growing market," says Katz. "With our two new offices, GigOptix now brings its full resources to China, including engineering, support, sales and marketing expertise that will enable GigOptix to better serve the needs of the local market," he adds.

Pre-production single-channel 40G and 100G SMT driver sampled

GigOptix has made available samples of its pre-production GX6255, a surface-mounted $8V_{pp}$ Mach–Zehnder Modulator (MZM) single-ended driver designed for use in 40G RZ-DQPSK and 100G DP-QPSK transponders.

The GX6255 is a low-power, compact surface-mount technology (SMT) MZM driver capable of outputting $8V_{pp}$ at up to 32Gb/s. It is designed to be fully compliant with industry-standard single-ended driven 40G RZ-DQPSK and 100G DP-QPSK modulators. It is typically used to amplify the data signals between the transponder multiplexer and its optical MZM and dissipates about 1.6W of power at $7.5V_{pp}$ output.

"Increasing consumer demand for bandwidth and the advent of cloud computing are driving network operators to upgrade from 10Gb/s links to larger 40Gb/s and 100Gb/s links to keep pace," says VP of marketing Padraig O'Mathuna. "Building on the success of our recently announced GX62455 quad-channel driver, we are proud to extend our 40G and 100G driver offering with our newest single-channel $8V_{pp}$ driver to offer customers a complete driver portfolio solution for all their 40G and 100G driver requirements," he adds. "Our driver portfolio, in combination with our comprehensive receiver portfolio of dual-channel transimpedance amplifiers (TIA) for 40G and 100G coherent systems and receiver amplifiers for 40Gb/s RZ-DQPSK systems, enable GigOptix to offer customers the widest selection of 40G and 100G solutions in the market," O'Mathuna claims.

Increasing consumer demand for bandwidth and the advent of cloud computing are driving network operators to upgrade from 10Gb/s links to larger 40Gb/s and 100Gb/s links to keep pace

The 100G DWDM line-side market will grow at a CAGR of 140% to more than 16,000 units by 2015

In a recent report on 100G components, market research firm Ovum forecasted that, after launching in 2010, the 100G dense wavelength division multiplexing (DWDM) line-side market will grow at a compound annual growth rate (CAGR) of 140% to more than 16,000 units by 2015.

www.GigOptix.com

Opnext reports higher-than-expected growth, to quarterly record of $86.4m

40G and 100G becoming key growth engine for optical industry

For its fiscal second-quarter 2011 (to end-September 2010), optical module and component maker Opnext Inc of Fremont, NJ, USA has reported record revenue of $86.4m, up 9.5% on $78.9m last quarter and 6.7% on $81m a year ago (and above guidance of $80–85m).

Of total revenue, Alcatel-Lucent, Cisco Systems Inc and Huawei Technologies Co Ltd each represented 10% or more (47% combined, down from 51% last quarter).

Revenue from sales of industrial and commercial products grew for a fifth consecutive quarter to $7.7m, up 14.9% on $6.7m last quarter and up 148% on just $3.1m a year ago.

Revenue from sales of 10Gbps and below products was $56.5m. As supply constraints improve, this is up 1.2% on last quarter's $55.8m (due mainly to increased sales of XFP modules) and up 13.2% on $49.9m a year ago (driven by increased sales of XFP and SFP+ modules, offset partially by lower sales of Xenpak and X2 modules).

Revenue from sales of 40Gbps and above products was $22.2m. Although this is down 20.7% on $28m a year ago (due mainly to a drop in revenue from 40Gbps subsystem sales), this is up a huge 35.9% on $16.3m last quarter (due mainly to an increase in sales of 40Gbps and 100Gbps modules). Sales had been expected to be flat during new product ramp-up.

"The strength in 40Gbps and above modules, combined with recent customer and industry analyst forecasts, offers encouraging evidence that the markets we have been investing in — 40G and 100G — are becoming a key growth engine for the optical industry," comments president & CEO Gilles Bouchard.

Although still down on 24.2% a year ago, non-GAAP gross margin has risen from 20.9% last quarter to 22.2%, despite lower average per-unit selling prices. This is due to the higher sales volumes, a higher mix of 40Gbps and above revenues, lower average per unit material and outsourcing costs, and lower obsolete inventory and warranty charges.

Due mainly to the higher gross margin, non-GAAP operating loss has been cut from $12m last quarter to $9.8m (although this is still higher than $8.2m a year ago). Likewise, although still up on $9.2m a year ago, non-GAAP net loss has been cut from $12.1m last quarter to $10.7m.

During the quarter, cash and cash equivalents fell by $9.4m from $106.9m to $97.5m. This reflects $6.2m of cash used in operations, $3m of capital lease payments and $2.1m of capital expenditure (down from $3.1m last quarter), partially offset by a $1.9m benefit from foreign currency exchange fluctuations.

For its fiscal Q3/2011 (to end-December 2010), Opnext expects revenue to rise to $87–92m.

www.opnext.com

Fiber-optic modules for harsh temperature environments

At the Electronica 2010 trade fair in Munich, Germany (9–12 November), Avago Technologies launched a new line of optical fiber transmitters and receivers optimized for harsh temperature environments.

The RoHS-compliant HFBR-152xETZ/252xETZ optical fiber modules provide reliable data transmissions over cost-effective 1mm-diameter plastic optical fiber (POF) or 200 micron hard-clad silica fiber in the –40°C to +85°C extended industrial temperature range. The firm says that designers can use the devices to implement system control or drives in wind turbines and solar farms, traction inverters in trains, and for other industrial applications and medical systems.

Extending Avago's Versatile Link series, the new modules eliminate the electromagnetic interference, crosstalk and electrical ground problems common with copper wire solutions while providing easier, more flexible installation, says the firm.

The HFBR-152xETZ transmitters are based on a high-power 650nm LED that is easy to drive and modulate, and operate at speeds of 1–125MBd over distances up to 100m.

The HFBR-252xETZ high-bandwidth receivers contain a PIN photodiode and internal transimpedance amplifier. The modules' plastic housings interlock for single-channel or duplex links in a horizontal mount configuration, providing flexibility during PCB layout.

The HFBR-1527ETZ transmitter and HFBR-2526ETZ analog receiver are designed for transmissions from 1 to 125MBd. The HFBR-1521ETZ transmitter and HFBR-2521ETZ digital receiver transmit from DC to 5MBd, and the HFBR-1522ETZ transmitter and HFBR-2522ETZ digital receiver transmit from DC to 1MBd.

"The addition of these new Versatile Link series modules with extended temperature range operation is based directly on requests from our customers in the rapidly growing renewable energy and transportation markets," says Mickael Marie, marketing manager for industrial fiber products.

www.avagotech.com

China's ZJF buys Ireland's Firecomms

€5m for POF R&D and engineering expansion

In what is said to be the first ever technology acquisition of an Irish high-tech firm by a Chinese corporation, Zhejiang-based ZJF Group has acquired Firecomms Ltd of Cork, Ireland, a manufacturer of transceivers (including its OptoLock technology, licensed worldwide) for consumer plastic optical fiber (POF).

Spun from Ireland's Tyndall National Institute in 2001, Firecomms develops high-speed optical components that drive fiber-optic networks in home, industrial and automotive applications. Established in 1994, ZJF is an integrated POF system and solutions provider with more than 3000 staff that sells to more than 100 countries, and has supply partnerships worldwide for illumination products with large retailers such as Walmart, Target and B&Q.

The deal guarantees €5m investment in R&D, together with expanding Firecomms' engineering team from 18 to 30 people over the next 12 months, as well as facilitating the rapid expansion of Firecomms' operations in mainland China.

"For some time now, mainland China has been our largest market," says Firecomms' CEO Declan O'Mahoney. "As the ZJF Group is a major global player in this sector, today's announcement not only allows us to guarantee investment capital and job growth for the future, it also provides us with access to the world's largest marketplace for our technology," he adds.

Firecomms' shareholders included Atlantic Bridge, ACT Venture Capital, Swisscom Ventures, Alps Electric and Enterprise Ireland. "We are very pleased with this outcome, which positions Firecomms for continued growth and success in the world's largest market," says Brian Long, managing partner at Atlantic Bridge, and member of Firecomms' board of directors.

"Our acquisition of Firecomms is driven by the recent decision by various provincial governments to classify plastic optical fiber as a major construction focus across China," notes ZJF's chairman Xuping Zheng. "Delivering this infrastructure with copper cables would result in over 1 million tons of CO_2 emissions for China, and would be impossible to implement as the demand for copper would far outweigh the world's supply. China is already the largest manufacturer of plastic optical fiber and we are combining those huge resources with Firecomms' leading technology," he adds.

"This increased investment in R&D, coupled with access to the broad resources of the ZJF Group, will be hugely advantageous for our customers," believes O'Mahoney. "In addition to giving us the ability to offer complete integrated networking solutions to our customers, the investment and access to a fast-growing marketplace will result in rapid development of POF solutions, and reduced costs for this reliable, easy-to-use technology," he says.

"The acquisition of Firecomms by the ZJF Group demonstrates the global appeal of the Irish high-tech sector," states Ireland's Minister for Enterprise, Trade and Innovation Batt O'Keeffe TD. "Ireland's enterprise base is now well diversified and our economic recovery is anchored in continued strong export growth and a thriving foreign direct investment sector," he adds.

"A recent study showed that foreign direct investment is generating more jobs per capita in Ireland than any other country," according to Barry O'Leary, CEO of inward investment promotion agency IDA Ireland. "IDA's published strategy Horizon 2020 calls for an increase in investments from new high-growth markets. This pioneering technology deal is a perfect example of why Ireland is increasingly recognized as a global innovation hub," he adds.

www.firecomms.com
www.zjfgroup.com

IN BRIEF

Infinera appoints chairman

Infinera Corp of Sunnyvale, CA, USA, a vertically integrated manufacturer of digital optical network systems incorporating its own InP-based photonic integrated circuits (PICs), has appointed Kambiz Hooshmand chairman of the board of directors and named co-founder Dr David Welch to its board of directors.

Hooshmand, who joined Infinera's board last year, has more than 20 years of experience in optical transport, routing, access, and related technologies. He was president & CEO of Applied Micro Circuits Corp from 2005 to 2009. Previously, he held senior positions at Cisco Systems Inc, including VP & general manager of Cisco's Optical and Broadband Transport business unit.

Welch is currently Infinera's executive VP & chief strategy officer. Previously, he held senior positions at optical component makers SDL Inc and JDS Uniphase. Welch has more than 80 patents and about 300 technical articles to his name. His role in the development of semiconductor laser technology and related products was recognized with the 1994 Adolph Lomb Award, the 1998 Engineering Achievement Award from the Lasers and Electro-Optics Society, and the 1999 Fraunhofer Award. Welch also currently serves on the boards of both the Optical Society of America (OSA) and the Optoelectronic Industry Development Association (OIDA).

"These appointments bring deep experience of many aspects of the telecom and technology businesses to Infinera," says CEO Tom Fallon. "Kambiz and Dave will play valuable roles on our board as we continue to grow and develop our business."

www.infinera.com

Oclaro's quarterly growth slows from 11.4% to 7.6%, as revenue, gross margin and adjusted EBITDA fall short

Late September slowdown prompts caution on December quarter

For its fiscal first-quarter 2011 (ended 2 October 2010), optical component, module and subsystem maker Oclaro Inc of San Jose, CA, USA has reported revenue of $121.3m. This is up 43% on $85.1m a year ago and 7.6% on $112.7m last quarter (compared to growth of 11.4% that quarter, and back to the level of the March quarter's growth rate of 8%). Revenue was on the low side of the forecast growth of 9% to $120–126m. "We experienced a slowdown in the rate of revenue growth in late September," notes president & CEO Alain Couder. However, telecom business in particular grew by slightly more than the overall revenue, being up 9% on last quarter.

On a non-GAAP basis, gross margin has fallen from 30.7% last quarter to 29% (short of the forecast 31–33%), although still up on 26.1% a year ago. Although up from just $4.1m a year ago, adjusted EBITDA has fallen from $12.3m last quarter to $10.9m (short of the forecast $12.5–15.5m). Net income has fallen from $11.5m last quarter to $3m (but still a big improvement from a net loss of $98,000 a year ago).

During the quarter, cash, cash equivalents, restricted cash and short-term investments fell from $111.6m to $94m. However, this was mainly due to Oclaro paying $12m in cash for the acquisition on 20 July of high-bit-rate optical transport subsystem maker Mintera Corp of Acton, MA, USA.

"Our guidance for the December quarter is cautious," says Couder. For fiscal second-quarter 2011 (to end-January 2011), Oclaro expects revenue of $116–124m, non-GAAP gross margin of 27–31%, and adjusted EBITDA of $6–11m. But Couder adds: "We continue to have confidence in our position in the market and believe the growth prospects for Oclaro and our customers in 2011 continue to be strong."

www.oclaro.com

Oclaro and JDSU receive Huawei Excellent Core Partner Awards

At its 2010 Core Partner Convention in Shenzhen in November, China's Huawei Technologies Co Ltd (one of the world's largest makers of optical networking equipment for the telecoms industry) presented its Excellent Core Partner Award to two optical chip and module makers.

Oclaro Inc of San Jose, CA was awarded for the second consecutive year, while JDSU of Milpitas, CA was awarded for its delivery of optical technology including its ROADM and tunable XFP products.

www.huawei.com

JDSU grows revenue despite supply & capacity constraints

Operating margin exceeds guidance

On a non-GAAP basis (including revenue from the acquisition of the Network Solutions Division from Agilent Technologies Inc at the beginning of May), for its fiscal first-quarter 2011 (ended 2 October 2010) JDSU of Milpitas, CA, USA has reported revenue of $411.3m, up 3% on $398.1m last quarter and up 38% on $298.6m a year ago.

Advanced Optical Technologies revenue was $60.5m (15% of total revenue), up 11% on last quarter's $54.6m and 12% on $54.1m a year ago. Communications Test & Measurement revenue was $182.8m (44% of total revenue), down 2% on last quarter's $186.2m but up 27% on $143.4m a year ago.

Communications & Commercial Optical Products (CCOP) revenue was $168m (41% of total revenue), up 7% on last quarter's $157.3m and 66% on $101.1m a year ago. CCOP operating income was $24.2m, compared with $19.1m last quarter and an operating loss of $1.5m a year ago.

Within CCOP, Commercial Lasers revenue was $25m (up 11% on last quarter's $22.6m). Optical Communications revenue was $143m (up 6% on last quarter's $134.7m).

Overall company gross margin has risen from 44% a year ago and 45.5% last quarter to 47.4% (the highest in five years). Operating margin has risen from 3.4% a year ago and 9.3% last quarter to 10.8% (above the guidance of 8.5–10.5%). Net income was $44.8m, up from $33.1m last quarter and just $9m a year ago.

"Our balance sheet remains strong," says president & CEO Tom Waechter. After generating $35.7m of cash from operations, during the quarter total cash and cash equivalents and short-term investments rose from $600.1m to $620m. "We expect to continue growing the business as supply constraints ease in our Optical Communications and Test & Measurement businesses and we invest in incremental capacity for Optical Communications," he adds.

For fiscal Q2/2011 (ending 1 January), JDSU expects revenue of $425–450m (up 6% sequentially).

www.jdsu.com

Emcore switches from $14m Bank of America credit facility to $35m Wells Fargo credit facility

Emcore Corp of Albuquerque, NM, USA, which makes components and subsystems for the broadband, fiber-optic, and solar power markets, says that it has terminated its existing loan agreement with Bank of America (a $14m revolving credit facility) and instead established an asset-based revolving credit facility with Wells Fargo that provides for borrowings up to $35m for working capital requirements, letters of credit and other general corporate purposes.

The credit facility is subject to certain financial covenants and a borrowing base formula and matures in November 2013. It bears interest at a rate per annum equal to the daily three-month LIBOR rate for the applicable interest period plus 3%. The loan is secured by substantially all of the firm's assets located in the USA and is guaranteed by certain subsidiaries. The loan agreement contains customary representations and warranties, and affirmative and negative covenants.

Additional information can be found in a current report on Form 8-K to be filed with the US Securities and Exchange Commission (SEC).

"We are pleased to have executed a significant increase in our credit facility," says chief financial officer Mark Weinswig (who was appointed on 12 October). "This credit facility, combined with our existing cash position and improved operating performance over the past year, ensures that we have the financial capability required to support our strategic plan," he adds.

During third-quarter 2010, Emcore's cash, cash equivalents, available-for-sale securities, and current restricted cash fell from $19m to about $16m. Working capital totaled $33.1m.

On 6 October, Emcore said that it had regained compliance with a NASDAQ rule to file its Form 10-Q report for third-quarter 2010 with the SEC. Subsequently, on 26 October, the firm said that it had also regained compliance with another NASDAQ rule by maintaining the closing bid price of its common stock equal to or above $1 per share for a minimum of 10 consecutive trading days.

www.emcore.com

Oplink grows 28% from last quarter as China factory capacity increased

For its fiscal first-quarter 2011 (to end-September 2010), optical networking component, module and subsystem maker Oplink Communications Inc of Fremont, CA, USA has reported record revenue of $49.6m, up 28% on $26.4m last quarter and 48% on $23.6m a year ago (and at the high end of the expected range of $47–50m).

Of total revenue, OMS (optical manufacturing solutions) comprised about 40%, passives more than 40%, and actives less than 20%.

Huawei and Tellabs together accounted for 37% of revenue.

On a non-GAAP basis, gross margin has risen from 31.2% a year ago and 33.5% last quarter to 33.9% due to scaling revenue, offset by increased labor costs in China (total company headcount grew from 3821 to 3855, mainly in R&D engineering).

Non-GAAP net income has risen further, from $4.4m a year ago and $6m last quarter to $8.3m.

During the quarter, Oplink generated $5.5m in cash from operations. So, despite spending $6.5m on repurchasing its stock, cash, cash equivalents and short-term investments fell only slightly, to $160m.

"We have improved our factory capacity and normalized our production lead-times," says chairman & CEO Joe Liu. "We have the production flexibility to meet a meaningful increase in demand without any further significant increase in headcount," he believes.

"With our new OMS design-wins, the continued growing demand on video transport and consolidated competitor landscape, we are optimistic about our long-term business opportunity, but near-term visibility remains limited [due to softness in demand for some passive product lines]," Liu adds.

For fiscal Q2 (to end-December), Oplink expects revenue of $50–53m.

www.oplink.com

IN BRIEF

Emcore hires CFO

The board of directors of Emcore has appointed Mark Weinswig as chief financial officer, reporting to CEO Dr Hong Q. Hou and responsible for the firm's finance and accounting functions.

"Mark brings a broad background of both finance and accounting, as well as a deep understanding of the fiber-optics industry," comments Hou.

Weinswig previously held leadership positions as controller, executive VP of business development, and interim CFO with technology firms including Coherent Inc and Avanex Corp (now Oclaro Inc). He was previously at Morgan Stanley's Institutional Equity Research Group, covering the telecoms equipment industry, and at PriceWaterhouseCoopers as an auditor. Weinswig received an MBA from the University of Santa Clara and a BS in business administration from Indiana University. He also has CFA and CPA designations.

Spectrolab mass produces record 39.2% solar cell

Production cell efficiency boosted from 38.5%; 40% targeted in 2011

Boeing Company says that its subsidiary Spectrolab Inc of Sylmar, CA, USA has started mass production of its C3MJ+ terrestrial photovoltaic cell, which boosts average solar energy conversion efficiency from the existing C3MJ cell's 38.5% to what is claimed to be an industry mass-production record of 39.2%.

Spectrolab says that the concentrator photovoltaic (CPV) cells — used for renewable energy — draw on the firm's 50-year history of manufacturing solar cells for space and terrestrial applications. "These more efficient cells are drawing interest from a number of current and potential customers," says Russ Jones, director of CPV business development.

"Last year [in August 2009] we set a new world record for efficiency with a test cell that peaked at 41.6% [as tested independently by the US Department of Energy's National Renewable Energy Laboratory]," he adds (since surpassed this October by Spire's 42.3%-efficient CPV cell.) The cell is a version of the lattice-matched triple-junction photovoltaic technology already in high-volume production for space and terrestrial applications, but with improvements in wafer processing to reduce how much of the cell's area is shadowed by its metal contact grid and to improve series resistance. "We now have entered production with essentially this same technology and plan to deliver the first of these 39.2% efficiency cells in January," says Jones.

Spectrolab says that it has introduced mass production of a new series of solar cells with increased energy-conversion efficiency each year since 2007. The existing C3MJ series entered production in mid-2009, and more than 2 million have been sold worldwide. "Given the new cells' close similarity to our existing production cells, we believe that our current C3MJ customers will be able to easily upgrade for more efficiency," Jones says.

The firm says it expects to achieve 40% average production efficiency for terrestrial solar cells in 2011.

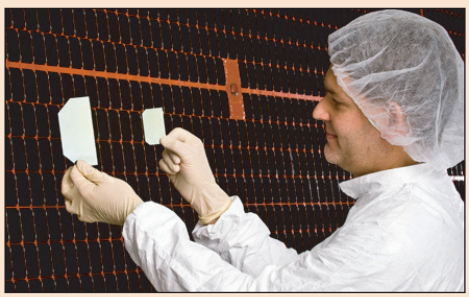
www.spectrolab.com

Spectrolab produces 3 millionth multi-junction space solar cell

Spectrolab has produced its 3 millionth multi-junction, space-based solar cell. Production records indicate that the gallium arsenide cell was delivered during the week of 25 October. Spectrolab has been manufacturing multi-junction solar cells for more than 15 years and other space products for more than 50 years.

"Our customers expect flawless satellites that can endure many years in space to enable national-security and Earth-observation missions, as well as consumer and business communications," says Craig Cooning, VP & general manager, Boeing Space & Intelligence Systems. "Spectrolab's solar cells have powered more than 500 satellites and interplanetary missions," he adds.

Spectrolab has been developing high-efficiency solar cells for space missions since the firm's founding in 1956. During the Apollo 11 mission in 1969, a Spectrolab product became the first solar panel to be placed on the moon. Today, Spectrolab solar panels are the only panels in operation on Mars, as part of a reconnaissance satellite and two land-exploration rovers.



Solar cells made by Spectrolab.

Spectrolab recently delivered solar panels to the NASA-Jet Propulsion Laboratory JUNO mission (the first mission to Jupiter to be powered by photovoltaic cells). Spectrolab's currently cells and panels power about 60% of all satellites in Earth's orbit, as well as the International Space Station.

"Many years of continuous improvement in product design and high-volume manufacturing experience have allowed Spectrolab to develop mature, cost-effective and repeatable processes, resulting in the delivery of high-quality, reliable and affordable products to both space and terrestrial customers," says Spectrolab's president David Lillington. "Our business continues to grow as we gain market share. We are increasing productivity and introducing higher levels of automation to meet this increased demand," he adds. "We expect to announce the production start of our next-generation space cells early next year."

In 2001, Spectrolab embarked on a strategy to adapt its space solar cell technology for terrestrial applications, converting concentrated sunlight to electricity with an average efficiency of more than 38.5% and benefiting from the same equipment, materials and processes used for space manufacturing. In 2009, a Spectrolab triple-junction, lattice-matched cell set a record of 41.6% for terrestrial concentrator solar conversion efficiency. This year, Spectrolab will deliver about 50MW of solar cells to terrestrial concentrated photovoltaic (CPV) customers, and expects to produce almost 150MW in 2011.

QuantaSol moves tunable CPV cells into pilot production

1MW orders for MQW triple-junction cells to be delivered in H1/2011

QuantaSol Ltd of Kingston-upon-Thames, UK, which designs and manufactures tunable concentrated photovoltaic (CPV) solar cells, is moving into pilot production following a successful period of global customer sampling.

Spun off from Imperial College, London in mid-2007 and funded by the Low Carbon Accelerator and Imperial Innovations, in June 2009 QuantaSol said that its strain-balanced quantum-well solar cell (SB-QWSC) had achieved record conversion efficiency of 28.3% for a single-junction PV cell at a concentration of greater than 500 suns (tested independently by Fraunhofer ISE). The firm has since been applying the technology to higher-efficiency multi-junction cells.

The firm claims that its latest technology, based on adding multiple quantum wells to triple-junction solar cells, enhances photovoltaic conversion efficiency and offers manufacturers a route to improving the performance of their CPV system while driving down the cost per kWh. QuantaSol has been sampling with customers across Europe, Asia and the USA for several months, and has worked closely with leading system vendors to enhance their systems by maximizing energy harvest.

"Our technology has always been focused on achieving maximum efficiency and power output in real-world conditions, and this has been pivotal in moving forward from the lab stage towards production," says CEO Chris Shannon. "We have been able to demonstrate genuine advantages in cost per kWh terms," he adds.

To date, QuantaSol has accumulated an order book of more than 1MW of cells, and these will be delivered through first-half 2011.

www.quantasol.com

SolFocus and Vision Electro Mechanical Company to build commercial CPV power plant in Saudi Arabia

SolFocus Inc of Mountain View, CA, USA says that Vision Electro Mechanical Company, a subsidiary of Construction Products Holding Company (CPC), is to build Saudi Arabia's first commercial solar power plant using CPV systems. Located in the Bahra region, the project will deliver around 300MWh of clean energy per year and is the first in a series of Saudi power stations planned by Vision.

"The high-sun conditions of the Middle East provide an ideal environment for reaping large-scale, low-cost solar energy from CPV systems," says SolFocus' CEO Mark Crowley. "Together with our partners at Vision, SolFocus will bring the world's most efficient and resource-friendly solar technology to Saudi Arabia, providing energy diversification for the country."

"We accomplished this partnership in line with Saudi's efforts to promote investment in renewable energy projects and serve power projects in the Gulf and the wider Arabian region," says Vision's general manager Hassan Chahine. "This is a breakthrough in Saudi Arabia's thrust for energy diversification. We believe the Bahra plant will serve as a model for the further research and study of clean water and power solutions that diversify the region's energy mix."

Vision will market and install the SolFocus systems, starting with the plant in CPC's Bahra industrial complex. It will also install other solar power stations in Saudi Arabia, as well as in the research centers of King Abdullah University of Science and Technology (KAUST).

Earlier this month SolFocus was the first CPV firm to announce a power warranty backed by Munich Re; in May it announced completion of the largest CPV installation in North America; and in 2009 it was the first CPV firm to secure International Electrotechnical Commission (IEC) certification for performance and safety.

www.solfocus.com

IN BRIEF

First performance warranty insurance in US for CPV panels

In collaboration with broker Woodruff-Sawyer & Co, Munich Re has introduced the first insurance solution to provide an effective performance warranty for CPV panels in the USA through a new plan that covers systems made by SolFocus.

SolFocus provides all its customers globally with a CPV system warranty of 25 years for power performance.

"As the first CPV company that can provide an insured performance-warranty to its customers, we are proud to pave the way for this advanced solar technology to reach commercial status and become a trusted, bankable technology for developers, financial institutions and utilities," says SolFocus CEO Mark Crowley. "The ability to provide such an insurance policy is critical for companies such as ours in providing confidence and trust to the marketplace," he adds.

www.munichre.com

SUNRISE test project unveiled by Canada's NRC

The National Research Council of Canada (NRC) has unveiled the SUNRISE (Semiconductors Using Nanostructures for Record Increased in Solar-cell Efficiency) test installation in the FlexHouse demonstration home of the Canadian Centre for Housing Technology (CCHT) at the NRC's Institute for Research in Construction (NRC-IRC) in Ottawa, Ontario. The project was formally started up in a ceremony hosted by Gary Goodyear, Minister of State (Science and Technology), and NRC president John McDougall.

SUNRISE is a collaborative research project between industrial partners OPEL Solar Inc of Toronto, Ontario,

SUNRISE tracker installation.

which makes high-concentration photovoltaic panels, and Ottawa's Cyrium Technologies Inc (which makes quantum-dot-enhanced multi-junction solar cells), as well as the NRC, the University of Ottawa's Centre for Research in Photonics, and the Université de Sherbrooke.

The project focuses on developing ultra-high-efficiency solar cells in combination with OPEL's concentrator design. Paired with OPEL's dual-axis tracker, the new panels are expected to validate target efficiencies for both cells and the system.

Funded by the NRC, the Business Development Bank of Canada (BDC) and the National Sciences and Engineering Research Council of Canada (NSERC), SUNRISE is the culmination of three years of research into using nanostructures to boost CPV system efficiency and output.

www.photonics.uottawa.ca/SUNRISE

OPEL's new CPV panel improves efficiency, reliability and manufacturing cost

OPEL Solar Inc of Shelton, CT, USA and Toronto, Ontario, Canada has launched its latest high-concentration photovoltaic (HCPV) solar panel. For shipping in spring 2011, the Mk-IX is designed for utility-grade grid-connected systems in medium-to-high solar irradiance climates.

The Mk-IX panel uses a dual-element refractive concentrator architecture, in combination with triple-junction solar cells produced by Boeing-Spectrolab. The panel's resultant high efficiency (boosted by 20–25% over the prior generation) results in much higher power generation per unit area compared with both silicon flat-panel and thin-film installations, it is claimed.

"This new version of our successful HCPV concentrator improves performance while reducing cost," says VP of engineering Dr Javier Berrios. "By using a more modular design, we are able to reduce overall manufacturing time, which reduces costs, while also increasing overall energy production per panel and reliability."

The new Mk-IX concentrates light more than 600-fold. It also improves energy conversion efficiency, achieving its performance rating at an irradiance of 850W/mm^2, placing it among the highest efficiencies for solar panels currently in commercial production, it is claimed.

Because of its standardized design, the Mk-IX offers increased durability and reliability. The new concentrator technology also uses a less complex, easily repeatable assembly process that can be transferred to different markets, generating more local manufacturing jobs.

"By next year, customers in North America, Europe, Asia and the Mid-East will be able take advantage of this advanced HCPV technology," says Berrios. OPEL claims to be the leading supplier of HCPV panels throughout the European and North African markets, and is expanding rapidly in the USA.

www.opelinc.com

OPEL receives patent for fourth-generation CPV module

OPEL Solar has been issued a patent from the US Patent office for its CPV module used for generating electricity in utility-scale solar power plants, as well as commercial and industrial building applications.

The new HCPV module was developed by Edward J. Linke and Francisco A. Middleton and represents the fourth generation of OPEL's HCPV technology and modules.

The HCPV module contains a housing structure that supports an array of photovoltaic cells and corresponding light guides. Using concentration lenses to focus incident solar radiation into the housing toward the light guides that then project the solar radiation onto photovoltaic cells, the module has been recognized as a new, highly efficient solar energy apparatus, says OPEL.

"Our current HCPV module is a high-performance, reliable, cost-effective system developed for a wide array of grid-connected solar systems for medium-to-high solar irradiance climates," claims president & CEO Lee M. Pierhal.

Amonix breaks ground on 150MW North Las Vegas CPV system manufacturing plant

After signing the lease on the property in July, Amonix Inc, which makes concentrated photovoltaic (CPV) systems using III-V multi-junction cells at its headquarters in Seal Beach, CA, USA, has broken ground on its new 214,000ft^2 manufacturing facility in North Las Vegas, NV in a ceremony presided over by the US Senate Majority Leader Harry Reid and attended by US Representative Shelley Berkley, the Nevada State Senate Majority Leader Steven Horsford, and City of North Las Vegas Mayor Shari L. Buck.

The facility will bring 278 private sector jobs to Southern Nevada and, according to the Nevada Development Authority, will contribute $118m in payroll and $12m in taxes to the local economy in its first five years. "More workers skilled in renewable energy jobs make our state even more attractive for renewable energy businesses," commented Horsford.

Amonix received a $5.8m American Recovery and Reinvestment Act competitive manufacturing tax credit (legislation championed by Reid and Berkley) to open the new facility. The firm has begun hiring area residents to fill management, technical and production jobs. Also, 135 local construction workers will build out the facility over the next few months.

In keeping with its commitment to produce sustainable energy in sustainable ways, the firm has installed an Amonix 7700 solar power system as part of the facility's electrical power source. The firm has also registered the major tenant improvement underway at the facility for certification through the US Green Building Council's LEED for Commercial Interiors (LEED CI) Rating System.

Amonix will use the facility to make CPV solar power systems for installations in Nevada and for export to neighboring states. At full capacity (operating 24 hours per day, seven days per week), annual production will be 150MW. The first line in the first phase will begin manufacturing by the end of Q1/2011.

"CPV solar is a key part of America's energy portfolio because of its compelling bottom lines in sunny and dry climates like the desert Southwest," says Amonix's CEO Brian Robertson. "These include the highest efficiency of any solar technology, cost at grid parity and the fact that CPV uses no water in the production of energy," he adds. "Just as the federal government has helped many infrastructure projects get going in the history of our nation, this facility was jump started by tax credits available through the Recovery Act."

www.amonix.com

OPEL launches wireless CPV tracker control network

OPEL Solar has announced a new wireless, utility-scale solar tracker control and management network developed in conjunction with its partner FEiNA in Spain.

The new system can be more easily deployed in solar fields because it does not require cables, which are normally used for network management. While older tracker systems required people on site for maintenance, problem-solving, and ongoing monitoring, the new wireless network allows key functions to be managed remotely and more cost-effectively. It can provide control and monitoring systems for solar fields currently being developed by utilities in the North American, European, and North African markets.

OPEL's tracker family ranges from small single-axis trackers to utility-scale single- and dual-axis trackers that can increase the production of a photovoltaic array by up to 45%.

"We obviously see the benefits of linking our customers to a network control system via wireless technology, which improves both operational efficiency and maintenance," says VP of engineering Dr Javier Berrios. "In partnership with FEiNA, with whom we've enjoyed a very successful relationship over the years, we are co-developing the next generation of solar tracker technology, which we see gaining significant acceptance, particularly in the European market," he adds.

The wireless tracker control technology can be used for any solar panel technology and is not exclusively designed for OPEL solar panel products. "It is important that our wireless tracker technology be PV panel agnostic," believes Berrios. "The operation and maintenance system is more efficient, therefore keeping the system operating at optimal level."

The new wireless tracker control is currently available for delivery in production volumes. FEiNA and OPEL currently have patent applications for the wireless system pending.

Through an exclusive agreement with FEiNA in Spain and with strategically located distributors, OPEL delivers tracker products worldwide. Its tracker control network system is CE Certified for use throughout Europe. Tracker systems, ranging from large rooftop applications to industrial solar farms, can be networked together to provide unison tracking and remote monitoring capabilities. The firm says that its trackers can be easily assembled and equipped with solar panels in less than four hours by a crew of 2–3 individuals without the need for special tooling, cranes or welding.

www.opelinc.com

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First Solar's sales rise 36% in Q3 to $798m

Full-year sales forecast raised from $2.5–2.6bn to $2.58–2.61bn

For third-quarter 2010, 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 reported net sales of $797.9m, up 66% on $480.9m a year ago and up 36% on $587.9m last quarter.

Quarter-to quarter growth is due mainly to increased system sales (driven principally by the sale of the 60MW (AC) Sarnia Phase 2 project in Canada), partially offset by a fall in module average selling prices (ASPs) and lower blended euro exchange rates.

Production amounted to a capacity of 350.2MW (an annualized run-rate of 59.6MW per line), up 2% on last quarter's 344MW (59MW per line) and up 20% on 292.4MW a year ago (53MW per line). Energy conversion efficiency has risen from 11% a year ago and 11.2% last quarter to 11.3%. The total cost per Watt produced has consequently reduced from $0.85 a year ago to $0.77 in Q3.

Net income per fully diluted share was $2.04, up from $1.84 last quarter and $1.79 a year ago.

"We continue to execute on our growth strategy and to develop sustainable markets for solar electricity," says CEO Rob Gillette. "Our investment in R&D, combined with plans to nearly double our manufacturing capacity, will help us meet robust customer demand while continuing to drive down the cost of solar power," he adds.

Capital expenditure has increased to $137.6m, up 4% on $133.5m last quarter and more than double $64.8m a year ago. Despite this, cash and marketable securities rose during the quarter from $960.5m to $997m.

First Solar has raised its forecast for full-year 2010 net sales from July's guidance of $2.5–2.6bn to $2.58–2.61bn (though still down on April's guidance of $2.6–2.7bn). Guidance for earnings per fully diluted share has been raised from $7.00–7.40 to $7.50–7.65. Also, after in July cutting its forecast for operating cash flow from $725–775m to $575–625m, the firm has raised it slightly to $595–620m. However, the projection for total capital spending has been reduced again, from April's forecast of $625–650m and July's forecast of $575–625m to now $550–600m (although this is still about double 2009's $280m).

www.firstsolar.com

CdTe, CIGS & metals supplier Apollo Solar appoints CEO

Apollo Solar Energy Inc of Chengdu, Sichuan Province, China has appointed Dr Jingong Pan as its new CEO.

Through its subsidiary Sichuan Apollo Solar Science and Technology Co Ltd, Apollo Solar Energy is a vertically integrated firm primarily engaged in mining, refining and producing high-purity tellurium (Te), tellurium-based compounds and other metals for the thin-film solar photovoltaic (PV) industry as well as for segments of the electronic materials market including radiation detection and infrared detection.

Products include ultra-high-purity metals and commercial-purity metals (such as selenium, antimony, bismuth, cadmium and zinc), cadmium telluride (CdTe) thin-film compounds, and copper indium gallium diselenide (CIGS) thin-film compounds.

Te used in the firm's products is sourced from its Dashuigou mine in Sichuan Province as well as from another mine in Shimian, Majiagou, China. Apollo's refining operations are based in a 330,000ft^2 facility in Chengdu.

Age 45, Pan has been a member of the firm's board of directors since March. He is currently an adjunct professor at the New Jersey Institute of Technology in Newark, NJ, USA. From 2000 to 2002, he was general manager of Flaming Sun (USA) Corp, and from 1997 to 2000 VP of Anton USA (Bank of China Group).

Pan received a Bachelor of Science degree from the Harbin Institute of Technology, Masters degrees from the Harbin Institute of Technology and the New Jersey Institute of Technology, and a Ph.D. from the New Jersey Institute of Technology.

In March, Apollo awarded a three-year $1.5m grant to establish the Apollo CdTe Solar Energy Research Center at New Jersey Institute of Technology, focused on improving the applications of CdTe materials for use in thin-film solar cells.

Apollo signs five-year deal to supply Te

Apollo Solar has signed a five-year purchase contract with a major global solar panel maker.

Apollo will provide 5N (five-nines purity) tellurium, which is the core material of CdTe thin-film PVs, with projected sales of RMB730m ($110m) over a five-year period.

"We have been cooperating closely for the past five years with this manufacturer, and we believe this purchase contract will be a win–win strategy for both of us in the long run," says Apollo Solar's CEO Dr Jingong Pan.

www.apollosolarenergy.com.cn

3M launches moisture-resistant front-side film for flexible CIGS, CdTe and OPV modules

At the Solar Power International 2010 show in Los Angeles (12–14 October), 3M of St Paul, MN, USA introduced its 3M Ultra Barrier Solar Film for flexible copper indium gallium (di)selenide (CIGS), cadmium telluride (CdTe) and organic photovoltaic (OPV) solar modules.

The result of more than a decade of development in transparent barrier technology as well as over 45 US patents and patent-pending applications covering construction, materials and processes, 3M Ultra Barrier Solar Film is highly transparent, provides moisture vapor transmission rates (MVTR) below 5x10–4g/m^2 per day, and demonstrates what is claimed to be excellent durability. The firm began high-volume production in October in order to supply its global thin-film solar customer base.

Designed to address the needs of flexible thin-film solar manufacturers, the Ultra Barrier Solar Film acts as a replacement for glass with high light transmission, good moisture barrier performance, and weatherability. Compared with glass–glass modules, large-area, lightweight flexible PV modules made with Ultra Barrier Solar Film can achieve lower balance of systems (BOS) costs by requiring less installation time, removing the need for metal racking, and reducing logistics expenditures, claims 3M. The firm adds that Ultra Barrier Film also enables lower module manufacturing costs by allowing manufacturers to commercialize large-area modules, effectively reducing fixed costs associated with module manufacturing, assembled in a continuous roll-to-roll process.

Ultra Barrier Film enables lower costs by allowing manufacturers to commercialize large-area modules

"High-efficiency flexible solar modules manufactured with 3M's Ultra Barrier Solar Film not only have the potential to drastically reduce the total system costs for rooftop solar installations, but also have an array of niche applications where our customers can take advantage of the unique module form factor," says Derek DeScioli, business development manager for the 3M Renewable Energy Division.

www.3M.com

DuPont launches new Kapton films for flexible and thin-film PV applications

DuPont Circuit & Packaging Materials of Wilmington, DE, USA has announced commercial availability of DuPont Kapton polyimide films engineered for thin film and flexible photovoltaic substrates. DuPont has developed two key products for amorphous silicon (a-Si) modules and copper indium gallium (di)selenide (CIGS) photovoltaic applications; and additional Kapton technologies are in development to further increase the efficiency and lifetime of photovoltaic modules, reduce overall system costs and help the industry reach grid parity faster.

Kapton polyimide films have a unique combination of electrical, thermal, chemical and mechanical properties that can withstand extreme temperature and other demanding environments with high performance, reliability and durability, claims Robert G. Schmidt, new business development manager, Photovoltaics. "They have made innovative design solutions possible in a range of industries over the last 40 years, including aerospace, automotive and industrial applications; and we are continuing to put science to work to increase efficiency and performance for the flexible and thin-film photovoltaic industry," he adds.

The new products include:

- Kapton PV9101 for ease of manufacturing and robust mechanical performance;
- Kapton PV9102 for ease of manufacturing and increased productivity; and
- Kapton PV9103 (which will be available later this year) for maximum productivity.

In thin-film a-Si modules and CIGS applications, the mechanical properties and dimensional stability of the substrates at elevated deposition temperatures are critical to producing cells with maximum efficiency and yields. DuPont says that the low coefficient of thermal expansion, high glass transition temperature and low shrinkage of Kapton polyimide films help to minimize stress at the interface with other materials of construction, during both processing and end use in temperature extremes. The thermal stability of Kapton films also allows processing temperatures in excess of 400ºC.

The firm says that Kapton PV series polyimide films provide roll-to-roll processing capability, low moisture uptake and high moisture release characteristics, good electrical properties and increased voltage endurance, and ceramic-filled versions to increase corona resistance and thermal conductivity.

DuPont Photovoltaic Solutions exhibited at the Solar Power International 2010 event in Los Angeles (12–14 October).

http://photovoltaics.dupont.com

Walsin Lihwa's 49% stake to propel CIGS PV firm Solarion into mass production

€40m from Taiwanese conglomerate joins €20m from Saxony to build 20MW Leipzig plant, for later expansion to 200MW

Walsin Lihwa Corp of Taipei, Taiwan has signed an investment cooperation agreement with Solarion AG of Leipzig, Germany to mass produce the latter's CIGS thin-film photovoltaic cells and modules, and to develop next-generation solar energy technologies.

Walsin Lihwa was founded in 1966 to make copper cables and wires, power cables and wires, and specialty steel products but, as an international conglomerate with diverse investments in high-tech industries, in recent years its long-term strategy has involved entering sectors from micro-electromechanical systems (MEMS) to LEDs and solar energy.

Spun off in 2000 from the Leibniz Institute for Surface Modification, in 2002 Solarion established Europe's first pilot line for manufacturing CIGS thin-film cells on a flexible carrier material. Its technology is based on proprietary ion-beam-assisted deposition of the CIGS absorber in a roll-to-roll process. Advantages are its low deposition temperature, improved solar cell energy conversion efficiency (claiming an average of 10%), higher process speed, and lower energy and material costs.

The use of a lightweight, flexible polyimide carrier enables new fields of photovoltaic applications, including building-integrated photovoltaics (BIPV), it is claimed. According to Solarion's chairman Dieter Waffel, cooperation with Walsin Lihwa paves Solarion's way to mass production, as well as helping to develop CIGS products and technologies featuring lower cost and higher efficiency.

Walsin Lihwa chairman Yu-lon Chiao (second right) completes €40m investment in Solarion.

Walsin Lihwa, via subsidiary Ally Energy Ltd BVI, is investing €40m to acquire a 49% stake in Solarion AG as well as a license to its CIGS technology patents, with Walsin Lihwa's chairman Yu-Lon Chaio and Solarion's chairman Dieter Waffel signing agreements covering not only technology licensing but also technical collaboration. The investment is also being supplemented by €20m in public subsidies from the city government of Leipzig (via a grant from the Development Bank of Saxony) under an incentive program to solicit foreign investment. Both Sven Morlok (State Minister of Economic Affairs of Saxony) and Barkhard Jung (Mayor of Leipzig City) attended the signing ceremony at Leipzig City Hall.

"We are pleased that we have found Walsin Lihwa, a global player and a strong partner, to support our long-planned global expansion strategy," says Solarion's CEO Karsten Otte. "We want to express our thanks especially to the Saxon Development Bank, CMS Hasche Sigle Düsseldorf, Euflex, Apricum and the Economic Development Offices of Saxony and Leipzig," he adds.

Walsin Lihwa and Solarion AG will together pursue mass production of CIGS thin-film solar cells by setting up an integrated solar cell and module plant in Leipzig. Construction should be completed in 2011 and commercial production should start in 2012. With a staff of 140 staff, initial annual capacity will be 20MW, but this will in future be boosted by a further 180MW facility to 200MW. Moreover, the patent license will enable Walsin Lihwa to independently manufacture and sell its own CIGS-based solar products.

www.solarion.net
www.walsin.com

Solarion orders roll-to-roll coating systems from centrotherm's FHR

Solarion has placed an order worth a double-digit amount in millions of euros for several roll-to-roll foil coating systems from centrotherm photovoltaics' subsidiary FHR Anlagenbau GmbH of Ottendorf-Okrilla, Germany.

For delivery next year, the systems will form a central component of Solarion's CIGS PV cell production with an annual capacity of 20MW.

The roll-to-roll process offers several advantages, says centrotherm photovoltaics' chief technology officer Dr Peter Fath. "These flexible, light and unbreakable cells are also particularly suited to large industrial roofs, and applications such as the textile, automotive and aerospace industries," he adds.

FHR and Solarion have been jointly developing technologies and systems to produce extremely light and flexible CIGS thin-film solar cells on plastic substrates since 2002. "With the fourth generation of these foil coating systems, we are now taking the step into the mass production of flexible CIGS solar cells," says FHR Anlagenbau's managing director Dr Reinhard Fendler.

www.fhr-ab.de

Moser Baer India wins government grant to develop CIGS solar cells

Silicon PV firm targets 15% efficiency

Moser Baer India Ltd (MBI) has been awarded a grant by the Indian government's Ministry of New and Renewable Energy (MNRE) to develop copper indium gallium diselenide (CIGS) photovoltaic cells.

MBI will conduct the work from its corporate R&D facility in Greater Noida, Uttar Pradesh. The focus of the project is to develop a differentiated, indigenous, commercially viable technology based on the core competencies of Moser Baer.

"Through Moser Baer Solar, a subsidiary of MBI, we have a wealth of experiences in crystalline silicon, thin-film silicon and concentrator PV and PV systems businesses," says chief technology officer Dr G. Rajeswaran. "This project, supported by MNRE, will utilize the core competencies of the Moser Baer Group and its vast resources to deliver high-efficiency CIGS solar cells, a promising next frontier in affordable thin-film PV... Owing to its high efficiency and cost effectiveness, CIGS based thin-film solar cell technology is likely to emerge as one of the most promising solar cells," he adds.

"Our aim is to address the gap between large-scale efficiencies (11–14%) and lab level efficiencies (19–20%) of CIGS technology," Rajeswaran continues. CIGS cells have shown 20.3% efficiencies under laboratory conditions, which is the highest of any thin-film technology.

However, few firms have succeeded in maintaining such efficiency and yield while scaling up manufacturing for high-volume commercial production. "This indicates that there is lot of room for innovation to develop a stable production process for this technology," says Rajeswaran. "We are working to develop the CIGS solar cells similar to the size of a typical crystalline silicon solar cell and thus avoiding the scale-up issues," he adds. "We plan to achieve cells with efficiencies of 15%, along with benchmark yield. Our initial estimate suggests that it is possible to achieve module price of less than $1/Wp [Rs.44.67/W]... Achieving these targets would place Moser Baer in a very unique position in the market."

www.moserbaer.in

IN BRIEF

centrotherm grows 22.3% in first nine months of 2010

For the first nine months of 2010 centrotherm photovoltaics AG of Blaubeuren, Germany, which provides equipment for the production of solar silicon, crystalline solar cells and CIGS thin-film photovoltaic modules, has reported revenue up 22.3% year-on-year, from €374.7m to €458.4m.

"Asian customers are expanding along the photovoltaic value chain, and in doing so are focusing their investments on high-efficiency technology, in order to realize economies of scale and declining manufacturing costs," says CEO Robert M. Hartung. "This is reflected in high sales generated abroad," he adds. The export ratio rose from 91.6% to a record 95.3%. Foreign business was dominated by the Asian market, with revenue of €385m (84% of total revenue).

With orders rising from €472.1m to €707.7m. centrotherm forecasts full-year revenue of €580–600m.

centrotherm buys 14.4% of Taiwan CIGS firm Sunshine

Stake to be expanded to 25% in early 2011

centrotherm photovoltaics AG of Blaubeuren, Germany, which provides equipment for the production of solar silicon, crystalline solar cells and copper indium gallium diselenide (CIGS) thin-film photovoltaic modules, has purchased 14.4% of the share capital of Taiwanese CIGS thin-film solar module maker Sunshine PV Corp.

centrotherm photovoltaics subsidiary Photovoltaics Asia Invest Pte Ltd of Singapore has invested a single-digit amount in millions of euros in Sunshine as part of a capital increase. The stake is to be expanded to a total of about 25% early next year.

centrotherm photovoltaics says that, with the share purchase, it has taken a strategic step to introducing new second-generation selenium plants at Sunshine, advancing centrotherm photovoltaics' CIGS thin-film technology. The investment also enables close cooperation with Sunshine, allowing manufacturing systems to be operated and further optimized under real mass-production conditions.

"We are pleased to further develop this second thin-film generation jointly with Sunshine," says Dr Frank Stubhan, CEO of centrotherm photovoltaics' Thin Film Module division. "CIGS thin-film technology offers enormous potential. With this step, we are backing this future market in a targeted manner," he adds. "We are currently experiencing major interest for CIGS technology from potential new customers." Together with its Taiwanese customer, centrotherm photovoltaics is working on boosting efficiency and throughput at the pilot plant. Sunshine is currently starting to sell the first modules from its Taiwanese production base.

www.sunshine-pv.com
www.centrotherm-pv.com/en

MiaSolé hits 15.7% with commercial-scale CIGS module

Increase from September's 14.3% narrows gap to polysilicon

MiaSolé of Santa Clara, CA, USA, which was founded in 2001 to make copper indium gallium diselenide (CIGS) thin-film photovoltaic panels, says the Department of Energy's National Renewable Energy Laboratory (NREL) has independently confirmed the 15.7% efficiency of its large-area production modules (1m^2 in size).

Closely following the 14.3% efficiency announced just in September, this is claimed to be the highest efficiency demonstrated for commercial-size thin-film modules, effectively closing the gap with polycrystalline silicon module efficiencies.

"This is a significant accomplishment as it represents the ability to manufacture full-scale CIGS modules with efficiencies equal to or better than that of polycrystalline silicon modules available in the world today but manufactured at a thin-film cost structure," says CEO Dr Joseph Laia. "We are executing ahead of our roadmap for efficiency improvements and feel confident in our ability to bring high-efficiency CIGS technology to the market place," he adds.

MiaSolé has previously announced that it would start shipping its 13% efficiency modules in second-quarter 2011 upon completion of UL and IEC certifications.

"An almost 1.5% absolute increase in efficiency in such a short time on a continuous roll-to-roll manufacturing line is impressive and demonstrates good process control and a validation of the MiaSolé approach," comments NREL solar researcher Dr Rommel Noufi. "This achievement significantly narrows the efficiency gap between manufacturing performance and cells produced in the laboratory (20.3%)," he points out. "It also moves CIGS technology well on its way to achieving DOE's target of $1 per Wp photovoltaic systems."

MiaSolé says that it now offers bank-financeable solar modules with efficiency comparable to polysilicon combined with the lower manufacturing costs of thin-film modules.

The firm's unique manufacturing process deposits CIGS on a flexible stainless-steel substrate and produces all of the layers required for the solar cell in a single continuous process. MiaSolé claims to be the only thin-film solar firm that uses sputtering processes in every step of the module's coating process, reducing manufacturing time and cost of production.

MiaSolé operates two manufacturing facilities and will ship 22MW in 2010. Products are designed for utilities and independent power producers to use in industrial-scale deployments such as large-scale rooftop and ground-mount installations.

www.MiaSolé.com

Camstar deployed to scale operations and drive product quality

MiaSolé of Santa Clara, CA, USA, which manufactures copper indium gallium diselenide (CIGS) thin-film photovoltaic panels, has deployed the SolarSuite enterprise software platform of software provider Camstar Systems Inc of Charlotte, NC, USA throughout its entire solar manufacturing value chain.

Founded in 2001, MiaSolé is growing rapidly, and the scalable manufacturing platform should enable it to shorten time-to-volume, improve product quality and reliability, and rapidly develop, roll out and enforce best known methods across new lines and plants.

"Camstar's SolarSuite provides visibility and consistent control over our manufacturing processes and resources," says MiaSolé's VP of operations Kevin Eassa. "Access to a rich set of process intelligence accelerates our ability to continuously innovate and improve while we expand operations," he adds.

"MiaSolé's rapid volume growth mandated a fast implementation that would immediately sustain high-volume transactions," says MiaSolé's senior director of IT Amiya Ranjan. "We were impressed with the inherent configurability and high performance of Camstar's platform that made it possible," he adds. "We applied a proven, phased, rapid deployment methodology and brought the solution into production in just 60 days, starting with resource and WIP tracking. We then added integration with process equipment controllers that allows automatic collection of very high-volume data and transactions. Instant visibility into equipment states, work-in-process and genealogy helps us meet or exceed target product quality, productivity and cost goals," Ranjan continues.

"Camstar is seeing rapid adoption of our solutions across the solar industry," says the firm's senior VP of global sales & marketing Rob Rudder. "As these companies race to bring innovative products to market, they realize that product quality will distinguish the winners in the cost per watt battle," he adds. "MiaSolé is the top innovator among their peers, and they recognize the absolute necessity of a comprehensive platform for manufacturing execution and quality that integrates with the rest of the systems landscape, including shop-floor automation, ERP and PLM systems."

XsunX ups CIGS PV cell efficiency further to 15.1%

XsunX Inc of Aliso Viejo, CA, USA has further enhanced the energy conversion efficiency of its thin-film photovoltaic (TFPV) cells — based on its copper indium gallium diselenide CIGSolar technology — from 15.09% (announced on 26 October) to 15.1%, after surpassing 14% just in mid-October. With other market-ready thin-film technologies functioning at 8–11% for solar modules, XsunX believes that CIGSolar illustrates conversion efficiency that may soon lead to gains over current technology.

"Our confidence that small-area co-evaporation processes is the key to delivering the best performance CIGS thin-film cells continues to be strengthened," says CEO Tom Djokovich.

CIGS thin-film researchers have concluded that the theoretical limit for CIGS solar technology conversion efficiency is 29%, although the highest percentage ever achieved is 20% in a laboratory setting.

"We are developing our technology on the same size substrates we intend to use in our commercial systems, about the same size as a silicon solar cell, so the efficiency levels we achieve in the laboratory we believe will be transferable to what we can offer the market," notes Djokovich. "Unlike current solar developers, we don't anticipate having to struggle with the challenges of scaling product while maintaining laboratory efficiencies."

XsunX claims that it has achieved 15.1% in a relatively short period of time and with less cost compared to other CIGS efforts that spanned many years and incurred significantly higher capital demands for less than similar results. The firm claims that this, coupled with the technology's perceived value as an alternate for the use of silicon solar cells, has accelerated industry's interest levels, leading not only to additional license discussions for XsunX but also allowing it to work towards executing its plan to develop joint venture license agreements to deliver the technology package through existing manufacturers.

XsunX says that this combination of leveraging existing branded manufacturers to deliver its systems and having branded module assemblers integrate the CIGSolar technology into their products allows it to significantly reduce the need for debt or equity financing to build factories directly while also providing bankability for its technology through proven manufacturers of solar modules.

Deposition of the CIGS cell layer is conducted on full-size 125mm square substrates. XsunX's test configurations used to measure efficiency are identical to that used by the National Renewable Energy Laboratory (NREL), and the firm's test equipment is calibrated to the standards of the National Institute of Standards and Technology (NIST).

www.xsunx.com

HelioVolt & NREL renew CRADA for CIGS development

Research aims for nanoscale building blocks to enable 15% efficiency

Building on its multi-year collaboration with the US Department of Energy's National Renewable Energy Laboratory (NREL), HelioVolt Corp of Austin, TX, USA says that it is extending the Cooperative Research and Development Agreement (CRADA) for research carried out at NREL's facilities to jointly develop the fastest and most efficient method for manufacturing low-cost thin-film copper indium gallium diselenide (CIGS) photovoltaics.

HelioVolt was founded in 2001 by Dr Billy J. Stanbery based on his proprietary FASST manufacturing process for rapid printing of thin-film CIGS material, either directly onto glass substrates for solar modules or onto flexible plastic substrate for embedding in building-integrated photovoltaic (BIPV) products (e.g. architectural glass and roofing tiles). The firm has so far raised more than $140m in venture financing to fund a move into volume production as well as international expansion.

"HelioVolt is deeply committed to our collaborative efforts with NREL. We continue to invest in the relationship because of the tremendous value our teams have jointly contributed to our technology evolution roadmap," says founder & chairman Dr BJ Stanbery. "CIGS modules are entering a very exciting commercial phase in the solar industry. We believe that high conversion efficiencies — above 15% on a full-size monolithically interconnected module rather than cell level — require developing innovative methods for producing nanoscale building blocks and synthesizing them into device-quality CIGS thin-film material," he adds. "Our work with NREL provides us a sound foundation for realizing these goals."

Many steps in conventional thin-film production require deposition of the material onto the substrate in a very low-pressure vacuum chamber. HelioVolt believes that future non-vacuum deposition processes can be less capital intensive, but depositing CIGS films on large areas with the precision necessary to achieve both high performance and low manufacturing costs is difficult without the advantages of its FASST process. HelioVolt and NREL's efforts in developing non-vacuum atmospheric pressure deposition processes aim to offer a combination of lower cost, process simplicity and reduced manufacturing time, while still delivering high-quality CIGS.

www.heliovolt.com

alwitra completes Solyndra's largest German installation

Solyndra Inc of Fremont, CA, USA, which manufactures copper indium gallium diselenide (CIGS) photovoltaic (PV) systems for commercial rooftops, says that roofing system maker alwitra GmbH of Trier, Germany has completed a 1.02MWp solar system (incorporating alwitra's highly reflective Evalon waterproofing membrane and Solyndra solar panels) for a warehouse belonging to the motorcycle accessories distributor Parts Europe GmbH of Konz, near Trier. The system is the largest Solyndra project in Germany to date, and its second largest worldwide. Alwitra is a Platinum Solyndra Solution Partner.

The project covers 13,000m^2 of rooftop with Evalon waterproofing membrane and about 10,700m^2 of rooftop with more than 5400 Solyndra panels (involving more than 33,000m of cabling). The project generates 1.023MWp (equivalent to the annual power needed to supply 250 households).

"On a rooftop of this size, Parts Europe gets strong benefits from the highly reflective Evalon waterproofing membrane and the power generation of the Solyndra solar system," says Clemens Jargon, Solyndra's president of EMEA and managing director of Solyndra GmbH of Holzkirchen, Germany. "alwitra's extensive knowledge of roof sealing and Solyndra's PV systems allowed them to complete the entire project in less than 10 weeks," he adds.

The warehouse of motorcycle accessories distributor Parts Europe GmbH of Konz, near Trier, bearing Solyndra's largest installation in Germany.

"The location and size of Parts Europe's warehouse is absolutely predestined for the use of solar power generation," reckons alwitra's president Joachim Gussner. "The unique design of Solyndra's cylindrical, non-penetrating and very light panels made them the best solution for this large project," he adds. "Using Solyndra with our Evalon waterproofing membrane allows us to offer the building owner the best combination of roof sealing solution and a solar system that actually gets more power as a result of the reflective qualities of the roof."

www.alwitra.de

Photon Energy installing 1.23MW Solyndra project in Prague

Prague-based solar energy firm Photon Energy a.s. has signed an engineering, procurement and construction (EPC) agreement for a 1.23MWp project and begun installation on multiple rooftops in Prague. The project is the first exceeding 1MWp in the Czech Republic using Solyndra panels, and the largest Solyndra installation in Eastern Europe.

The turnkey project involves the installation and development of 18 rooftop systems on the roofs of municipal buildings owned by the administration of Prague 15. Installation has begun and is expected to be completed by the end of December.

Novacento a.s. obtained permission to install solar systems on the roofs, which are primarily school and nursery buildings. Photon Energy has agreed to provide vendor financing for about 80% of the project to Novacento, which will also work with the US Export Import bank to seek to secure long-term project financing after the connection of the last system.

"Partnering with Solyndra, with their proven and readily bankable technology, allowed us to complete the planning process quickly," says Photon Energy's CEO Michal Gärtner. "Their performance on flat roofs, and lightweight, non-penetrating design was ideal for the schools and other buildings encompassed in this project," he adds.

"The forward-looking Prague city administration is bringing clean energy to the city while generating income from otherwise unutilized rooftop space," comments said Clemens Jargon, Solyndra's president of EMEA and managing director of Solyndra Gmbh, who describes the Czech development as a 'high-visibility, showcase project'.

www.photonenergy.as
www.solyndra.com

Nazca completes Solyndra's largest French project

Fully integrated engineering, procurement and construction (EPC) contractor Nazca, a Platinum Solyndra Solution Provider, has completed a 1.28MW solar system installation on a large warehouse close to Toulouse (Solyndra's largest installation in France, and one of the largest worldwide).

The warehouse was built by GSE Group (which founded its subsidiary Nazca in late 2007) and subsequently sold to 'Port de Barcelona', one of the main commercial transport and distribution arteries in the Mediterranean area. The port of Barcelona is a founding member of the Toulouse Goods Terminals, which were created to bring port services closer to end-customers. .

"We expect the French solar industry to focus on innovative and high-value rooftop installations in the next year and this project, with a strong partner like Nazca, stands as a great example of the benefits of Solyndra solar systems," says Clemens Jargon, Solyndra's president of EMEA and managing director Solyndra GmbH. "In a short amount of time, they were able to install the Solyndra system with more than 70% net photovoltaic roof coverage, resulting in a maximized power density and renewable energy production," he adds.

Solyndra's largest installation in France.

"The Solyndra product and tight support teams made it easy to install the panels and bring the project to the roof quickly," says Julien Puel, CEO of Nazca SAS. "GSE Group, who rents the warehouse rooftop and operates this MW-size Solyndra PV installation, is demonstrating its commitment to sustainability and green business practices while achieving a fair return on their system investment," he adds.

The building concept exploits Solyndra system advantages including the system's light weight. Solyndra's non-penetrating mounting system, with no ballast, allowed Nazca to design a system that generated significant power without requiring additional engineering. The system, installed on a new, white reflective 'cool roof', consisted of more than 7000 Solyndra panels and will generate 1360MWh/year of photovoltaic electricity. According to the EPA carbon calculator, this is the equivalent of powering 600 households.

"Solyndra has proven itself in hundreds of installations around the world and we are confident that this system will produce the energy and revenues that we have modeled," says GSE founder & president Michel Hugues. "Solyndra has a wealth of reliability and performance data that was very helpful as we worked to secure financing for the system."

www.nazcaenergy.com

Solyndra announces collaboration with roofing materials firm Sika

Solyndra has announced a multi-year sales agreement with roofing materials manufacturer Sika Services AG of Baar, Switzerland. The firms will work together to promote Sika's highly reflective roofing products together with Solyndra's rooftop photovoltaic systems.

Sika is said to be the world's number one market leader in construction chemistry and is present in 74 countries, with more than 12,500 staff. The agreement will initially focus on markets in Germany, France, Italy, UK, Spain, Slovenia and the Czech Republic, where Sika has a leading position providing roofing solutions including highly reflective membranes.

"Sika has a strong reputation as a supplier of roofing materials and photovoltaic systems worldwide. We are pleased to work together with them to develop a powerful combined offering for the challenging environment of the commercial rooftop solar market," says Clemens Jargon, Solyndra's president EMEA (Europe, Middle East and Africa) and managing director of Solyndra GmbH of Holzkirchen, Germany. "Their knowledge of rooftops and materials combined with our expertise in solar systems will help us work together to generate the highest amount of energy from commercial and industrial rooftops."

"We have found the lightweight, non-penetrating Solyndra system to be an excellent complement to our highly reflective rooftop materials and, as interest in reflective, cool roofs grows in Europe, our two companies will work together to present a strong combined offering to our customers," says Heinz Meier, Sika's corporate system engineer Solar. "Both companies have built their reputations by providing durable, lasting systems that will protect and generate power from rooftops for more than 20 years."

www.sika.com
www.solyndra.com

IN BRIEF

Ascent signs Czech distribution deal

Ascent says that Czech Republic-based solar integrator Votum is distributing its lightweight, flexible thin-film CIGS modules for building-integrated photovoltaic (BIPV), building-applied photovoltaic (BAPV) and portable power solutions, providing access to multiple market segments in the Czech Republic's solar market.

"This relationship will give us access to a rapidly growing market for BIPV and BAPV applications," says Ascent Solar's president & CEO Farhad Moghadam. "We also expect that other products in our lineup of flexible, lightweight CIGS modules will be marketed through this relationship," he adds. "Votum has a sound solar integration business and is an excellent partner to have for distribution of our products in the Czech Republic."

www.votum.cz

Public offering raises $20.25m

Ascent Solar Technologies Inc of Thornton, CO, USA, which makes monolithically integrated flexible thin-film photovoltaic modules based on copper indium gallium diselenide (CIGS), has closed its public offering of 5.25 million shares of common stock (announced on 11 November) at a price of $4.15 per share.

Ascent Solar expects to use the net proceeds of about $20.25m (after offering expenses and underwriting discounts and commissions) for the completion of its 30MW FAB2 production plant and for general corporate purposes.

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 existing 145,000ft^2 headquarters in Thornton. Ascent began initial production of CIGS modules from its high-volume FAB 2 production plant there this May.

USB modules for portable, off-grid charging

At October's Solar Power International 2010 show in Los Angeles, Ascent launched its OEM-ready USB-charger-integrated modules for portable, off-grid charging.

Integration of the USB outlet makes it a universally acceptable application that can meet the demand of a diverse and growing market for portable power in developed and emerging countries, says the firm.

"With the growing proliferation of power-on-the-go needs to meet the rising electronic application from cell phones to other personal electronic devices, our USB-integrated light-weight, rugged and efficient CIGS modules can meet this demand," claims senior VP of sales & marketing Rafael Gutierrez. "This OEM product will be an important solution for our off-grid portable power portfolio," he adds.

www.ascentsolar.com

Ascent's modules installed at comparative thin-film PV test site

Thin-film CIGS laminated PV modules made by Ascent are ready for beta-test deployment at the JM Technical Center (JMTC) in Littleton, CO of Denver-based Berkshire Hathaway firm Johns Manville, which makes products for building insulation, mechanical insulation, commercial roofing, and roof insulation (as well as fibers and non-wovens for commercial, industrial and residential applications). Ascent's modules will be compared side-by-side against thin-film modules already installed at JMTC.

"The installation at our test site will provide the performance data we need in order to demonstrate the readiness of Ascent's emerging high-power lightweight CIGS modules in order to make it available to our customers," says Dr Tim Swales, Johns Manville VP of R&D. "We look forward to further collaboration and assessment."

The test installation aims to collect performance data, evaluate architecture aesthetics and showcase the potential of Ascent's CIGS modules against existing thin-film technology. For the pilot installation modules have been applied to the top surface of the roofing membrane. The long-term aim is to integrate the modules into the roofing material itself as a factory-applied solution that JM markets under the Power Blanket brand. Ascent says the external deployment will help to set a standard for the integration and installation of lightweight flexible CIGS modules, as it is the first time a CIGS monolithically integrated module made using a plastic substrate has been integrated onto an existing commercial roofing installation for competitive evaluation.

"Installation onto the test site is a real indication that our product development is progressing and is crucial to our viability for larger system installations down the road," says Ascent's president & CEO Farhad Moghadam.

"Now that we have established IEC 61646 certification and have UL certification pending, we are pleased to launch pilot project installations with an industry leader," says senior VP of sales & marketing Rafael Gutierrez. "Ascent Solar's entry to the BAPV [building-applied photovoltaic] market with the highest-power-density flexible solutions and highest-power modules will enable a new level of power production for flexible commercial applications."

www.jm.com

France's DisaSolar to distribute Ascent's PV modules, for integration into train roofs and commercial signage

Ascent Solar Technologies Inc of Thornton, CO, USA has signed a distribution agreement with DisaSolar of Paris, France, a newly established subsidiary of Megamark/DisaTech Group (which provides complete solutions in architectural, industrial and corporate signage in France and other European countries). DisaSolar is dedicated to flexible photovoltaics (PV) in the French market.

The firm will distribute Ascent's lightweight, flexible thin-film copper indium gallium diselenide (CIGS) solar modules for off-grid applications, integrating flexible panels into passenger train roofs and commercial signage structures.

The agreement gives Ascent access to additional emerging market segments in Europe. Recently, the two firms demonstrated PV module integration into train rooftops in partnership with French regional rail company SNCF. Ascent says that the unique characteristics of its modules complement DisaSolar's heritage in system integration for transportation and corporate signage applications, enabling novel applications in emerging segments.

SNCF's Photovoltaic Train (left) and Ascent Solar's modules applied to roof.

"Ascent Solar has a flexible, lightweight, CIGS solar module technology that is uniquely qualified to open new opportunities in everyday power generation," says DisaSolar's president Stephane Poughon. "Leveraging the expertise of Megamark/DisaTech Group combined with the quality and performance of Ascent Solar products, DisaSolar aims to quickly become a leading French provider of innovative integrated solar products," he adds.

"This relationship will give us access to new and emerging market opportunities in transportation that could provide significant growth over the coming years in France as well as other countries across the globe," says Ascent's president & CEO Farhad Moghadam. "We also expect that other products in our lineup of flexible, lightweight CIGS modules will be marketed through this relationship."

www.disasolar.fr

India's TERI to evaluate Ascent Solar's flexible CIGS modules for 'Lighting a Billion Lives' program

Ascent Solar Technologies Inc of Thornton, CO, USA has entered into a memorandum of understanding for The Energy and Resource Institute (TERI) of New Delhi, India to perform testing and performance evaluation of its flexible copper indium gallium diselenide (CIGS) thin-film photovoltaic modules and to study the feasibility of using them for its flagship program 'Lighting a Billion Lives' (LaBL) as well as other projects currently under development. Upon successful completion of the evaluation, TERI and Ascent Solar will mutually decide on the terms and conditions for the use of Ascent's modules.

"Our collaboration with Ascent Solar will help engage the much needed newer, cutting-edge solar photovoltaic technologies into our ongoing electrification projects for rural applications including solar lighting through our flagship programme Lighting a Billion Lives," says Akanksha Chaurey, director Decentralised Electricity Solutions and LaBL Campaign at TERI.

"India is one of the largest off-grid electricity markets in the world, and the need for innovative and cost-competitive off-grid electricity generation in urban and rural markets in India presents a tremendous opportunity for Ascent," says the firm's senior VP of corporate development Ashutosh Misra. "TERI is a premier organization focusing on developing a range of technologies that have created new paradigms of development underlining the sustainable use of natural resources, and are proven for their effectiveness and economic viability," he adds. "Our joint collaboration to develop various solar energy solutions for TERI's rural electrification projects including its flagship 'Lighting a Billion Lives' based on solar technology provides us with a unique opportunity to grow our market share in India," says Misra. "Our unique, light-weight, ruggedized, high power density thin-film CIGS modules enable ease of installation, handling and transport that are an ideal solution for LaBL and other programs like it."

http://labl.teriin.org
www.ascentsolar.com

SoloPower's flexible CIGS module receives IEC European certification, joining UL North America certification

SoloPower Inc of San Jose, CA, USA has become the first solar company to obtain certification to both IEC (61646 and 61730) standards and UL 1703 standards for flexible, thin-film copper indium gallium diselenide (CIGS) photovoltaic (PV) modules, enabling it to sell its lightweight CIGS modules in Europe in addition to North America. "We are now on a path to developing global market channels," says CEO Tim Harris.

SoloPower's flexible CIGS module achieved IEC 61646 and IEC 61730 certifications through TÜV SÜD America Inc. Previously, in early September, the firm announced that its module had received ETL Mark certification to the UL 1703 standard by Intertek. The certification standards test product durability, safety, reliability, and performance.

The firm has obtained certification under IEC and UL standards for its initial module format, the SFX1 (70Wp and 75Wp, 0.3m x 2.9m, 2.3kg/5lbs). Its SFX1-i3 module (up to 260Wp, 0.88m x 3m, 6.8kg/15lbs.) is currently completing certification testing.

www.solopower.com

IN BRIEF

PVflex's flexible CIGS PV module gains IEC61646 and 61730 certification

PVflex Solar GmbH of Fürstenwalde, Germany has achieved complete certification according to IEC61646 and 61730 of a flexible production-ready copper indium gallium diselenide (CIGS) photovoltaic (PV) module. The modules have an output of 165Wp and dimensions of 1.99m x 0.88m. Certification was conducted by TÜV Thuringia.

Founded in 2006, PVflex produces flexible modules for building-integrated photovoltaics (BIPVs) that can be installed on industrial and commercial rooftops using only direct adhesion to the roof skin without the usual substructure. Also, new lamination methods using barrier technology developed by PVflex protect the sensitive CIGS solar cells against water and water vapour, improving long-term durability.

PVflex says that it aims to establish further sample plants using its module in the next few months. Large-scale production and distribution of the modules is planned for second-half 2011.

www.pvflex.com

DOW POWERHOUSE becomes first solar shingle to gain UL certification

The Dow Chemical Company of Midland, MI, USA says that its DOW POWERHOUSE Solar Shingle has become the first residential solar roofing shingle with an integrated connection system to receive UL safety certification.

In 2007, Dow won a $20m grant from the Department of Energy as part of its Solar America Initiative to develop building-integrated photovoltaic (BIPV) arrays for residential and commercial markets. In October 2009, Dow Solar unveiled POWERHOUSE as the first in a portfolio of building-related solar power products.

Dow chose CIGS as the PV material and Global Solar Energy (GSE) of Tucson, AZ as the preferred supplier. Dow says the flexible foil substrate of GSE's cells provides the required level of flexural durability to allow the shingle to perform reliably in a demanding environment.

POWERHOUSE panels hence come in the form of a solar roofing shingle that can be installed by a roofer along with standard asphalt shingle materials. The firm says that it reduces installation time and complexity by using a system design that eliminates on-roof wiring, minimizes through-roof penetrations, and allows installation in the same manner as a standard roofing shingle.

Given the new nature of the solar shingle, Dow Solar worked closely with UL to identify a series of tests to assess the safety of the design and of all elements of the combined solar and roofing product. The final listing that was awarded represents compliance to a diverse sequence of UL's safety and building standards, specifically UL 746, 1703, 1897, 790, 486 and 514. More than 50 individual tests were conducted to assess safety of the shingle against building code standards, including wind and fire resistance, and electrical code requirements, such as proper wiring and PV connections.

"We had to take a unique approach in order to test the product as both a roofing shingle and a PV system," says Jeff Smidt, VP & general manager for UL's Global Energy business.

Dow will continue with its own reliability and durability testing in support of commercialization. It is now performing tests on installed systems in addition to individual shingles in order to assess the product's durability, using Design for Reliability and Physics of Failure methodologies to measure performance against weather, extreme temperatures etc.

The product should be available in select US markets by mid 2011.

www.ul.com

www.dowsolar.com

Saint-Gobain and Hyundai Heavy Industries form JV

Avancis' 100MW 2nd German plant to be duplicated in Korea

After in June starting construction of a second plant in Germany for its subsidiary Avancis in Torgau, Saxony Germany to produce copper indium gallium diselenide (CIGS) thin-film photovoltaic (PV) modules, Saint-Gobain of Courbevoie, France (which designs, makes and distributes building materials and electronic materials) has announced the construction of a third PV panel manufacturing plant in Korea after forming a 50:50 joint venture called Hyundai Avancis in association with South Korea's Hyundai Heavy Industries Co Ltd (HHI). Each firm will invest 110bn won (about $100m), making a total of 220bn won (just under $200m).

As well as being a leading shipbuilder, HHI is one of few firms to manufacture both solar power and wind turbine system products, and is said to be South Korea's only company able to produce the entire solar value chain of products, ranging from polysilicon, solar cell and solar module all the way to power conditioning systems. HHI is currently expanding its facilities to increase annual production capacity of silicon solar cell and modules from 330MW to 600MW (in August winning a $700m contract to build a 175MW plant from US-based Matinee Energy).

The JV's first manufacturing facility will be designed identically to the second Avancis plant under construction in Germany, in terms of both technology and manufacturing capacity, making it South Korea's largest thin-film solar cell plant. It will hence produce an annual volume of 850,000 modules based on CIGS thin-film PV technology, designed for rooftops and solar fields (giving a power output of 100MW, or the equivalent yearly energy requirements of a town with 15,000 inhabitants). Construction will start in December, so the site should be operational from second-quarter 2012 and will supply the global market. Its modules will be marketed independently by Avancis and HHI (which will be the only Korean firm able to produce both crystalline silicon and thin-film solar cells).

HHI chairman Min Keh-sik (left) with Saint-Gobain chairman Pierre-Andre de Chalendar (center). Courtesy of HHI.

Based on depositing coatings of CIGS on a glass substrate, the technology developed by Avancis avoids using traditional crystalline silicon. It could allow production costs as low as other thin-film based techniques, while its solar energy conversion efficiency (above 12% industrially and up to 20% in the laboratory) is close to the higher yields achieved using polycrystalline silicon cells, says Saint-Gobain. As well as being suitable for solar fields, CIGS thin-film PV modules are especially suited to roof installations, due to their simplicity of assembly, attractive appearance and reliability, the firm adds.

By expanding into the high-efficiency CIGS PV market under a joint venture with Saint-Gobain, HHI is on track with its plan to become a global supplier in the renewable energy sector via innovation and diversification

"Already well located in Korea (particularly in flat glass, where it has four float lines and several processing units for the automotive and building sectors), Saint-Gobain strengthens its position in this country in association with HHI, whose industrial and technological know-how is recognized worldwide," says Jean-Pierre Floris, senior VP of Saint-Gobain and president of its Innovative Materials Sector. Saint-Gobain will provide glass for the CIGS PV cells via its Korean unit HanGlas.

"By expanding into the high-efficiency CIGS PV market under a joint venture with Saint-Gobain, HHI is on track with its plan to become a global supplier in the renewable energy sector via innovation and diversification," says HHI's chairman Keh-Sik Min. HHI aims to be a top-five solar power producer by 2015.

http://english.hhi.co.kr
www.saint-gobain.de/en

Solar Frontier enters global CIS module supply agreement with GE

GE to provide power plant expertise to enhance Solar Frontier's CIS technology for utility-scale installations

Tokyo-based Solar Frontier K.K., a subsidiary of Japanese energy business Showa Shell Sekiyu K.K., is to supply its proprietary CIS (copper, indium, selenium) thin-film photovoltaic (PV) modules in the form of GE-branded panels as part of US firm GE's globally marketed portfolio of solar energy solutions. In return, GE will provide its power plant expertise to enhance development of Solar Frontier's CIS technology for use in utility-scale installations.

Solar Frontier says that GE testing and benchmarking determined that its modules offered a combination of performance and efficiency that meets the established standards of GE's global brand.

"By teaming up with a billion-dollar global industry leader, Solar Frontier demonstrates that the solar market has matured to support large-scale players," says Solar Frontier's president & CEO Shigeaki Kameda. The modules will be part of GE's utility-scale solar projects. The contract will ensure that its customers have a reliable supply of thin-film solar modules for large ground-mount and roof-top installations.

"Our modules have been proven in field tests since 2003, and we will have gigawatt-scale production online by next year," says Kameda. "For a stable, mature solar market, we have to combine reliable panels with reliable supply chains," he adds.

The modules will be made at Solar Frontier's automated production plant in Miyazaki, Japan, which was opened at the beginning of October. Starting operation next year, it is scheduled to become the world's largest PV factory (at 900MW) when the third phase of production comes online later in the year.

The agreement with Solar Frontier was included in GE's announcement of an expanded portfolio of highly differentiated solar solutions that aim to establish GE as the "global leader in the renewable energy space", offering both leading technology and "the unique bankability that comes with one of the world's leading brands."

www.gepower.com

Solar Frontier to supply 3.3MW of modules to Thailand's Gunkul

Solar Frontier is to supply Gunkul Powergen Co Ltd with 3.3MW of its modules (38,500 panels) for a power plant project coordinated by Marubeni in Phetchabun Province, northern Thailand that aims to sell electricity to the Provincial Electricity Authority of Thailand. The project is scheduled for completion by the end of 2010.

"This solar power plant is the first of a number of solar facilities Gunkul Powergen is planning in Thailand," says Gunkul Engineering's CEO Gunkul Dhumrongpiyawut. "The selection of Solar Frontier to supply all the panels for the first stage of this project reflects our confidence in the superior performance of its CIS modules," he adds.

"Thailand has year-round sunshine, which represents great potential for solar energy solutions, but also challenges in terms of heat and humidity that Solar

Frontier proves well suited to meet," says Solar Frontier's CEO Shigeaki Kameda. "This agreement is part of the momentum we are building in Thailand and throughout Asia."

While Thailand introduced a feed-in-tariff and other programs in 2007 with the original aim of installing 500MW of solar energy systems by 2020, this goal is now predicted to be exceeded as early as 2012.

www.solar-frontier.com

Solar Frontier to co-develop IBM's CZTS solar cells

CZTS explored for evolutionary compatibility with CIGSSe

Solar Frontier, a subsidiary of Japanese energy business Showa Shell Sekiyu K.K. that makes copper indium gallium sulfur selenium (CIGSSe, or CIS) thin-film photovoltaic cells, has agreed to jointly develop thin-film solar cell technology devised by IBM based on copper, zinc, tin, sulfur, and selenium (CZTS). The research will mainly take place at IBM's Thomas J. Watson Research Center in Yorktown Heights, NY, USA.

Similar to Solar Frontier, DelSolar Co Ltd of Hsinchu Science-Based Industrial Park, Taiwan (a subsidiary of Delta Electronics) also recently (in late September) partnered with IBM in developing the technology.

In February, IBM announced record efficiency of 9.6% for CZTS-based solar cells, up 40% on previous CZTS solar cells. The new joint development aims to couple IBM's research with Solar Frontier's thin-film development and manufacturing capabilities to create a cost-competitive solar technology that is inexpensive and uses earth-abundant (indium-free) materials.

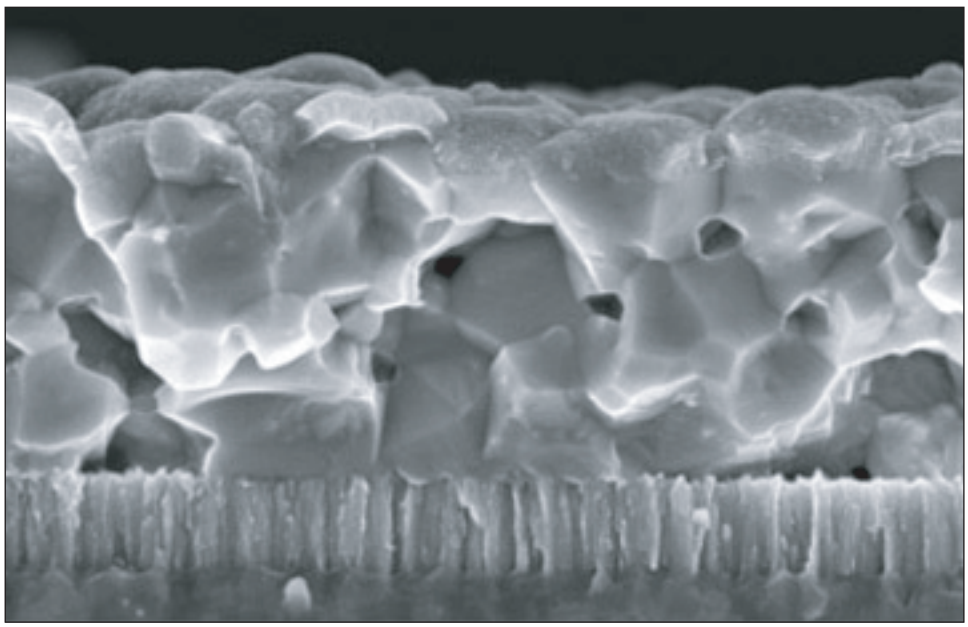
CZTS-based technology uses materials that avoid heavy metals and are readily available at a lower cost. By virtue of these materials, the goal of the project is to create next-generation solar technology that lowers the cost of producing electricity, enabling solar energy to become a ubiquitous alternative to carbon-based energy sources.

Solar Frontier currently has two manufacturing facilities in Miyazaki, Japan. A third plant with annual capacity of 900MW will become operational in 2011, making it the world's largest PV production facility and bringing Solar Frontier's total capacity to 1GW (expected to be the world's largest CIS PV capacity).

"Solar Frontier's extensive experience in the R&D of CIS thin-film photovoltaic technologies has delivered numerous conversion efficiency breakthroughs that have resulted in world-class records," says the firm's chief technology officer Satoru Kuriyagawa. "We are interested in exploring CZTS for its evolutionary compatibility with our CIS thin-film technology. The goals of the project correspond with Solar Frontier's mission to combine both economical and ecological solar energy solutions," he adds.

"Solar Frontier is one of the world's leading experts in CIS-based thin-film solar panels," says T.C. Chen, VP of science & technology IBM Research. "Adding Solar Frontier's deep expertise in thin-film-based solar device technology to this project will strengthen the collaborative effort we began in this area with [process equipment maker] Tokyo Ohka Kogyo Co Ltd [in mid-2008] for developing chemistry and tooling expertise; and more recently adding DelSolar's solar module and manufacturing expertise," he adds. "This team will significantly increase our ability to create CZTS photovoltaic technology that achieves sustainable grid parity."

www.ibm.com
www.solar-frontier.com



Microscope image of the CTZS cell from IBM.

IBM co-developing CZTS with DelSolar

In September IBM also signed an agreement with Taiwan's DelSolar Co Ltd to jointly develop CZTS thin-film photovoltaic cells, leveraging DelSolar's expertise in PV technology and processing (see October/December issue, page 84).

"This agreement is a significant step in the progress of our effort to create efficient solar cells using earth-abundant materials with novel processes," said T.C. Chen, VP of Science and Technology at IBM Research at the time. "This new collaboration between DelSolar, TOK [Tokyo Ohka Kogyo Company Ltd], and IBM now puts us firmly on the path to commercially viable technologies and processes for solar cells that could bring us closer to grid parity," he added.

"DelSolar is pleased to combine forces with IBM and TOK for the joint-development of the game-changing technologies to enable grid-parity PV products," said DelSolar's chairman & CEO R.C. Liang.

Free-standing GaN substrate improves nitride solar cell

Japanese researchers boost nitride PV energy conversion efficiency from 0.98% to 1.41% by switching from sapphire to GaN substrate.

Researchers from Meijo and Nagoya universities have used free-standing gallium nitride (GaN) substrates to create nitride semiconductor solar cells with higher open-circuit voltage and fill-factor compared with devices grown on sapphire [Yosuke Kuwahara et al, Appl. Phys. Express, vol3, p111001, 2010].

One well-known effect of using free-standing GaN substrates to create nitride semiconductor devices is improved material quality, reducing parasitic resistance effects. Such devices can also use 'vertical' conduction arrangements with n- and p-electrodes on the top and bottom of the chip, rather than the 'horizontal' arrangement needed with insulating sapphire, where the two electrodes have to be on the conducting nitride side of the component.

In theory, gallium indium nitride (GaInN) semiconductors should be able to cover the range of solar photons from infrared 1.9mm wavelengths (0.65eV) with InN up to 365nm near-ultraviolet with GaN (3.4eV). In reality, GaInN is difficult to grow with large In molar fraction.

The researchers tested devices with In ~10%. The devices that were produced had photoluminescence peaks around the violet wavelength 390nm. Unfortunately, this only covers a small part of the solar power spectrum. More efficient solar cells have bandgaps in the range 1–2eV that can pick up photons from the visible range where the spectrum peaks.

The short-wavelength nitride solar cells produced by Meijo/Nagoya are thus not ideal for the spectrum of solar radiation. Hence the conversion efficiencies seen are limited to a few percent. In August, Texas Tech researchers reported nitride solar cells on sapphire with higher In molar fractions of ~35%, giving longer wavelength coverage, that had conversion efficiencies up to 3.03% when subjected to 30-sun illumination (www.semiconductor-today.com/news_items/2010/AUG/TEXAS_240810.htm).

Meijo/Nagoya produced two devices grown in the (0001) 'c-plane' direction (Figure 1): one on an undoped GaN-on-sapphire layer, the other on free-standing GaN. The researchers found that using free-standing GaN reduced dislocation densities from ~10^9/cm^3 on sapphire to ~10^7/cm^2 with the free-standing material. The growth technique was MOCVD.

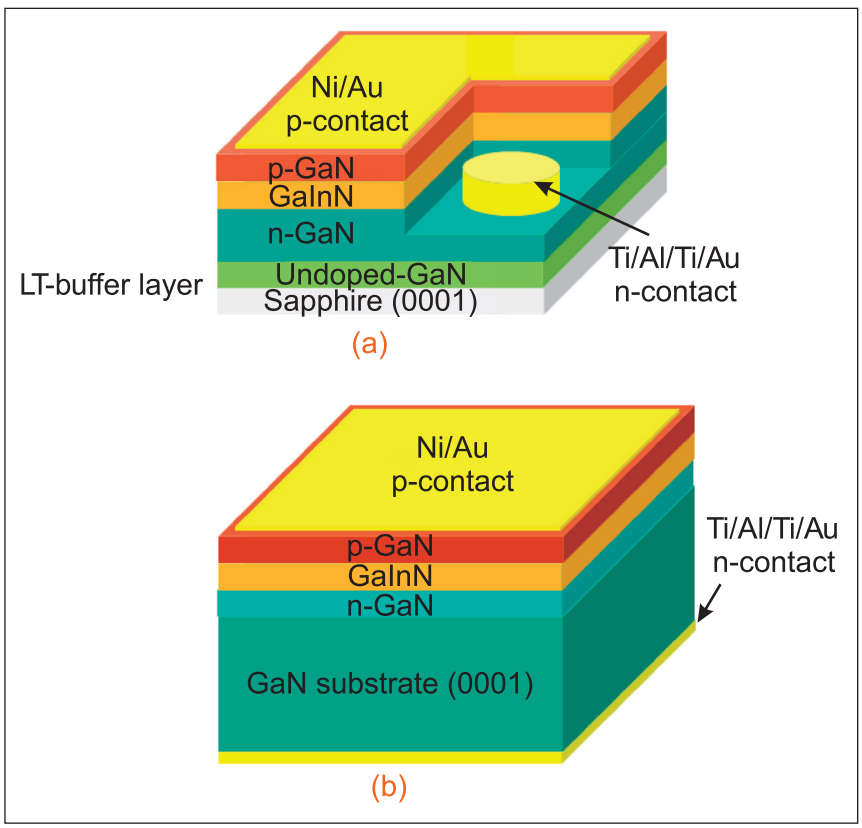


Figure 1. (a) GaInN-based solar cell with thick u-$Ga_{0.89}In_{0.11}N$ (250nm) layer on sapphire substrate covered with low-temperature-deposited (LT) buffer layer and (b) GaInN-based solar cell with thick u-$Ga_{0.90}In_{0.10}N$ (250 nm) layer on free-standing GaN substrate.

The n-type layers were 2mm thick, and the undoped GaInN were 250nm. The p-GaN layers had carrier concentrations of 3.6x10^{18}/cm^3. The thickness was 100nm on the free-standing GaN and 50nm on the sapphire substrate. The researchers estimated that 92% of sunlight with photon energies above the GaInN bandgap could be absorbed in the GaInN layer.

Ohmic semi-transparent p-contacts consisting of nickel-gold were deposited and annealed. The transparency was found to be about 67% for 370nm wavelengths. The n-contacts consisted of

titanium-aluminum-titanium-gold. For the free-standing GaN one could apply the contact to the back-surface, since the material was n-type conducting (with a carrier concentration of $4.5x10^{18}/cm^3$). The use of a back-contact allows a vertical conduction scheme. Since sapphire is insulating, for the comparison device a separate horizontal conductive structure was needed. Neither device had anti-reflective coatings to improve photon collection.

A variety of material characterizations were carried out: x-ray diffraction (XRD), transmission electron microscopy (TEM) and microscopic photoluminescence. The external quantum efficiency (EQE) was calculated using the photocurrent under excitation by a xenon lamp in a spectroscope.

From the x-ray diffraction study, the researchers determined that the In molar fraction for the GaInN layers was 0.10 and 0.11 for the free-standing GaN and sapphire devices, respectively. It was also found that the GaInN layer crystal structure were less twisted, tilted and dislocated on the free-standing GaN.

The devices were tested for photovoltaic power generation in a solar simulator with an air mass index of AM1.5 and 1.5-sun intensity at room temperature (Table 1). The open-circuit current with the free-standing GaN device is described as 'low', with the sapphire device having a slightly higher value. The researchers think this could be due to the thicker p-GaN layer used (100nm) for the free-standing device, making it harder for the light to get through to the active GaInN layer.

Although both devices have a maximum EQE of 55% at 370nm, the free-standing GaN device has a lower total EQE due to absorption in the p-GaN layer below 365nm. The researchers estimate the internal quantum efficiency (IQE) at 82%, close to the theoretical maximum of 92%.

Table 1. Performance characteristics of nitride-based solar cells on sapphire and GaN substrates. R_s = series resistance; R_{sh} = shunt resistance.

Device performance	Sapphire substrate	GaN substrate
Maximum EQE (%)	55	55
EL peak wavelength (nm)	394	388
R_{sh} (Ω-cm^2)	$3.47x10^3$	$2.33x10^4$
R_s (Ω-cm^2)	$1.39x10^2$	$1.38x10^2$
J_{sc} (mA/cm^2)	1.82	1.59
V_{oc} (V)	1.62	2.23
Fill factor (%)	52	61
Conversion efficiency (%)	0.98	1.41

The free-standing GaN device did perform better in terms of open-circuit voltage (1.4x) and fill factor (1.2x). The fill factor expresses the maximum output power as a fraction of the product of V_{oc} and I_{sc}. These higher values are attributed to the better-quality material growth that was enabled by use of a free-standing GaN substrate.

New Energy and Industrial Technology Development Organization Project, Research and Development on Innovative Solar Cells provided partial support for the research. ■

http://apex.jsap.jp/link?APEX/3/111001

Author: Mike Cooke

Developing layer transfer for mixing compounds with silicon

On-currents of 1.4mA/μm have been achieved in indium arsenide transistors on insulator on silicon substrates.

Transistors with high-mobility indium arsenide (InAs) channels have been built on insulating silicon dioxide (SiO_2) layers on silicon substrates by using layer transfer techniques [Hyunhyub Ko et al, Nature, vol468, p289, 2010].
The participating institutions were University of California Berkeley, Lawrence Berkeley National Laboratory, Taiwan's National Tsing Hua University and University of New Mexico.

InAs transistors with a gate length of 0.5μm built using this technique achieved 'on' currents of 1.4mA/μm with source–drain (V_{DS}) and gate (V_{GS}) voltages of 1V. The researchers describe this 'on' current value as 'impressive'. The on/off current ratio was 10^4.

The researchers believe that similar layer transfer techniques could be used to put other materials on SiO_2/Si substrates to give a range of 'X-on-insulator' (XOI) devices.

The InAs layers were first grown on gallium antimonide (GaSb) substrates using molecular beam epitaxy (MBE). The InAs was grown on a previous layer of aluminum gallium antimonide ($Al_{0.2}Ga_{0.8}Sb$), also deposited using MBE.

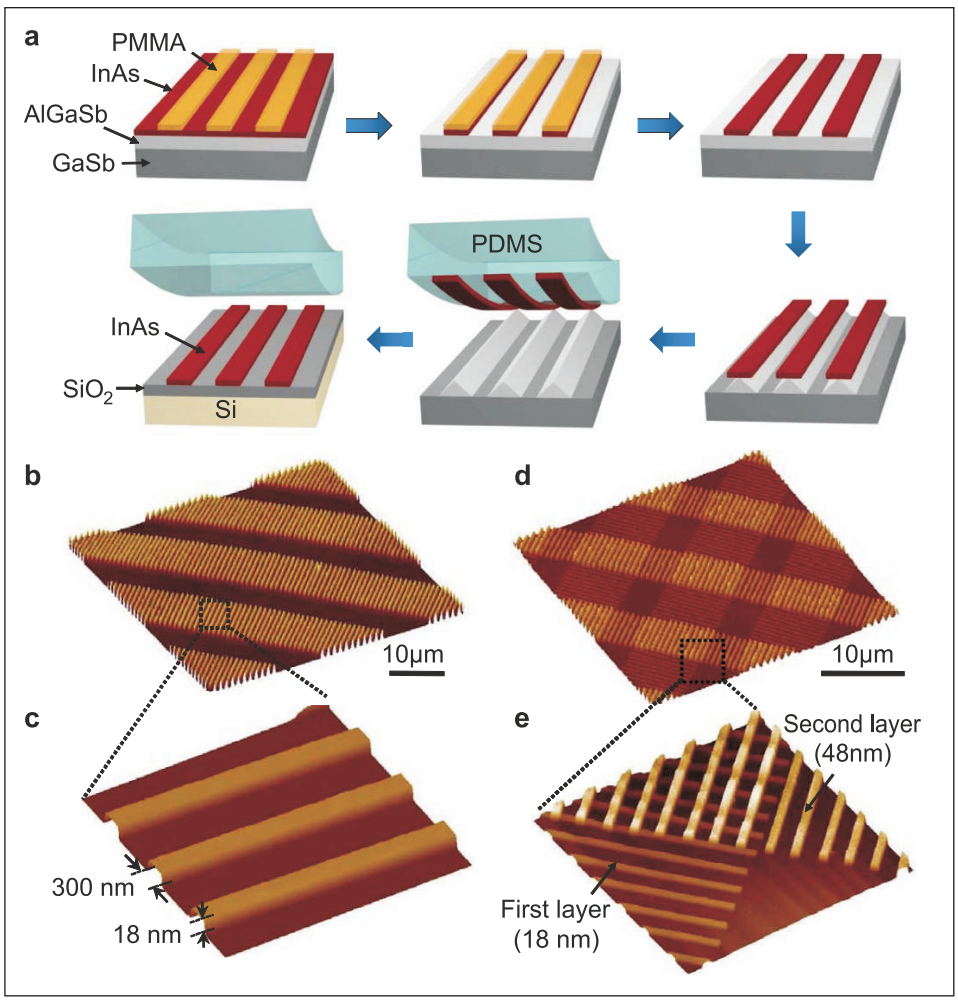


Figure 1. Fabrication scheme for ultra-thin InAs XOI (a), and AFM images (b–e).

The InAs layer was then transferred to silicon in a number of steps (Figure 1). The InAs is first formed into nano-ribbon strips using lithographic polymethylmethacrylate (PMMA) patterning and citric acid/hydrogen peroxide etching.

The AlGaSb underlayer was then etched using ammonium hydroxide solution to release the InAs nano-ribbons. A 2mm-thick polydimethylsiloxane (PDMS) elastomer substrate was used to detach the InAs from the AlGaSb/GaSb and then stamp it onto the SiO_2/Si substrate. The SiO_2 was thermally grown on the silicon.

The thickness control of the InAs is provided by the epitaxial growth process, while the length and width are determined using lithography. The researchers also experimented with structures where two layers of wires — one 18nm thick and the other 48nm thick — were laid one on top of the other (Figure 1 d, e).

The overlay capability is seen as offering capacity for 'generic heterogeneous and/or hierarchical assembly of crystalline semiconducting materials', including 'fabrication of both p- and n-type transistors on the same chip for complementary electronics based on the optimal III–V semiconductors'.

Measurements with atomic force microscopy suggested a surface roughness of less than 1nm. High-resolution transmission electron microscopy (HRTEM) was also used to characterize interfaces between the various materials used.

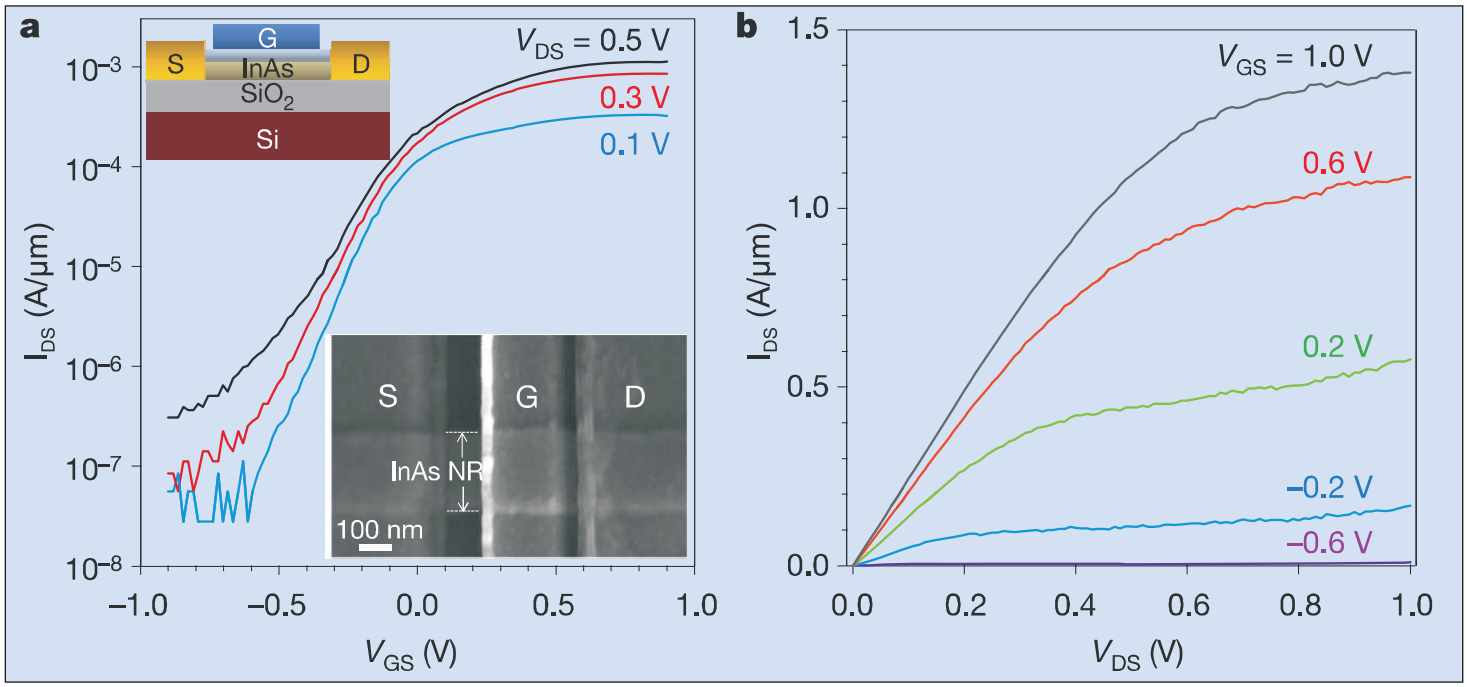


Figure 2. Top-gated InAs XOI FET schematic and transfer (a) and output (b) performance characteristics. The InAs thickness is ~18nm, the ZrO_2 is ~8nm. The gate length was 0.5μm (width ~320nm = 0.32μm).

Two types of transistor were built to test the electronic properties of the InAs material. One construction used the silicon substrate as a back-gate and nickel metal as source/drain contacts to the InAs channel.

A more complex top-gate structure used a zirconium dioxide gate dielectric and nickel gate contact, again with nickel source/drain contacts (Figure 2). Zirconium dioxide (ZrO_2) has a high dielectric constant (~20) compared with SiO_2's 3.9. A thermal process at 350°C for 1 minute improved the device performance, creating a 1nm-thick InAsOx passivation layer on the InAs ribbons.

The on/off current ratio for the top-gate device was 10^4, while the sub-threshold swing ($SS=dV_{GS}/d(\log I_{DS})$) was 150mV/dec (one device registered 107mV/dec). InAs and InGaAs quantum well FETs have typical SS values of ~70mV/dec and 75mV/dec, respectively. Low values of SS are needed for a sharp switch between 'off' and 'on'. Commercial logic devices have typical SS values of ~70mV/dec. Standard silicon CMOS technology has a fundamental lower limit of 60mV/dec, although alternate channel materials and/or different structures such as tunnel devices could reduce this. The peak transconductance of the InAs transistor was 1.6mS/μm at V_{DS} = 0.5V.

The researchers comment: 'The devices reported here use a relatively thick gate dielectric, which could be scaled down in the future to further improve the gate electrostatic control and the SS characteristics.'

Using the interface trapping density as a fitting parameter in their device model, the researchers obtained a D_{it} value of $10^{11}/cm^2/eV$ for the InAsOx passivated device, a 60x improvement over unpassivated transistors. More accurate extraction of D_{it} using CV (capacitance–voltage) measurements is difficult in narrow-bandgap materials such as InAs compared with silicon-based structures.

The back-gate device was used to study the field-effect mobility for various thicknesses of InAs. For layers less 18nm the mobility increases approximately linearly and then saturates to a value of $5500cm^2/V\text{-}s$. These compared well with simulations performed by the researchers to 'demonstrate the effectiveness of the XOI platform as a clean and predictable material system for exploring high-performance devices while highlighting the critical role of quantum confinement and surface contributions in the transport properties of InAs, even at relatively large thicknesses'.

The measured saturated field-effect mobility for the back-gate device is around half the comparable figures for InGaAs and InAs quantum well structures of $10{,}000cm^2/V\text{-}s$ and $13{,}200cm^2/V\text{-}s$, respectively. Field-effect mobilities tend to be lower than bulk values due to device and surface state mobility-reducing contributions that are not present in Hall-effect measurements on bulk material (InAs $\sim 40{,}000cm^2/V\text{-}s$).

As future research projects, the team is considering using similar layer transfer techniques with other compound semiconductor materials and developing techniques to scale up the process for use with larger-diameter 200mm and even 300mm silicon substrates. ■

http://dx.doi.org/10.1038/nature09541

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

Non-polar nitride boost to blue and true-green laser diode

University of California Santa Barbara spin-off Soraa achieves record wall-plug efficiency of 23% for a blue laser diode emitting at 447nm.

Soraa Inc of Goleta CA, USA has published performance details of record high-efficiency blue laser diodes (LDs) built on non-c-plane gallium nitride (GaN) semiconductors substrates [James W. Raring et al, Appl. Phys. Express, vol3, p112101, 2010]. The company has also developed true-green laser diodes for which it expects 'substantial performance improvements' in the coming months.

Soraa works on developing III-nitride semiconductors, 'focusing on disruptive energy-saving solutions'. The firm was founded in 2008 (as parent company to Kaai Inc) by the University of California Santa Barbara (UCSB) professors Shuji Nakamura, Steve DenBaars and Jim Speck, whose names appear on the Soraa paper.

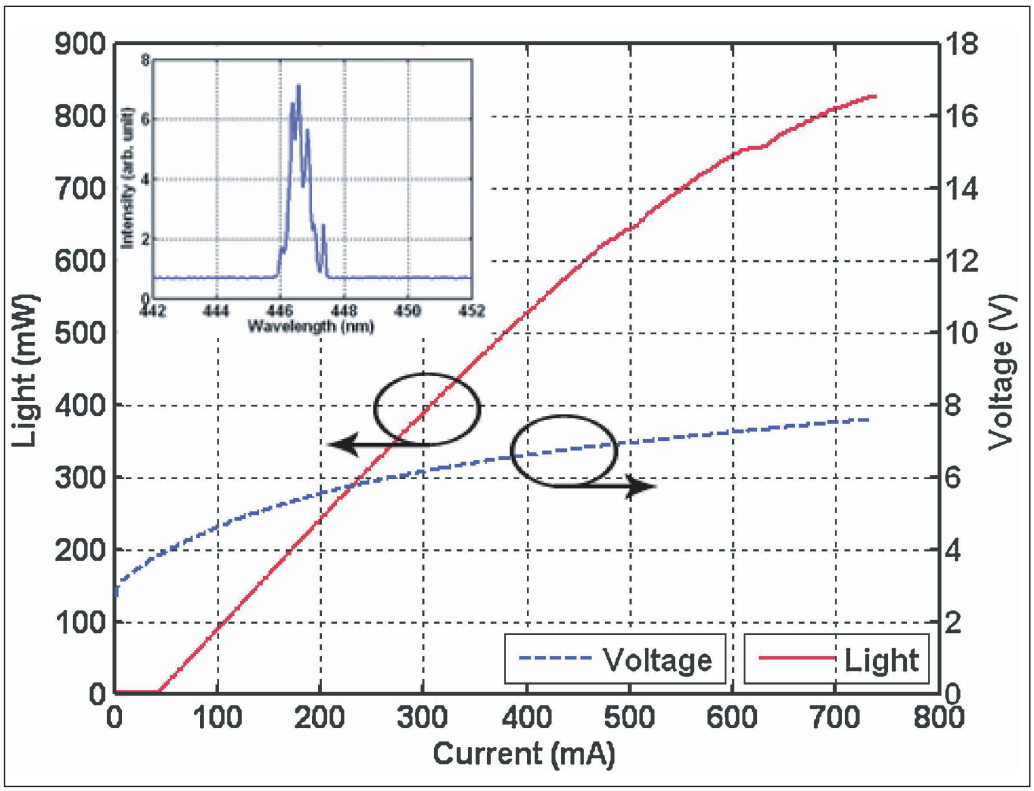


Figure 1. CW light-output vs current and voltage (LIV) characteristics of single-mode blue-emitting laser diode. Inset: lasing spectrum at 447nm.

Light emission from indium gallium nitride (InGaN) devices power an increasing number of applications, including biomedical instrumentation and therapies, imaging, reprographics, scientific research, defense, security, data storage, and projection displays.

The present commercial InGaN technology uses c-plane substrates that suffer from polarization electric fields, mainly arising from piezoelectric strain effects. These fields tend to reduce the overlap between the electron and hole carriers, reducing their chances of recombining as suitable photons. By working with other orientations of the nitride crystal structure it is hoped to reduce the polarization fields and thus increase recombination and hence the efficiency of light-emitting devices. Non-c-plane $\{20\bar{2}1\}$ orientations were used by Sumitomo in 2009 to extend laser diode performance into the true-green region of the spectrum (520–570nm), with pulsed lasing at 531nm and continuous wave (CW) lasing at 520nm.

The Soraa report is rather coy about the device structure and does not give any details about particular nitride orientations used. Possibly the company wants to keep this useful information to itself for commercial advantage and is perhaps indicative that sample devices will be available from Soraa in the near future. The multi quantum well (MQW) laser structures were grown on free-standing GaN substrates with 'selected orientations', using 'conventional' processing technology. Some clues to the structures would no doubt emerge from a search and study of UCSB's recent work.

The epitaxial MQW structures were formed into laser cavities measuring 600μm and 900μm in length and with widths in the range 1.5–2.5μm. The laser diodes had surface ridge architectures, aiming at a single lateral mode. The epitaxial material was processed further to apply metal for contact pads, and the result was then singulated, mounted and assembled into

standard transistor outline (TO) can packages.

The researchers are claiming the highest CW wall-plug efficiency (WPE) and light output power values 'reported to date' for blue laser diodes emitting at 447nm wavelengths (Figure 1). One device with a 900μm cavity had kink-free operation up to 750mW, and powers in excess of 800mW were achieved. The peak WPE for this device was 22% at 200mW. A 600μm cavity device achieved a WPE of 23.2% at 180mW. These results beat a previous achievement of 18% WPE by Osram Opto Semiconductors of Regensburg, Germany for a c-plane device reported earlier this year.

The threshold current/voltage values for the 900μm and 600μm Soraa devices were 45mA/3.8V and 30mA/3.8V, respectively. The corresponding slope efficiencies were 1.55W/A and 1.62W/A. The measurements were carried out at case temperatures of 25°C.

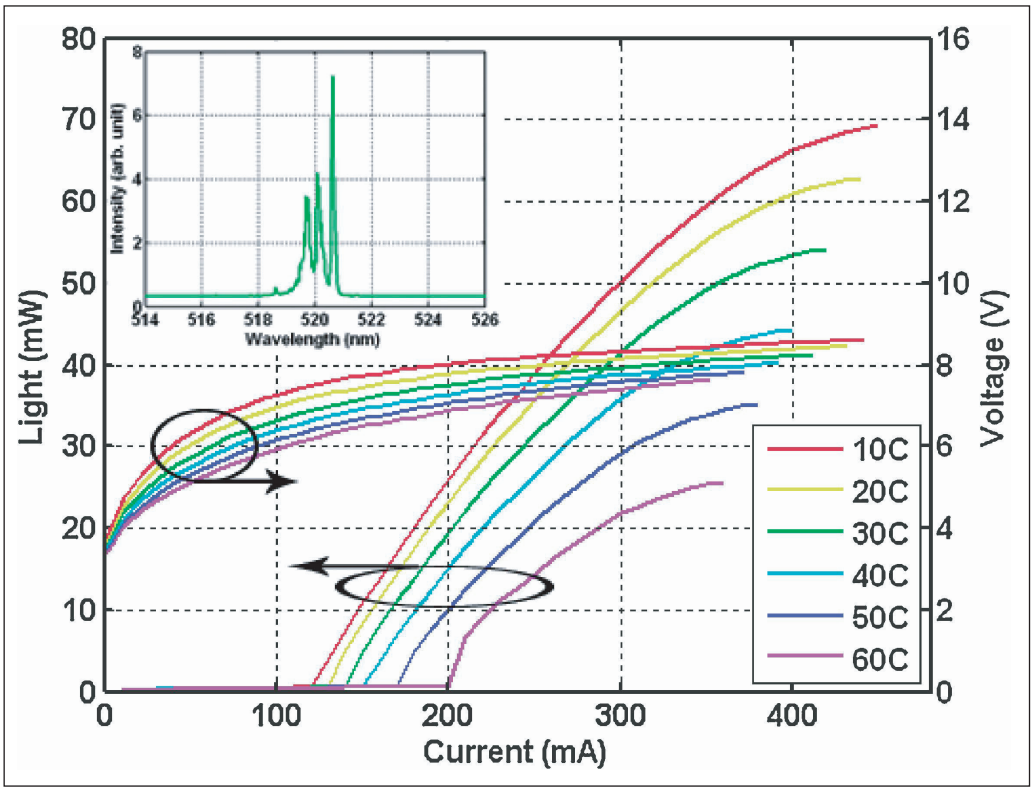


Figure 2. CW–LIV characteristics at case temperatures of 10–70°C of a green-emitting laser diode. Inset: lasing spectrum at 521nm at case temperature of 20°C.

Further testing involved varying the temperature of 600μm devices. The threshold current temperature characteristic (T_0) was 130K, which falls in the 'typical' range of 125–140K that Soraa has for its other devices. (High values of T_0 are desirable.) The WPE was more than 20% at 100mW and more than 22% at 180mW at all case temperatures in the range 10–70°C. The highest peak WPE achieved was 23.6% at a case temperature of 50°C and 200mW output power.

A 600mm cavity device achieved a wall-plug efficiency of 23.2% at 180mW. These results beat a previous achievement of 18% WPE by Osram Opto Semiconductors of Regensburg, Germany for a c-plane device

Operating lifetimes of five devices were determined by operating at 40°C for more than 2000 hours with 60mW output power. Using a linear extrapolation of the operating current increase needed to maintain 60mW output, the mean lifetime was ~10,000 hours, with a spread of 8000–23,300 hours.

A true-green laser diode emitting at about 521nm was also presented (Figure 2). Since producing true-green LDs is still very challenging, it is no surprise to see WPE values an order of magnitude less in size. At 20°C, the threshold current and voltage were 130mA and 7.3V, respectively. The peak WPE is given as 1.92%. The slope efficiency was more than 0.3W/A, and output powers of more than 60mW were reached. By varying the temperature, the T_0 value was determined to be 160–180K in pulsed operation (avoiding self-heating effects). Lifetime measurements are reported to be 'underway'.

Although the true-green device does not match the performance under CW conditions of 2.3% WPE at 50mW output power by Osram Opto on c-plane GaN, the researchers contrast the 15-year development with their own 15 months on non-c-plane material 'with substantial performance improvements expected in the months to come'.

For both blue and true-green devices, the full-width at half maximum (FWHM) of the spectral enveloped was about 1nm. The FWHM divergence angles in the 'slow' (due to width of active region) and 'fast' (due to epitaxial layer thickness of active region) axis directions were 9–12° and 15–18°, respectively, for the blue devices. The true-green device had the same slow-axis range, but a slightly tighter fast-axis range of 13–17°. ■

www.soraa.com

http://apex.jsap.jp/link?APEX/3/112101

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

Singapore researchers create amber light for nitride LEDs

InGaN quantum dots in wells yield yellow emission: AlN cap layer used to prevent indium out-diffusion during doping activation anneal.

Multi-quantum wells (MQWs) built of indium gallium nitride (InGaN) semiconductors are widely used to produce short-wavelength visible light from green through blue to ultraviolet. Researchers would like to fill out the red end of the visible spectrum. In principle, this could be achieved with higher indium content in the InGaN material. However, with higher indium content there is a tendency to clump into higher In and lower In regions, rather than having a homogeneous In distribution.

Researchers from Singapore's Institute of Materials Research and Engineering (part of the Agency for Science, Technology and Research, A*STAR), and the Singapore–MIT Alliance at National University of Singapore, have been using this clumping effect to create quantum dots (QDs) with suitable longer-wavelength yellow emission properties [C. B. So et al, J. Appl. Phys., vol108, p093501, 2010]. The researchers also developed an aluminum nitride (AlN) capping layer technique to protect the dots from the high-temperature thermal processing needed to create the p-contact of LED devices.

The researchers grew three types of three-period MQW sample on c-plane sapphire using MOCVD. The barrier material consisted of GaN. The wells consisted of two InGaN layers — a 1nm 'wetting layer' and a 2nm layer with higher trimethyl-indium (TMIn) flow rate (and hence In content). The purpose of the wetting layer is to reduce the strain for subsequent quantum dot growth. The trimethyl-gallium (TMGa) flow rate was the same in both cases. The growth temperature was 725°C.

The well growth was interrupted between the layers in two of the sample types (samples B and C) to allow indium-rich quantum dots to form where TMIn flowed under ammonia-rich conditions (the nitrogen source) for 30 seconds (Figure 1). In the case of sample C, a ~1.2nm AlN layer was inserted between the wells and the GaN barrier.

The aim of using the AlN layer was to reduce degradation of the QDs under further growth, through indium out-diffusion for example. Also the high-temperature anneals for p-contact activation was a concern. Atomic force microscopy (AFM) morphology studies were used to understand the various growth processes and to develop improved samples.

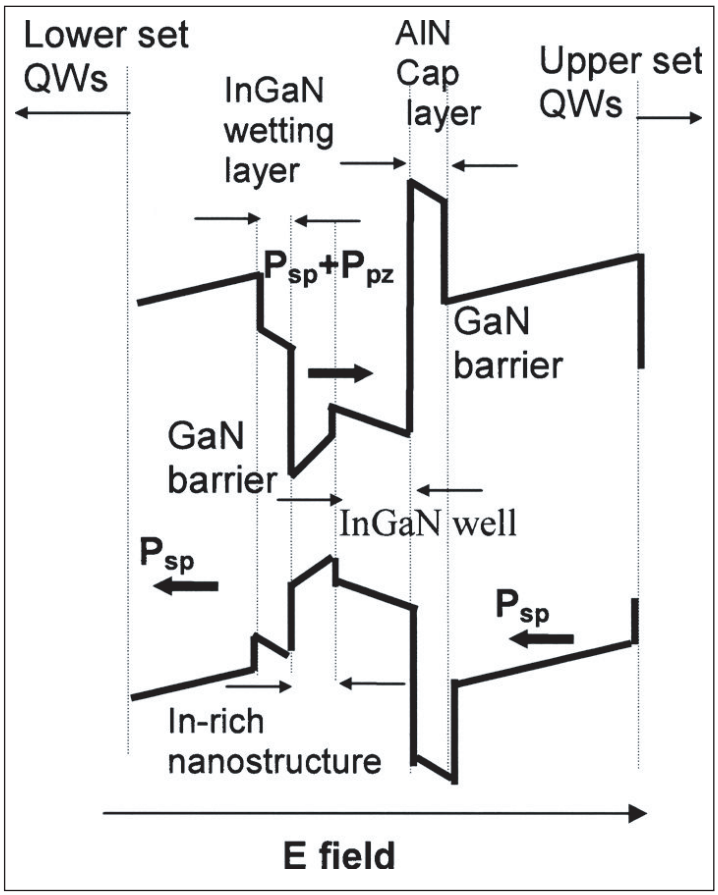


Figure 1. Schematic representation of energy band profile of strained AlN/InGaN QDs/InGaN/GaN quantum well.

Once the MQWs had been grown, a 10nm GaN capping layer was applied. The B and C material was used to create LEDs (samples X and Y) by adding p-AlGaN (25% Al) and p-GaN as the electron-blocking layer and p-contact, respectively. The magnesium doping was activated with a 20 minute anneal at 825°C in-situ in the growth chamber. Transmission electron microscopy (TEM) was used to understand the impact of this process on the samples. It was found that the anneal tends to shrink the QDs, but there was less of an impact in samples with AlN between the wells and the barriers.

Photoluminescence studies on the QD samples without p-contact layers were carried out and it was found that a simulation anneal at 820°C blue-shifted the

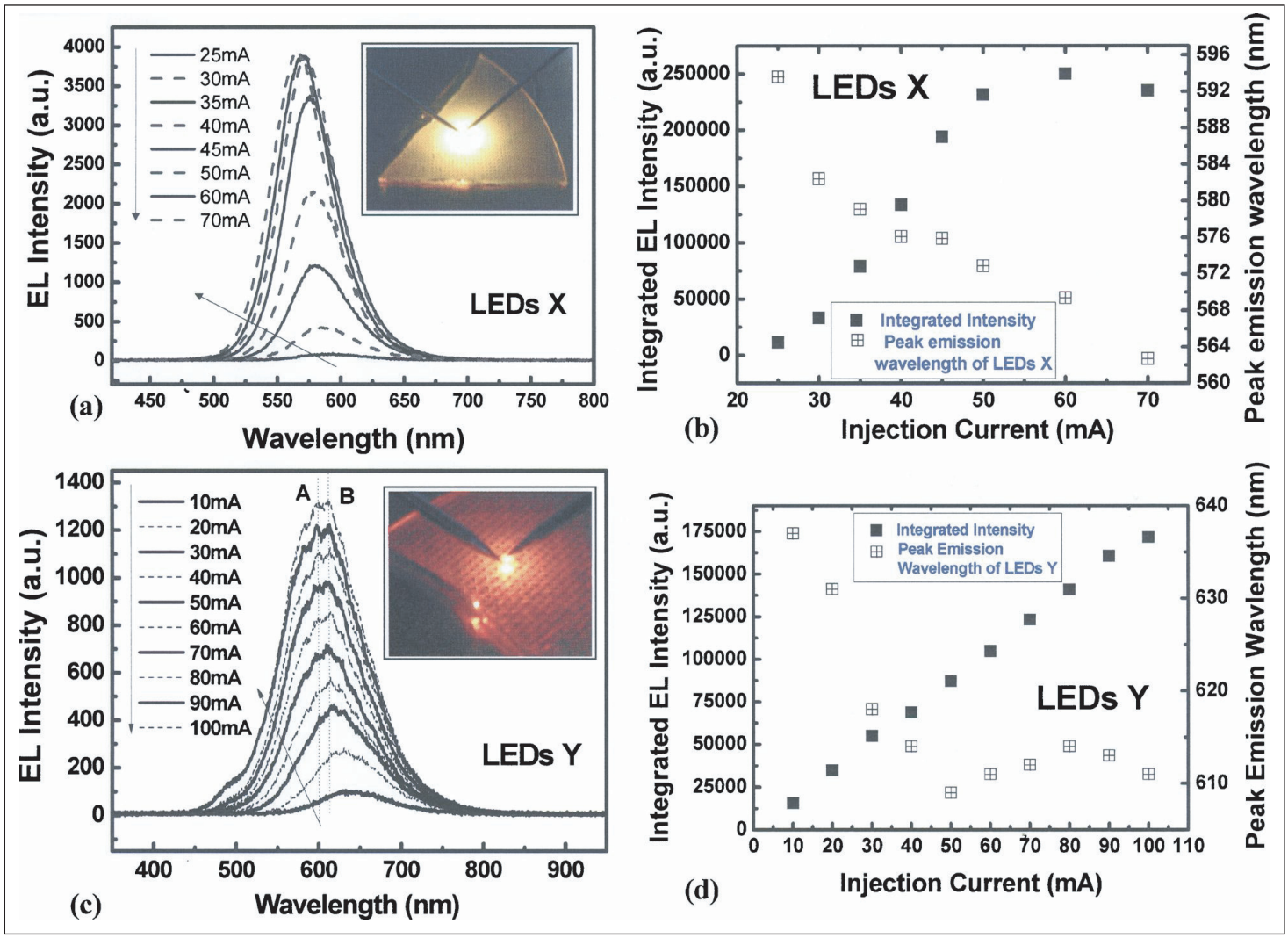


Figure 2. Current-dependent EL spectra (left) and plots (right) of the light-output power and peak emission wavelength of LEDs as a function of injection current, for LEDs X (top) and Y (bottom).

emission from B (without AlN caps) but red-shifted that from C (with AlN). The effect of annealing is out-diffusion of the high indium content of the dots. Without the AlN cap, the indium can diffuse also out of the well into the surrounding barrier region. However, with the cap, the indium is confined to the well region, creating longer-wavelength-emitting material there (red-shift). In the case of sample B without cap, the effect of wider indium diffusion creates a lower indium content in the well layers

With the cap, the indium is confined to the well region, creating longer-wavelength-emitting material there (red-shift)... The AlN cap also reduced the strain between the InGaN well and GaN barrier for the second and third periods of the structure. This reduces the amount of polarization charge at interfaces and hence also the polarization electric fields in the structure

and also allows strain relaxation, reducing piezoelectric polarization fields. Both these factors would tend to produce a blue-shift. (Piezoelectric fields tend to create a red-shift in InGaN MQWs grown in the c-direction.)

Electroluminescence studies on the LED structures showed the devices to be yellow emitting, with broad emission bands covering wavelengths 500–680nm for sample X (without AlN caps) and 550–750nm for sample Y (with AlN). The dominant peaks of the samples blue-shifted with increasing current (30mA to 70mA): from 582nm to 562nm for sample X; and from 668nm to 658nm for sample Y. The smaller shift in sample Y is taken by the researchers as suggesting that the effect of piezoelectric fields is smaller in LED Y.

Thus, it is believed that the AlN cap also reduced the strain between the InGaN well and GaN barrier for the second and third periods of the structure. This reduces the amount of polarization charge at interfaces and hence also the polarization electric fields in the structure. ■

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Author: Mike Cooke

Nitride wells tune in to green and white

GaInN quantum wells have been used to both create and convert blue-violet light to longer-wavelength green-yellow colors.

Researchers in France have developed a monolithic nitride semiconductor system for creating and converting blue-violet light into green-yellow [B. Damilano et al, J. Appl. Phys., vol108, p073115, 2010]. By creating a suitable balance of the direct blue-violet and converted green-yellow light, it is possible to create quasi pure-green and even white emission.

Normally white light-emitting diodes are produced by covering a blue or violet LED with a yellow phosphor material such as cerium-doped yttrium aluminum garnet (YAG:Ce). A number of techniques have been proposed to avoid the complication and cost of adding such phosphor layers.

The approach of the researchers from Centre de Recherche sur l'Hétéro-Epitaxie et ses Applications (CRHEA) — which is part of France's Centre National de la Recherche Scientifique (CNRS) organization — is to use gallium indium nitride (GaInN) multiple quantum wells (MQWs) for both photon emission and conversion.

The nitride layers of the color conversion portion of the device (Figure 1) were grown by MOCVD on c-plane sapphire. The non-intentionally-doped (nid) GaN buffer layer was 6.6μm.

The green-yellow MQW color convertor (nid) consisted of a 20-period structure with 3.1nm GaInN wells and 20nm GaN barriers. The last nid GaN barrier layer was somewhat thicker at 300nm. Photoluminescence experiments on the structure showed that its performance was not uniform across the wafer. Near the flat portion of the wafer edge, the emission wavelength was around 500nm (blue-green), but this increased to 580nm (yellow) at the opposite side.

The blue-violet light-emitting layers were grown by MBE. The researchers report that a first attempt using MOCVD to grow the active layers was not successful, presumably due to the high temperatures (>900°C) 'annealing'/disrupting the previous color converter layers.

The n-GaN (silicon doped) layer was 2.2mm grown at 820°C. The active layer was a 5-period MQW with the GaInN well layers grown at 570°C and the GaN barriers at 800°C. The nitride layers were completed with p-type (magnesium doping) layers consisting of a 20nm $Al_{0.1}Ga_{0.9}N$ electron-blocking layer and a GaN layer grown at 760°C. The emission wavelength varied between 405nm at the center of the wafer to 450nm at the edge — these fall within the violet range (380–450nm), bordering on blue (440–490nm).

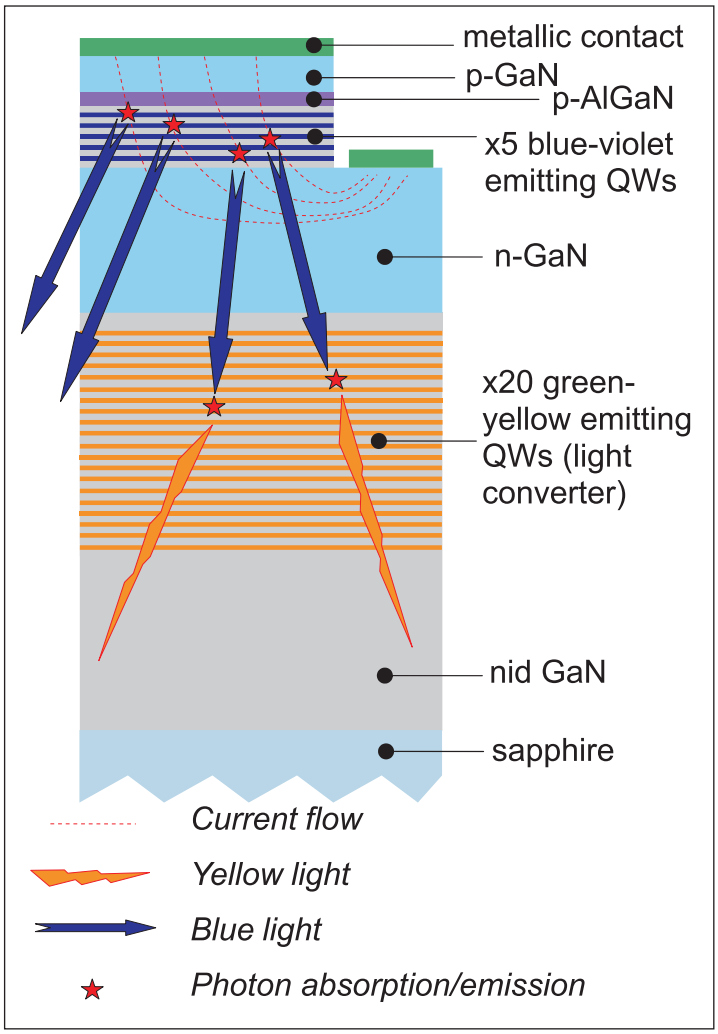

Figure 1. Structure of the device, consisting of a blue LED grown on top of 20-period green-yellow emitting GaInN/GaN MQWs.

This epitaxial material was used to create LEDs through normal methods: photolithography, dry (plasma) etch and contact metal deposition. The p contacts were non-transparent nickel-gold, which reflected some light back through the color conversion structure.

Although variations in device properties are not desired in a commercial environment, the researchers used their non-uniformities to study a spread of characteristics. In one group, the active layer emission wavelength (pump) was fixed at 430nm (as determined from devices without color converters grown using the same conditions) — i.e. devices were taken at a fixed radius from the center of the wafer. In another group, the color converter wavelength was fixed at 520nm by taking devices at a fixed distance from the flat edge of the wafer.

At 20mA continuous injection current with a fixed pump wavelength (430nm), it was found that the secondary peak from color conversion reduces by a factor of ~30 as the wavelength increased from 500nm to 580nm. With a fixed color conversion wavelength (520nm) at the same injection current, the shorter wavelength pump of 405nm had a conversion peak ~10x that of a pump with 450nm.

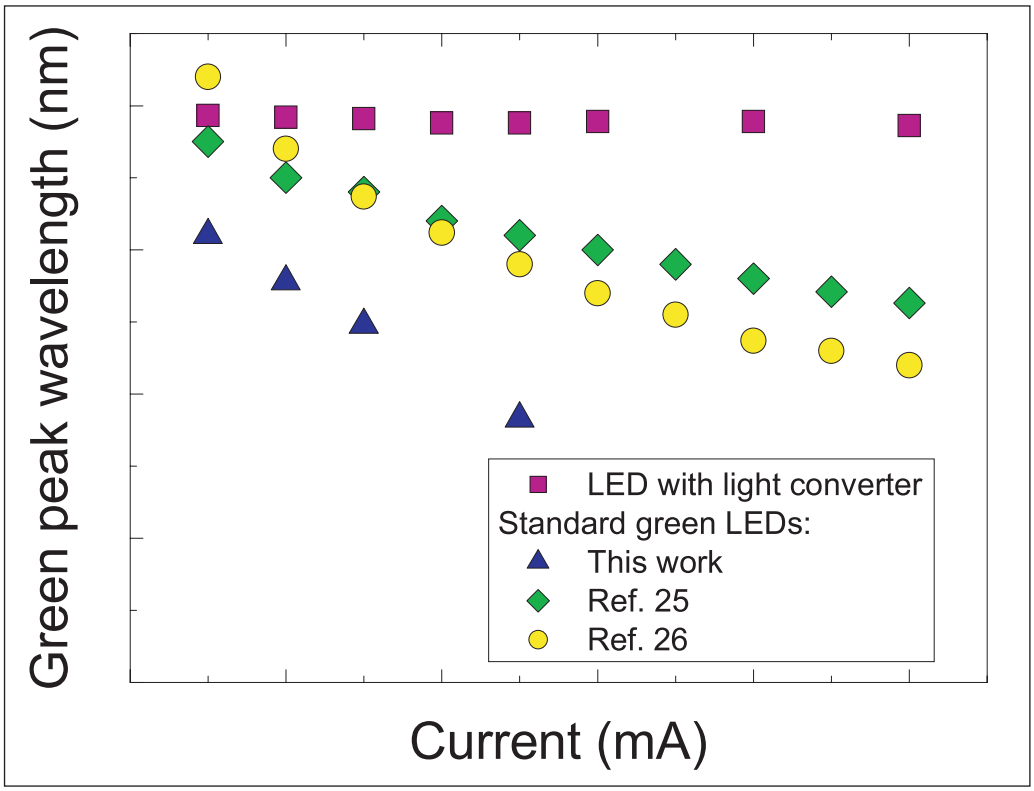

Figure 2. Variation in electroluminescence peak wavelength versus current for standard green LEDs (triangles, diamonds, circles) and for green peak of LED with nitride MQW light converter (squares).

With the 520nm color converter, it was found that the chromaticity coordinates changed from quasi pure-blue (0.168, 0.615) to quasi pure-green (0.148, 0.166) in the move from a 405nm to a 450nm pump. It was also possible to find 'white' light-emitting devices on the wafer with a pump wavelength of 406nm and a converter wavelength of 565nm: chromaticity coordinates were (0.328, 0.351); correlated color temperature was 5683K; and color rendering index (CRI) was 41.6. The researchers say that this corresponds to mid-morning/mid-afternoon light. The CRI could be improved (100 is the usual target), the researchers suggest, by increasing the full width at half maximum (FWHM) of the yellow peak, realized by using GaInN color converter QWs emitting at different wavelengths, instead of having identical QWs.

The pumped devices could also produce green light without the large efficiency droops seen in traditional devices — if all the blue photons could be converted to green, then large output power devices would result

Variation of the light output with current was also studied using a device with a 408nm (violet) pump and 529nm (green) converter. Up to 60mA the chromaticity coordinates stayed approximately constant at around (0.218, 0.498); at 100mA, this shifted to (0.201, 0.429), indicating an increase in the blue component. The researchers interpret the shift as being mainly due to Joule heating effects at larger currents. It is found that the 'blue' component red-shifts to 409.3nm at 100mA, which is an effect associated with bandgap narrowing due to heating. The absorption of the light converter decreases with longer pump wavelengths, reducing the green emission. The observed decrease in green emission (~20%) is larger than expected (~14%) — the researchers suspect that the internal quantum efficiency of the converter MQWs also decreases due to heating effects.

The green peak wavelength of the pump/converter set-up is far more stable compared with LEDs designed to emit green light (Figure 2). Standard LEDs produced using a 520nm converter MQW structure had a blue-shift of 12.7nm over the range 10–50mA, although this is larger than for some reported devices. The pump/converter combination saw a blue–shift of only 1nm in the range 10–100mA.

The researchers suggest that the pumped devices could also produce green light without the large efficiency droops seen in traditional devices — if all the blue photons could be converted to green, then large output power devices would result. ■

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Author: Mike Cooke.

Varying wells to combat LED efficiency droop

Taiwan researchers investigate graded well thickness to improve LED efficiency.

Researchers at National Chiao-Tung University (NCTU) and Epistar Corp have used quantum wells with varying thickness to reduce 'efficiency droop' effects in indium gallium nitride (InGaN) blue light-emitting diodes (LEDs) [C. H. Wang et al, Appl. Phys. Lett., vol97, p181101, 2010].

Nitride semiconductors are the dominant material for making devices emitting light with shorter wavelengths (<540nm) of green, blue, violet and ultra-violet. These devices work at high efficiency at relatively low current but, as the current increases, the efficiency tends to fall off for various reasons, particularly with the longer-wavelength region (green). Overcoming this problem would enable lower-cost LED lighting installations to work with less power consumption.

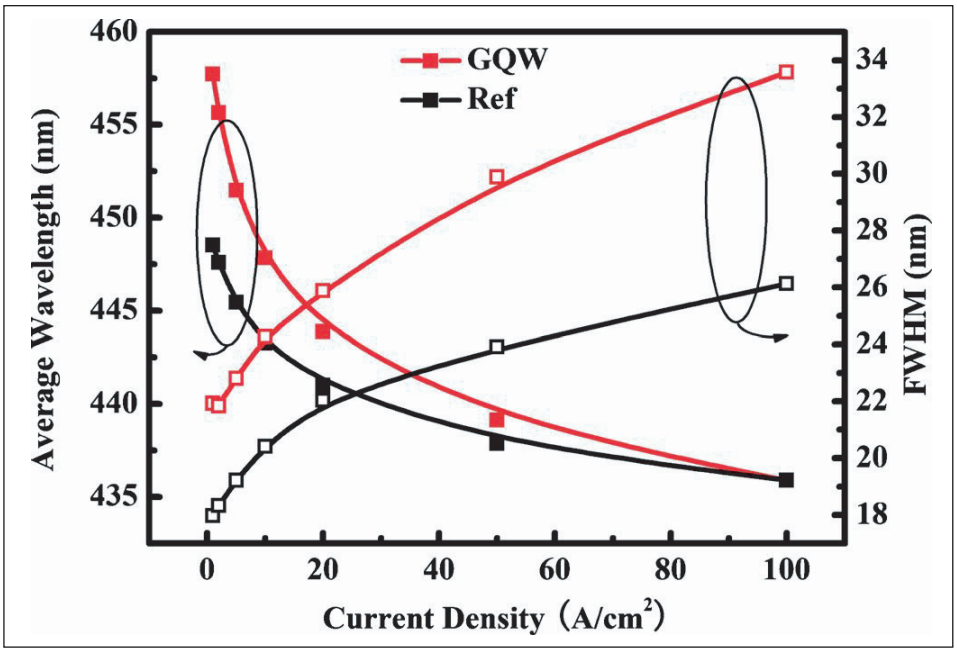

Figure 1. Average wavelength and FWHM as a function of current density for reference and GQW LEDs.

Multi-quantum well structures with InGaN wells and barriers of GaN (or sometimes InGaN with a different composition) are used to create light emission, with one side injecting holes and the other electrons. It has been found that, while the electrons travel across the structure fairly evenly (or overshooting into the p-contact/hole source region), the holes tend to be concentrated near the p-injection contact.

By making the wells wider towards the p-contact, the NCTU/Epistar group hoped to improve the hole concentration across the active region. The hole carrier lifetime in thicker wells tends to be longer, allowing a larger proportion to move on to the next well.

The researchers grew their nitride LED structures using metal-organic chemical vapor deposition (MOCVD) on c-plane sapphire. The base for the MQW structures was a 4nm GaN nucleation layer followed by a 4μm n-GaN buffer.

On top of this, a superlattice was constructed using 10x InGaN/GaN pairs. The graded-thickness MQW (GQW) structure consisted of InGaN (In molar fraction 15%) quantum wells with 10nm GaN barriers. The well thicknesses were 1.5, 1.8, 2.1, 2.4, 2.7 and 3nm, as determined by the growth time. A reference LED with constant thickness wells was also produced with a well thickness of 2.25nm, a value that makes the active volume equal for the graded and ungraded structures.

The p-contact layers consisted of an electron-blocking layer of 20nm AlGaN (15% Al) and 200nm of p-GaN. These epitaxial structures with transparent indium tin oxide (ITO) contact layers applied were formed into 300μm x 300μm LED mesas. Nickel-gold was applied for the contact pads.

The electroluminescent (EL) testing of the devices showed the GQW device to be red-shifted relative to the reference up to 100A/cm^2 current density (Figure 1). Also, the width of the emission line is wider. However, over this energy range the blue-shift with increasing current is greater in the GQW device, so that the emission wavelengths of the two devices are approximately equal at 100A/cm^2.

Normally, LED blue-shift is attributed to band-filling effects making the energy difference between electron and hole levels greater (and hence increasing the recombination photon energy). Also, charge screening effects can play a role. These effects arise from the quantum-confined Stark effect (QCSE), where

piezoelectric polarization fields are developed from the strained nature of the wells. Increases in the full-width at half maximum (FWHM) of emissions are often attributed to band filling and self-heating.

For the GQW devices, based on simulations, the researchers believe that the increased blue-shift is due to more recombination occurring in the narrower wells as the current density increases. Since the wells emit at somewhat different wavelengths, the symmetry of the spectral peak gives information about the balance of recombination across the structure.

The asymmetry factor (AsF = FWHM divided by twice the distance from the low wavelength intersect to the peak, giving 1 for a symmetric peak) for the regular LED changed from 1.04 to 0.98 as the current increased from a density of 1A/cm^2 to 100A/cm^2. The GQW devices change from 1.05 to 0.89 over the same range. The low AsF value shows increased contribution from the blue-end and decreased contribution from the red end of the spectral distribution.

The researchers comment: 'These enormous changes in wavelength and linewidth might make the design of the GQW concept impractical for lighting applications.'

Future work for the group could include grading the indium content of the wells to compensate somewhat for these undesired effects. This could be done by reducing the indium content of the wider wells.

The researchers also measured the effect on efficiency droop (Figure 2). The light output power of the GQW was 24.3mW, compared with 18.0mW for the reference device, at 20A/cm^2. It was also found that grading increases the point at which the efficiency droop starts (30A/cm^2 vs 2A/cm^2 in the reference) and reduces the fall off after that point (16% drop from peak at 200A/cm^2 vs 32%).

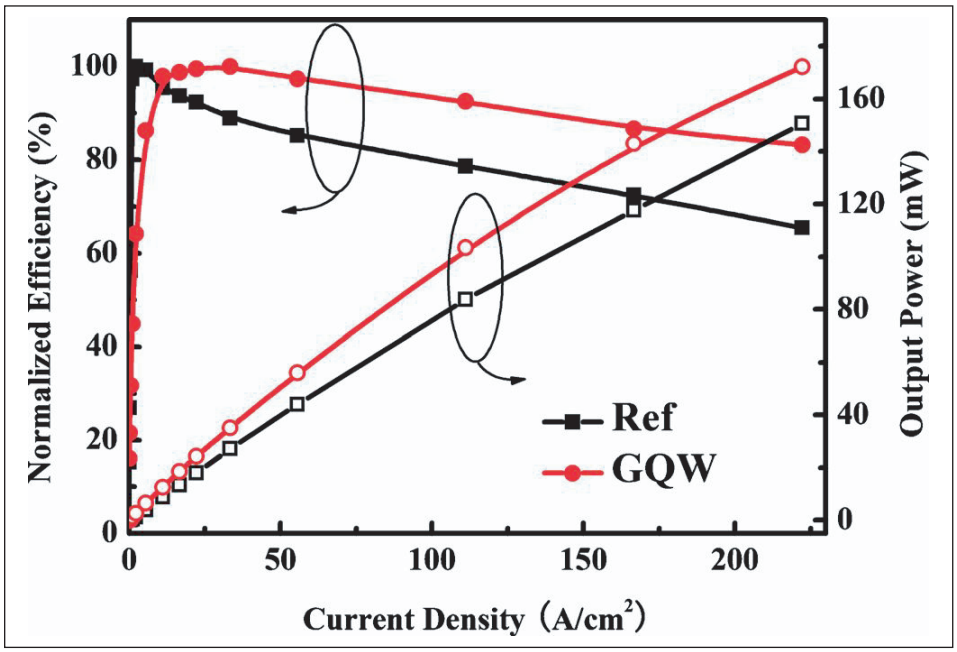

Figure 2. Comparison of normalized EL efficiency and light output power (L) curves vs current density.

The researchers suggest that the improved hole distribution and consequent reduction of Auger effects that kick in at high carrier concentrations lead to better recombination rates into photons rather than other mechanisms. ■

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www.epistar.com.tw/about-e.htm

Author: Mike Cooke

Polarized LED from RPI and Kyma promises more efficient displays

A record polarization intensity ratio of 0.77 has been achieved for top surface emission from >500nm-wavelength AlGaInN LEDs.

The Smart Lighting Engineering Research Center (ERC) at Rensselaer Polytechnic Institute (RPI) in Troy, NY and III-nitride materials provider Kyma Technologies Inc of Raleigh, NC, USA have used non-standard crystal growth directions to create a nitride semiconductor light-emitting diode with a polarization intensity ratio of 0.77 [Shi You et al, Appl. Phys. Express, vol3, p102103, 2010]. The researchers comment that this polarization intensity ratio is, to their knowledge, "the highest value obtained in top surface emission of any AlGaInN LED for wavelengths longer than 500nm from planar surface emission".

Polarized LEDs could be used to make more efficient back-light units for liquid-crystal displays (LCDs). Nematic-phase liquid-crystal displays use polarized light to create images. The liquid-crystal material is put between a pair of polarizers. By varying the configuration of the liquid-crystal structure under an applied electric field, the light's polarization can be shifted, thus modulating the transmission. If this set-up is driven by unpolarized light, then more than half the source's power is thrown away by the first polarizer.

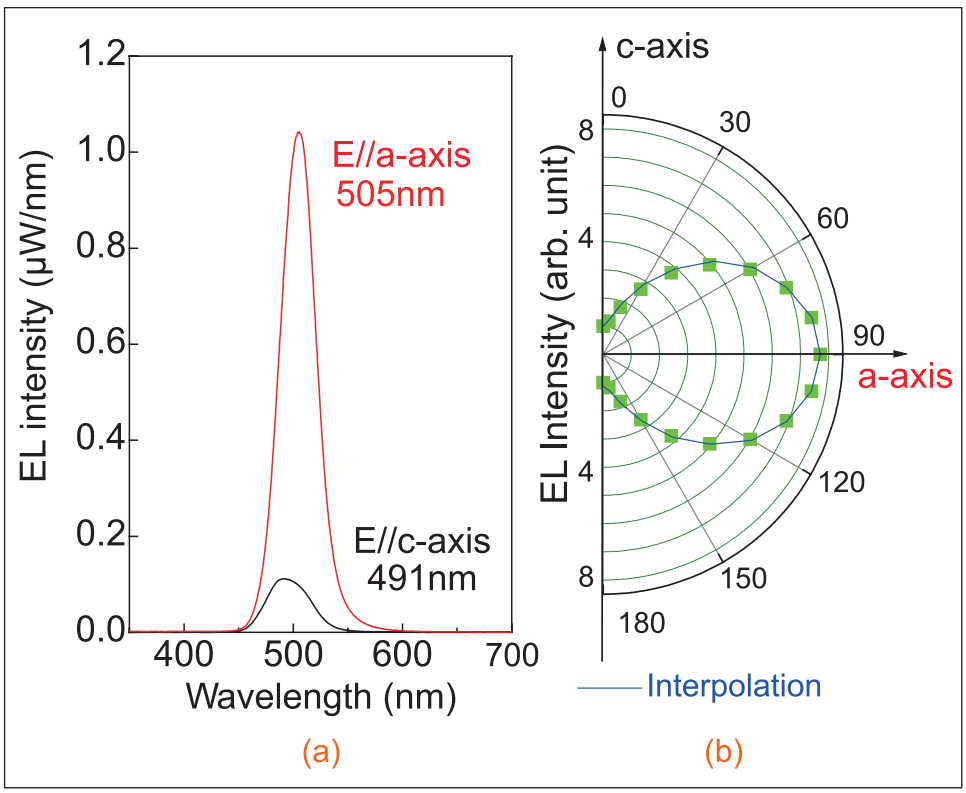

Figure 1. (a) Polarization-resolved EL spectra of m-plane LED at 20mA. Emission polarized along the c-axis peaks with maximum intensity at 491nm, while emission polarized along the a-axis has an intensity peak at 505nm. (b) EL intensity as a function of polarization angle together with interpolation of both main perpendicular components. At 0° and 180°, the polarizer is along the c-axis, and at 90° it is along the a-axis.

In the past couple of years, a number of research groups have been investigating nitride semiconductor LEDs grown in crystal directions different from the usual c-direction to improve performance, in particular to avoid wavelength shifts in the output light with drive current arising from the electric polarization fields that are directed in the c-direction in these structures. LEDs grown in non-polar and semi-polar directions also produce linearly polarized light.

The Rensselaer Polytechnic and Kyma researchers used gallium nitride (GaN) substrates that were 5mm x 10mm rectangular slices cut from free-standing bulk wafers (50mm diameter, up to 7mm thick) grown in the c-direction using hydride vapor phase epitaxy (HVPE). The study used substrates with surface m- and a-planes with off-cut angle less than 0.2°. Chemo-mechanical polishing was used to reduce the surface roughness to less than 0.5nm root-mean-square (rms) on both sides.

The light-emitting diode structures were grown using metal-organic chemical vapor deposition (MOCVD). The multi-quantum well (MQW) light-emitting active regions consisted of five or eight pairs of indium gallium nitride (InGaN) wells and GaN barriers.

The indium fraction and well/barrier thicknesses were determined by combining information from x-ray diffraction (XRD) and high-resolution transmission electron microscopy (HR-TEM). The well thicknesses were in the range 3–4nm and the barriers were 20–25nm. The residual roughness of the MQW layers

was determined by atomic force microscopy (AFM) — in the a-samples the value was 1.23.0nm rms and in the m-samples it was 0.20.5nm rms.

The n-type injection region was grown first on the substrate and consisted of 1μm of silicon-doped GaN. This was followed by the MQW sequence.

Photoluminescence (PL) studies show the m-plane MQW structures to have a polarization ratio that is about 30% higher than that for the a-plane samples. The researchers comment that current theory does not predict this, and suggest that the higher roughness values of the a-structures could be due to relaxation of the anisotropic strain effects and confinement that are thought to affect mainly the polarization of the output light through shifts and splitting of the valence band structure.

The electroluminescence (EL) of one of the m-plane MQW structures was studied by adding a 15nm AlGaN electron-blocking layer and 120nm p-GaN injection layer to complete it into an LED. The polarization components along a- and c-axes were measured at an injection current of 20mA over a range of wavelengths (Figure 1).

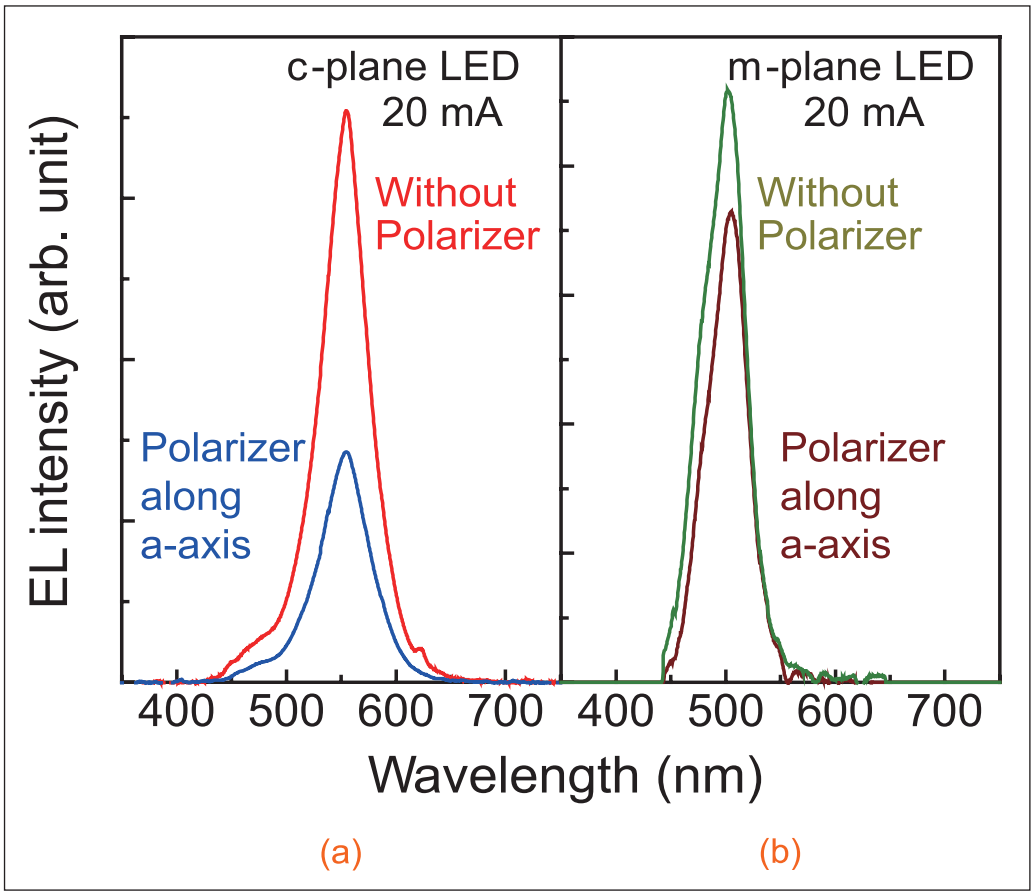

Figure 2. EL spectra of (a) c- and (b) m-plane LEDs with and without polarizer.

The light polarization with the electric field parallel to the a-direction had a peak at 505nm (blue-green), while the c-polarization was much smaller (about 13% of the a-peak) and centered at a shorter wavelength 491nm. This shorter wavelength indicates an energy transition increase of ~70meV in this direction. Theoretical predictions based on splitting due to strain effects would give 40meV. The discrepancy could be due to quantum confinement effects.

The use of polarized light from m-plane LEDs could enhance the output efficiency of polarized systems, potentially reducing power consumption. In the case of the 0.77 polarized light created in their latest experiments, the researchers say that the same polarized output power could be achieved with 44% less input light power, compared with a standard c-plane LED

The team expects that higher polarization could be achieved with proper packaging and suppression of die edge emission. The angular dependence of the polarization also fits the assumption of two intensities coming from separate components parallel to the a- and c-directions. The random contribution from light internally scattered within the LED is described as being 'very low'. The researchers hope that moving to longer wavelengths (e.g. green at ~530nm or deep green at ~550nm) could increase the polarization ratio, particularly for m-plane structures.

The effect of linear polarizers on the emissions from standard c-plane and m-plane LEDs were also compared (Figure 2). The c-plane emission was reduced by 57.7%, while the loss for the m-plane LED was only 25.4%.

The use of polarized light from m-plane LEDs could enhance the output efficiency of polarized systems, potentially reducing power consumption. In the case of the 0.77 polarized light created in their latest experiments, the researchers say that the same polarized output power could be achieved with 44% less input light power, compared with a standard c-plane LED. ■

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www.kymatech.com
Author: Mike Cooke

New demand puts tension into gallium/indium supply chain

As orders have picked up from the 2008-2009 financial crisis, strain has been put on compound semiconductor raw material supplies. Now, China may be planning stockpiles that could further restrict access to indium and gallium. Mike Cooke reports.

The materials indium and gallium have a growing range of applications. Although both are widely used in compound semiconductor devices, the use of indium extends greatly beyond this sphere. In fact, the most widespread use of indium is in ITO (indium tin oxide) transparent conducting layers, as applied in flat-panel displays, touch screens, smart-phones, high-efficiency solar panels and high-efficiency, long-life LED lighting (both for LCD back-lights and, in the future, more general applications).

Also some of these applications are dependent on indium and gallium semiconductor technology to work at all. For the emission of long-wavelength light, i.e. red-orange-yellow (ROY), various combinations of indium gallium arsenic and phosphorous (InGaAsP) are used. The shorter wavelengths — green, blue, violet and beyond — are covered by indium gallium nitride (InGaN) compound semiconductors.

Aluminum (Al) (another group III metal) also has uses in both regimes (particularly for high-brightness ROY light emission in the forms AlGaAs and AlInGaP), but is not a concern in supply terms, being relatively easy to extract in large quantities from bauxite. The purpose of aluminum is generally to shorten the wavelength through widening the bandgap of semiconductor layers, and also for barriers in quantum well structures.

Indium and gallium also find use in light absorption/solar cell active layers, both in the combinations already mentioned (high efficiency, but high cost) and in the lower-cost copper indium gallium diselenide (CIGS) form [Mike Cooke, Semiconductor Today, vol4, issue 3, p88, April/May 2009].

At present, the greatest demand for high-brightness LEDs (HB-LEDs) is for those used as backlights in LCD TVs/displays (marketed as 'LED TV' by manufacturers), replacing more traditional technologies such as cold-cathode fluorescent lamps (CCFLs). The switchover is allowing LCD manufacturers to produce thinner panels that operate on a lower energy budget. Other advantages include a brighter display, better contrast and cooler running.

The LEDs used in such units can be 'white' or 'RGB'. The 'white' flavor refers to a blue InGaN LED with a yellow phosphor material such as cerium-doped yttrium aluminum garnet (Ce:YAG) that produces an approximation to white. The 'RGB' option is more expensive, but gives a better-quality result. RGB LED systems use combinations of separate red, green and blue LEDs to achieve a full-color result with truer blacks, whites and color rendering performance (color gamut).

Market research firm Display Search believes that more than 50% of LCD TVs will be LED-backlit next year. In 2014, they will account for more than 80% of shipments on the market researcher's most recent assessment (Figure 1).

By 2014, another researcher, Strategies Unlimited, puts the HB-LED market at $19bn, representing a 30% compound annual growth rate (CAGR) over 2009 [High-Brightness LED: Market Review and Forecast 2010]. For particular applications, such as signs/displays and illumination, the expected CAGRs are even higher (61% and 45%, respectively). For more general illumination and signage, further attractions of HB-LEDs include lower power consumption and longer operating lifetimes (up to 50,000 hours, versus 10,000 hours for compact fluorescent or 2000 hours for incandescent).

Raw material pricing

However, such new LED production activity feeds demand back down the supply chain and puts pressure on raw material prices. Many semiconductor producers are used to being able to beat down materials prices because substances such as silicon are as common as muck (or at least rock and sand). With HB-LEDs the situation is different — practically all devices use the very rare metals indium and gallium. However, even here Taiwanese manufacturers have been able to bargain until recently.

A big change in the balance of power has come from "competitors backed by huge corporations, such as Samsung and LG, much better positioned to absorb

higher material costs and to guarantee their supply in a constrained market", says the market research firm Strategy Analytics. In May, Strategy Analytics was warning of a shortage of key semiconductor materials in second-half 2010 [`Materials Shortage to Restrict Rampant LED Market', Strategy Analytics, 2010].

In the near-term, the firm was predicting a 20% rise in trimethyl-gallium (TMG) prices. This material is the precursor source for Ga used most commonly in the metal-organic chemical vapor deposition (MOCVD) process generally employed for nitride semiconductor hetero-structuring.

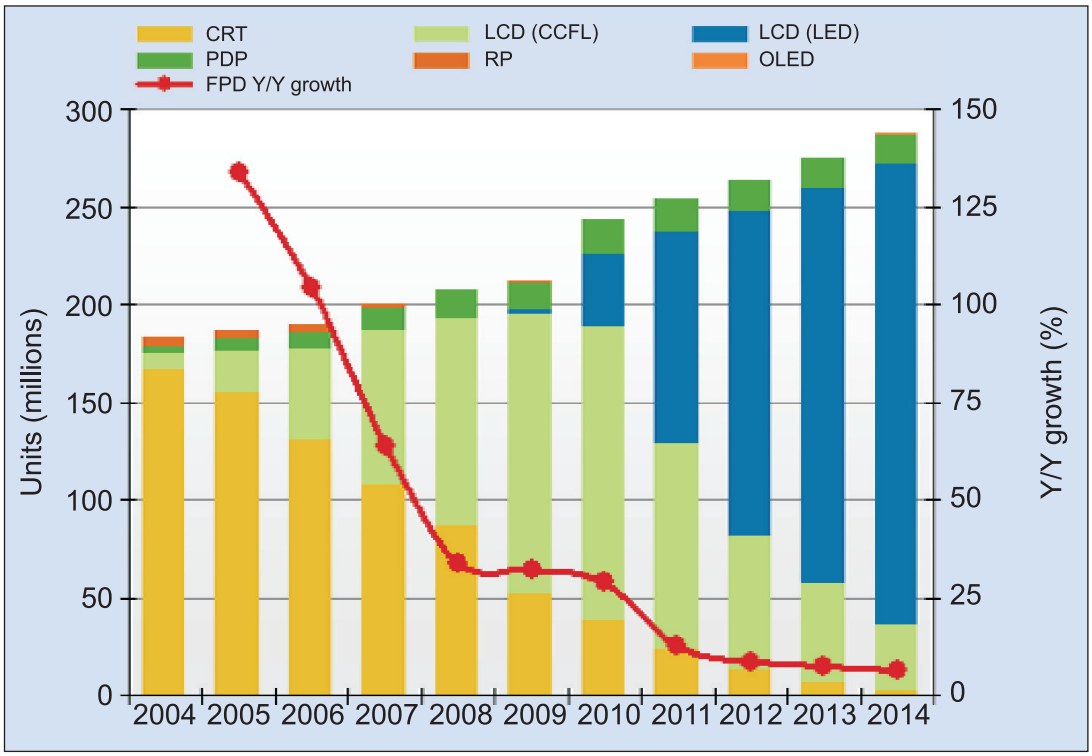


Figure 1. Worldwide TV market by technology. Source: DisplaySearch Quarterly Advanced Global TV Shipment and Forecast Report, Q3, 2010.

TMG prices have gone from a couple of dollars per gram to $10/g earlier this year, before settling to a more comfortable $3–4/g. The supply of the sapphire base wafer was also cited as being in short supply.

These concerns come on top of those connected with sharply increased demand coming recently from China for MOCVD growth reactors [Mike Cooke, Semiconductor Today, vol5, issue 7, p90, September 2010].

Other epitaxial techniques use liquid- or vapor-phase, or even molecular beams, to produce semiconductor layers. The source materials in these cases are much simpler, or even elemental species.

Metal-organic precursor suppliers expand

A number of companies are currently rushing to meet the TMG shortfall: AkzoNobel, Albemarle, Chemtura, Dow Electronic Materials and SAFC Hitech have all this year announced planned expansions of metal-organic (MO) capacity for group III metals (see news pages 32–33 of this issue).

Steven Entwistle, VP of the Strategy Analytics Strategic Technologies Practice, commented in May: "Capacity expansions already in progress should relieve these constraints by mid-2011. Until then, the average selling price (ASP) of high-brightness LEDs based on gallium nitride should hold up well."

Dow in fact made two announcements, one this November concerning breaking ground for a new facility in Korea, and another in June covering more general plans for expanded production of TMG. The company has been adding 'significant TMG capacity' to its facilities in the USA to meet short-term demand. The Korean facility is expected to come online in early 2011 (probably Q2), aimed at meeting longer-term demand. At the end of the multi-phase plan, Dow says that it will have a total TMG capacity of 60 (metric) tons/year. In future, the firm also expects that other metal-organic chemicals will be available from Korea.

A Korea production site is convenient both for customers in that country and also for other nations of the Asia-Pacific region such as Taiwan where much LCD and semiconductor production is carried out. Dow Electronic Materials is the biggest supplier of TMG to Korea and sees itself as the leading supplier of precursors to the LED market as a whole and has patented precursor manufacturing processes and delivery technology.

Expanded high-purity metal-organic capabilities are also among the aims of a Korean investment by US company Albemarle, announced in September. The company presently produces TMG in the USA, and the new Korea facility is expected to 'mirror' this capability. The facility will begin with TMG purification in early 2011, adding in other capabilities through next year.

AkzoNobel, Albemarle, Chemtura, Dow Electronic Materials and SAFC Hitech have all this year announced planned expansions of metal-organic capacity for group III metals

In August, the US company Chemtura signed a memorandum of understanding for a metal-organic

Table 1. Average year-end prices for In and Ga. Source: US Geological Survey, Mineral Commodity Summaries, January 2010.

$/kg	2005	2006	2007	2008	2009
Indium					
Indium Corp 99.97%	946	918	795	685	500
New York dealer 99.99%	961	815	637	519	390
Gallium					
Average for 99.9999% & 99.99999% US import	538	443	530	579	480

Table 2. World indium refinery production in metric tons. Source: US Geological Survey, Mineral Commodity Summaries, January 2010.

	2008	2009e
Belgium	30	30
Brazil	5	10
Canada	45	50
China	310	300
Japan	65	60
Korea, Republic of	75	85
Peru	6	20
Russia	12	12
Other countries	25	30
World total (rounded)	**570**	**600**

joint venture with Korean company UP Chemical. The Korea-based JV would manufacture and sell high-purity metal-organics such as trimethyl-aluminum (TMA), along with TMG (up to 30 ton/year TMG capacity is expected). Supply is due to begin in December 2010, with a fully integrated manufacturing capability being established at the Korean site for TMG and TMA in late 2011. Again, the focus will be on supplying South Korea and Asia-Pacific more generally, hoping to pick up on the expected HB-LED bonanza.

Chemtura also has a subsidiary based in Germany — Chemtura Organometallics GmbH — where TMA production is to be added to an existing facility for producing diethyl-zinc (DEZ), which is a substance used as a polymerization catalyst. The TMA product line will become operational in 2012, the company says.

Netherlands-based AkzoNobel plans to double TMG capacity at its Texas-based facility, with the new production volume becoming available in February 2011. "The capacity addition will further enhance AkzoNobel's position as the leading global producer of this material," the firm says. This comes on top of the firm previously announcing a doubling of its TMG production in May 2010. AkzoNobel also produces indium-, aluminum-, zinc- and magnesium-based metal-organics.

The firm's US operation had been under Chapter 11 bankruptcy protection since March 2009 due to the global recession. Plans for reorganization have been accepted by the relevant court and the firm emerged from Chapter 11 protection in November 2010.

SAFC Hitech was another company investing in increased TMG production with $2m funding at its UK manufacturing facility in Bromborough. Some money for the project came from local government and development agencies. Again the immediate focus is support of HB-LED production.

Now, at the beginning of December, SAFC Hitech too has also announced a further expansion for the Asian market, this time at its plant in Kaohsiung, Taiwan (see news pages). The firm plans to build a dedicated facility for transfilling, technical service and production of LED and silicon semiconductor precursors (to be operational by late 2011).

Another way to expand production has been followed by Korea's Lake LED Materials gaining investment from process materials supplier ATMI, giving the US firm a minority interest. Lake LED Materials is a start-up with capabilities for producing TMG (24 ton/year, according to http://english.etnews.co.kr/news/detail.html?id=2010 11040009), trimethyl-indium (TMI), TMA, triethyl-gallium (TEG), bis-cyclopentadienyl-magnesium (Cp_2Mg), and other metal organics. ATMI says that it will "help accelerate commercial LED materials introductions, with select marketing and technology rights".

Sources and costs of raw materials

A large part of the high cost of these materials is down to the rarity of the source metals. In the past five years (Table 1), indium prices have ranged from almost $1000/kg down to less than $400/kg. Gallium has been somewhat more stable, at around $500/kg. These are year-end figures and prices for indium have in some periods exceeded $1000/kg. The price fell dramatically following the 2008 economic crash, but improving economic conditions subsequently pushed indium prices to about $600/kg in November 2010.

In 2009, world primary production of gallium was estimated to be 78 tons, down from the previous year's 111 tons [US Geological Survey, Mineral Commodity Summaries, January 2010]. The refined gallium estimate was 118 tons. This latter figure includes scrap recycling. Capacity figures are 184 tons for primary production, 167 tons for refining, and 78 tons recycling. The USGS also gives refinery production figures for indium of 600 tons in 2009 (Table 2).

The main source for gallium is from the aluminum ore bauxite, where the USGS estimates the gallium content of world deposits to be more than a billion kilograms. However, further deposits of gallium could be associated with zinc ores. These estimates assume a gallium concentration in bauxite of 50 parts per million. The concentration in zinc ore is the same. However, this material can only be accessed if the deposit is eco-

nomic. This would depend both on the viability of the respective ores for their primary product (aluminum or zinc) and on trace metal extraction capability. The USGS comments that only a small percentage of gallium in these ores is 'economically recoverable'.

The main indium source is sphalerite, a zinc sulfide ore. The indium concentration in these deposits ranges from 1ppm to 100ppm. Although indium occurs in higher concentrations in some tin and tungsten vein stockwork deposits, these sources are difficult to process for indium extraction in an economic fashion.

Another possibility has been raised recently by South American Silver Corp. The firm has been performing exploratory drilling at Malku Khota, Bolivia. The site has been qualified under the Canadian National Instrument 43-101 mineral resource classification as having an indicated resource of 144.6 million ounces of silver and 845 ton of indium plus an inferred resource of 177.8 million ounces of silver and 968 ton of indium.

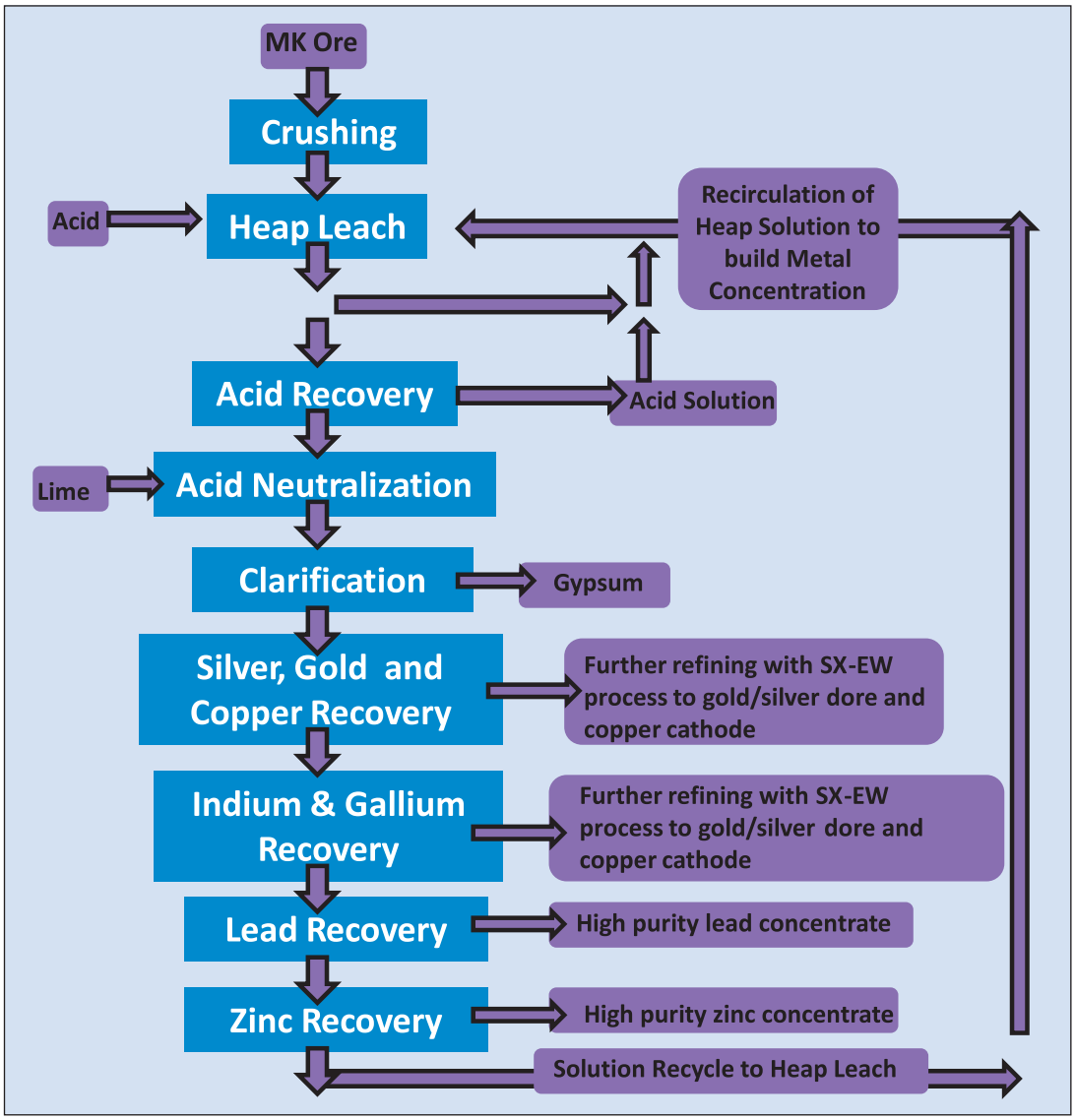


Figure 2. Metallurgy flow sheet for proposed acid-chloride leach process.

The two best intercepts of this drilling with the minerals at the site give indium contents of 2.7ppm (=grams/ton) and 1.4ppm. The figures for gallium are in fact higher, at 3.6ppm and 3.2ppm.

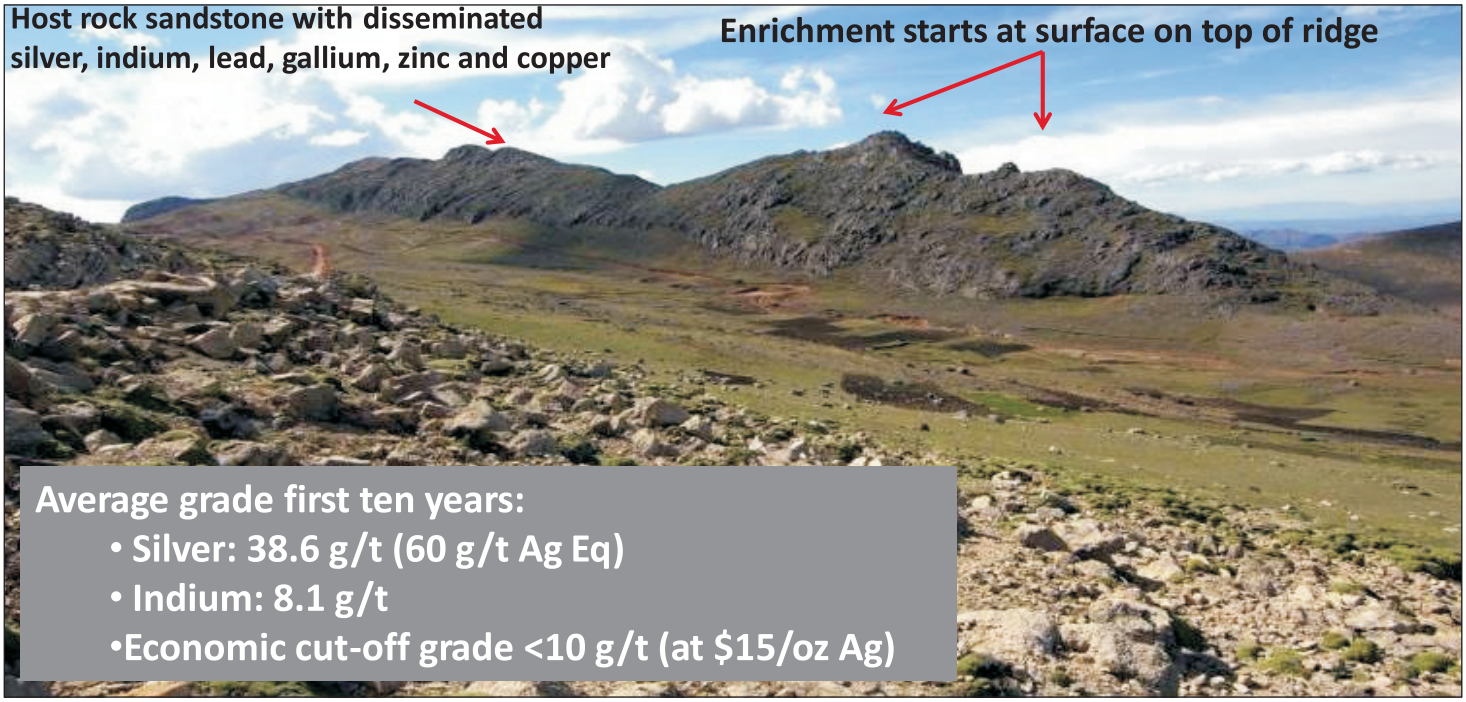
The firm reports that it has carried out metallurgical and process-related test work to refine leach recovery characteristics for silver and indium and associated gold, copper, lead, zinc and gallium mineralization (see Figure 2). The Third Quarter President's Message and Project Update comments: "The test work to date indicates the amenability of heap leaching and/or milling of the mineralized material at Malku Khota."

In copper mining, leaching is used to dissolve the desired material in a solvent, which is then subjected to 'electro-winning' (i.e. electrolysis). South American Silver sees this as a possibility for recovering indium from its silver ore. Another possibility is to gather the indium as part of the silver refining process, similarly to the techniques used in zinc smelting.

The firm says that it is "committed to upholding high environmental and social standards while focusing on delivering the financial growth its shareholders expect". The Altiplano region of Bolivia (where Malku Khota is situated) has been involved in large-scale mining since the Spanish conquest of the Incas (who knew of the silver deposits).

The traditionally highly exploited local population has been exposed to the heavy-metal pollution that can arise from such operations. Some effort is presently being made (not directly connected with South American Silver's explorations) by the French Institut de Recherche pour le Développement (IRD) public research institute to assess the level and effect of pollution in the area [http://en.ird.fr/the-media-library/scientific-news-sheets/357-the-impact-of-mining-in-bolivia].

In terms of present sources for gallium and indium, China figures prominently. For gallium the main producers are China, Germany, Kazakhstan, and Ukraine. China is also responsible for about half of the world's production of indium (Table 2). Of US gallium imports



Mineralization at Malku Khota, Bolivia, showing sandstone rocks bearing indium and gallium deposits.

(29 tons in 2009), the USGS reports that 24% comes from Germany, 20% from Canada, 16% from China, and 12% from Ukraine, with 28% emanating from 'other' sources. For indium (95 tons), the US is more reliant on China (40%), with the remainder from Japan (19%), Canada (18%), Belgium (7%) and 'other' (16%).

While the US government does not maintain stockpiles of either indium or gallium, other nations do. In particular, Japan Oil, Gas and Metals National Corporation (JOGMEC) announced plans to set up stockpiles of 42 days worth of standard national consumption of these metals in 2009. Korea set up rare-metal stockpiles in 2006, and announced plans to increase this activity in the period up to 2016.

The US edition of China Daily reported in November 2010 (based in turn on Shanghai Securities News report involving 'unnamed sources') that indium and gallium were among ten rare metals that the State Bureau of Material Reserve was considering for stockpiling to stabilize supply and prices. At about the same time, the China Securities Journal reported moves by China's Commerce Ministry to place stricter controls on rare-metal exports — a 2–3% cut in quotas per year, according to more 'unnamed sources'.

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Such developments have raised concerns that China is moving to withhold shipments of materials for political reasons. The 31 Japanese importers of rare-earth materials reported disruptions in shipments recently in a Japanese finance ministry survey. In the recent case of rare-earth shipment disruptions in Japan and the USA, some suspect the shortages are due to a territorial dispute (Japan) and a trade disagreement (USA) with China. The October shipments from China fell by 77% from the previous month's volume.

The Chinese government has denied such charges and says that it would not use its near-monopoly in rare earths as a bargaining tool. China also points out that it introduced the rare-earth restrictions in 2006 to minimize the harmful effects on the environment of mining such materials. Indeed, pollution concerns have restricted the amount of rare-earth extraction elsewhere in the world. In China, long-term unlicensed, indiscriminate extraction practices — in addition to wasting national resources — have seriously damaged ecosystems near mining operations.

One alternative to aggressive increases in mining is the recycling of waste that contains these materials. In May, the United Nations Environment Programme (UNEP) called for "rapid improvements in the recycling rates of so-called 'high-tech' specialty metals like lithium, neodymium and gallium" [http://hqweb.unep.org/Documents.Multilingual/Default.asp?DocumentID=624&ArticleID=6564&l=en&t=long].

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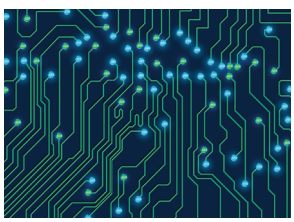

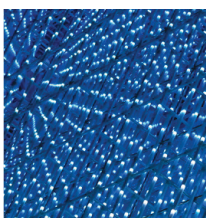

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100 Sunnyside Blvd.,
Woodbury, NY 11797, USA
Tel: +1 516 677 0200
Fax: +1 516 714 1231
www.veeco.com

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

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

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.

KLA-Tencor
One Technology Dr,
1-2221I, Milpitas,
CA 95035,
USA
Tel: +1 408 875 3000
Fax: +1 408 875 4144
www.kla-tencor.com

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

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

19–21 January 2011
Lighting Japan: the 3rd LED/OLED Lighting Technology Expo
Tokyo Big Sight, Japan
E-mail: light-e@reedexpo.co.jp
www.lightingjapan.jp/english

22–27 January 2011
SPIE Photonics West 2011
San Francisco, CA, USA
http://spie.org/photonics-west.xml

25 January 2011
2nd International Conference on PV Module Recycling
Madrid, Spain
www.epia.org/events/upcoming-events

28–30 January 2011
International Symposium on Semiconductor Materials and Devices (ISSMD-2011)
Vadodara, Gujarat, India
E-mail: cjpanchal_msu@ssmd.in
www.ssmd.in

1–3 February 2011
Transformations in Lighting: 2011 DOE Solid-State Lighting R&D Workshop
San Diego, CA, USA
E-mail: solidstate@courtesyassoc.com
www1.eere.energy.gov/buildings/ssl

16 February 2011
PHOTON's 3rd Thin Film Conference
San Francisco, CA, USA
E-mail: info@photon-expo.com
www.photon-expo.com/en

16–19 January 2011
2011 IEEE Radio & Wireless Symposium (RWS 2011)
Renaissance Glendale, Phoenix, AZ, USA
E-mail: info@flyevents.net
http://rawcon.org

20–24 February 2011
IEEE International Solid State Circuits Conference (ISSCC 2011)
San Francisco, CA, USA
E-mail: isscc@ieee.org
http://128.100.10.145/isscc

22–24 February 2011
Strategies in Light 2011
Santa Clara Convention Center, CA, USA
E-mail: lubah@pennwell.com
www.strategiesinlight.com

22–24 February 2011
SNEC PV POWER EXPO 2011
Shanghai, China
E-mail: info@snec.org.cn
www.snec.org.cn

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27 February – 1 March 2011
Industry Strategy Symposium 2011 (ISS Europe 2011): 'Europe – Exploiting its Strengths'
Grenoble, France
E-mail: clee@semi.org
www.semi.org/isseurope

1–4 March 2011
LED CHINA 2011
Guangzhou, China
E-mail: led-trust@ubm.com
www.LEDChina-gz.com

6–10 March 2011
OFC/NFOEC 2011 (Optical Fiber Communication Conference and Exhibition/ National Fiber Optic Engineers Conference)
Los Angeles Convention Center, CA, USA
E-mail: info@ofcconference.org
www.ofcnfoec.org

13–17 March 2011
OTST 2011: International Workshop on Optical Terahertz Science and Technology
Santa Barbara, CA, USA
E-mail: support.otst@gmail.com
http://otst2011.itst.ucsb.edu

15–17 March 2011
LASER World of PHOTONICS CHINA
Shanghai, New International Expo Centre (SNIEC), China
E-mail: laser@mmi-shanghai.com
www.world-of-photonics.net/en/laser-china/start

15–17 March 2011
SEMICON China 2011
Shanghai New International Expo Centre (SNIEC), China
E-mail: semichina@semi.org
www.semi.org/scchina-en

20–23 March 2011
Euro-MBE 2011: 16th European Molecular Beam Epitaxy Workshop
Alpe d'Huez, France
E-mail: embe2011@grenoble.cnrs.fr
http://embe2011.neel.cnrs.fr

21–23 March 2011
SEMATECH Surface Preparation and Cleaning Conference (SPCC 2011)
Austin, TX, USA
E-mail: spcc@sematech.org
www.sematech.org/meetings/spcc

21–24 March 2011
GOMACTech-11 (36th annual Government Microcircuit Applications and Critical Technology conference)
Orlando, FL, USA
E-mail: john.franco@dtra.mil
www.gomactech.net

28 March 2011
3rd Thin Film Solar Summit Europe
Berlin, Germany
E-mail: matt@thinfilmtoday.com
www.thinfilmtoday.com/europe

4–6 April 2011
CPV-7 International Conference on Concentrating Photovoltaic Systems
Las Vegas, NV, USA
E-mail: info@cpv-conference.org
www.cpv-conference.org

13–15 April 2011
11th Fiber Optics Expo (FOE 2011)
Tokyo Big Sight, Japan
E-mail: foe@reedexpo.co.jp
www.foe.jp/en

14–15 April 2011
3rd Photovoltaics Thin-Film Week, including:
— International Workshop on CIGS Solar Cell Technology
— 3rd Thin-Film Industry Forum (TIF 2011)
Berlin, Germany
E-mail: info@solarpraxis.de
www.solarpraxis.de/en/conferences

16 – 21 April 2011
54th Society of Vacuum Coaters Annual Technical Conference (2011 SVC TechCon)
Chicago, IL, USA
E-mail: svcinfo@svc.org
www.svc.org

18–20 April 2011
Semiconductor and Integrated Opto-Electronics Conference (SIOE'11)
Cardiff University, Wales, UK
Abstract deadline: 1 February 2011
E-mail: K.A.Shore@bangor.ac.uk
www.astro.cardiff.ac.uk/research/pm/events/?page=sioe

18–21 April 2011
SPIE Optics & Optoelectronics
Prague Congress Centre, Czech Republic
E-mail: customerservice@spie.org
http://spie.org/x25077.xml


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