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# semiconductorTODAY

COMPOUNDS & ADVANCED SILICON

Vol. 4 • Issue 6 • July/August 2009

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# Green lasers power ahead

# 3G drives RFIC recovery


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CPV efficiency hits 25% • Veeco buys DayStar's NY assets

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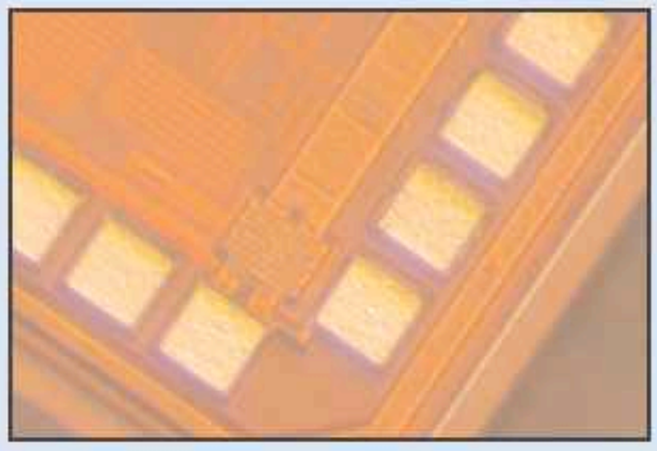
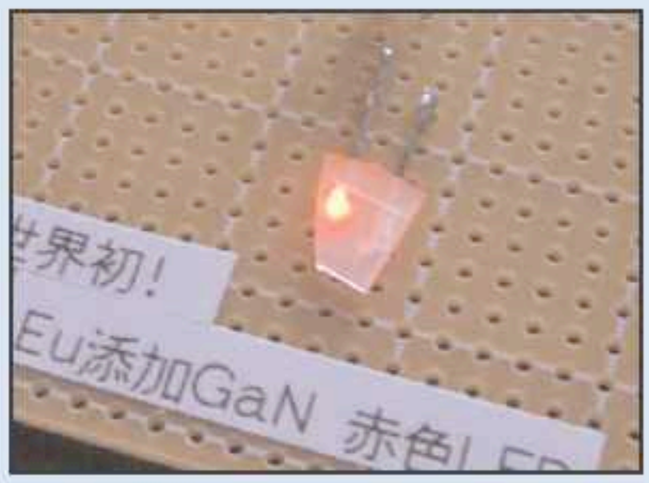
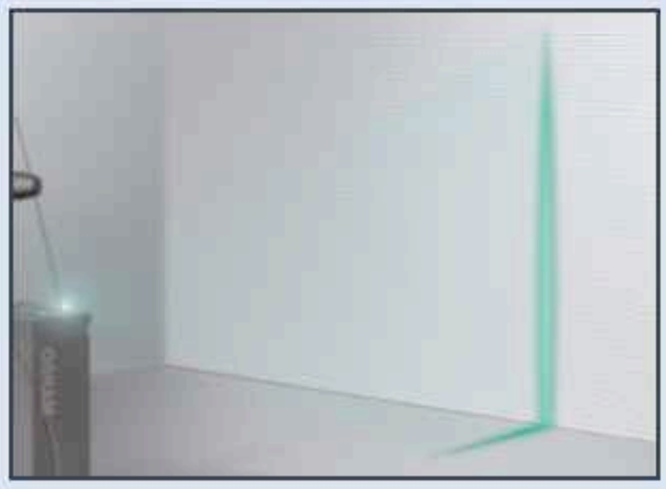


**p52** GigOptix's new GX3110 linear transimpedance amplifier chip for 11.3Gb/s SONET applications.




**p44** Osaka University claims first red electro-luminescence from MOCVD europium-doped GaN LEDs.



**p47** Light from Osram Opto's direct-emitting 'true green' (515nm-wavelength) InGaN laser, which has an optical power output of 50mW.

**Cover:** Anadigics' AWT6224 and AWT6282 WCDMA PAs are used in Samsung's Omnia HD and Memoir phones. Such 3G and smart-phone handsets — in particular from Samsung, which has been outgrowing rivals — are driving the rebound in RFIC makers' revenues in Q2/2009. **p14**

# editorial

# Rebound in revenues widespread in Q2/2009

Confirming forecasts by the likes of RF Micro Devices (reported in our May issue) of an upturn in orders towards the end of first-quarter 2009, Q2/2009 evidenced better-than-expected revenues — representing a widespread rebound after Q1 — across RFIC makers RFMD, TriQuint, Skyworks and Anadigics (returning to profit in the case of the first three). This was driven by a return to growth in quarterly cell-phone sales, particularly due to the uptake of 3G and market-share gain by Samsung (pages 10–18). Correspondingly, a strong recovery was also seen for GaAs epiwafer foundries Kopin and IQE (see page 23), as well as substrate makers such as AXT (page 24).

Also seeing a strong rebound in orders are MOCVD reactor makers Veeco and Aixtron (pages 26–27). However, both attribute this mainly to a surge in manufacturing of high-brightness LEDs (mainly in Korea and Taiwan) — particularly for backlighting LCD TVs. Again, Samsung is largely driving this as it launches 'LED' TVs and takes market share in LCD TVs, for which LED backlighting is forecast to overtake CCFL backlighting in 2014 (see page 5).

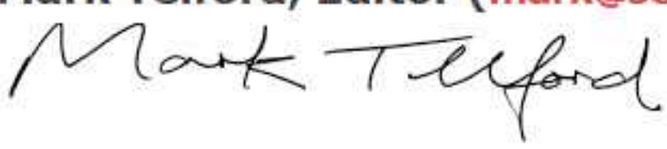
Another, longer-term consequence of the ramp up of GaN-based LED production is the scale-up of equipment by the like of Oxford Instruments Plasma Technology for larger batches of 2-inch and 4-inch wafers (page 30), as well as order activity for the likes of metrology equipment vendor Nanometrics specifically for HB-LED manufacturing, as well as thin-film photovoltaic cell manufacturing. Meanwhile, sapphire substrate maker Rubicon Technologies has also attributed its quarterly upturn to the boom in manufacturing LEDs — predominantly in Taiwan — for backlighting applications. Despite Taiwan's continuing adherence to using 2-inch wafers, the firm expects sales of 4-inch substrates to pick up in Q4/2009 and production orders for its 6-inch sapphire substrates to start in late 2010/early 2011 (page 34).

In optical communications, the June quarter saw Oclaro report positive adjusted EBITDA in its first quarter since its formation from the merger of Bookham and Avanex (page 50), while Opnext halved its losses on a slight increase in revenue. Although JDSU reported a slight drop in revenue, it forecasts a return to growth in the September quarter (page 54), while Finisar expects soon to report better-than-expected sales growth for its quarter ended 2 August (to be reported next issue).

Regarding non-telecom optoelectronic applications, full-color displays have been driving rapid recent advances of InGaN-based semiconductor lasers beyond blue–violet wavelengths. In late February Osram demonstrated the first GaN-based laser emitting at blue–green wavelengths beyond 500nm, and at the end of May Japan's Nichia Corp reported lasing at 510–515nm. Now, Sumitomo Electric has reported pure-green lasing at up to 531nm (near the 532nm wavelength of frequency-doubled lasers used in existing commercial green lasers), while Osram has boosted power output to 50mW in 'true green' 515nm lasers (pages 46–47).

Such technical advances promise to boost markets for semiconductor lasers in display applications such as pocket laser projectors and laser TVs, which should add further to the compound semiconductor sector's prospects.

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



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***Semiconductor Today* covers the R&D and manufacturing of compound semiconductor and advanced silicon materials and devices** (e.g. GaAs, InP and SiGe wafers, chips and modules for microelectronic and optoelectronic devices such as RFICs, lasers and LEDs in wireless and optical communications, etc).

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- conference reports;
- event calendar and event previews;
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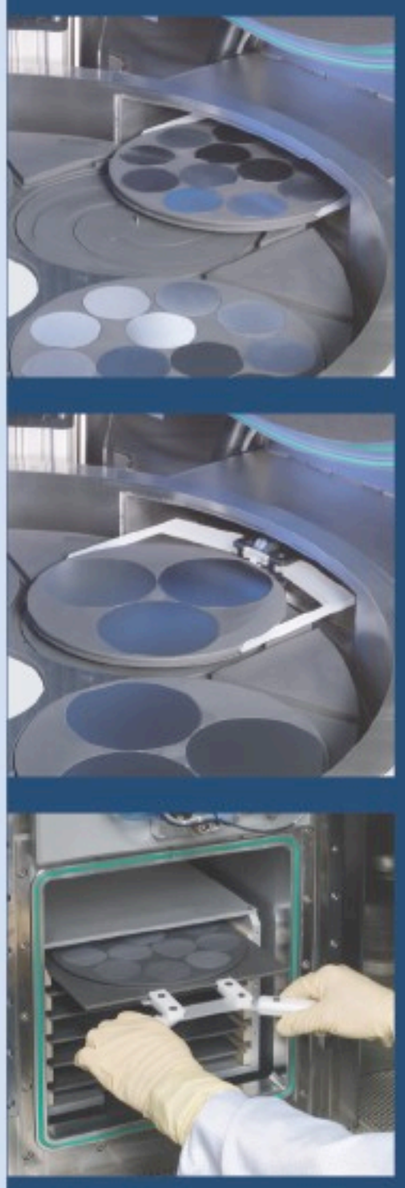

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news

# CPV poised for period of expansion

Despite a number of challenges, the CPV industry could emerge as one of the renewable energy stars of the second decade of the 21st century, according to the report 'CPV Industry Growth Forecast & Strategic Landscape' from CPV Today Business Intelligence.

For an emerging technology like CPV, the last few years have proved to be an eventful period, during which a spate of CPV firms have introduced prototype and commercial projects, comments the report.

There is no doubt that the industry is on the brink of growth, but at the same time it is hindered by a number of internal and external technological and financial constraints, it adds. But then, traditionally, PV technologies have taken several years before showing scalable industrial success. CPV too, being an emerging technology with few commercial projects on the ground and starting to move towards commercial implementation, needs time to establish itself.

However, there is no shortage of optimism as far as the CPV industry is concerned, reckons the report.

It adds that the industry is poised for a period of expansion, with orders being placed for large projects in Australia. Spain, Italy and Greece are all ramping up for commercial-scale installations over the coming year and the USA, where most CPV firms are based, will benefit from the Obama administration's stimulus package.

The supply base is well positioned to service increased levels of demand for components and equipment to manufacture CPV systems, and R&D projects designed to improve reliability and enhance performance are leading to progress. "Our research shows CPV is a confident, technology-led industry which could, with the right incentives, emerge as one of the renewable energy stars of the second decade of the 21st century," comments CPV Today's Carlos Márquez.

The size of the CPV market, in terms of installed systems, is estimated at 24.5MW for up to 2009.

Currently, the CPV market is estimated to be under 0.2% of the solar market by both volume and value.

In percentage terms, CPV has enormous market potential, it is reckoned. Research shows that industry experts anticipate that CPV systems will hold an estimated 10% of the solar energy market by 2020, with this market penetration being mainly at the smaller and larger utility end of the market. Conventional PV is likely to continue to expand organically over the same time period. Research shows a broad consensus that CPV installations will be of the order of 6GW by 2020. These will largely consist of projects of 5MW or higher and will be located in areas of greater than 2000kWh/m$^2$ per annum of direct solar irradiation.

The report emphasizes that many firms are still in the pre-commercial phase where seed capital is essential to fund the manufacturing of prototypes and test systems. Since venture capitalists need to keep a steady flow of investment returns, and green technology remains the most favoured VC investment sector, it is likely that strong start-up and early-growth firms will continue to attract funding, it is reckoned.

Currently, the CPV industry is at a crux between testing and commercialization. This transition point is characterized by having many competing modalities or technological approaches at phase two, and fewer in phase three, as uncompetitive or less marketable approaches fail to attract funding or customers. Typically, a few firms are expected to dominate phase three at the expense of less well funded competitors, the report concludes.

**www.cpvtoday.com**

IN BRIEF

## Silicon foundries target energy sector

United Microelectronics Corp (UMC) of Taipei, Taiwan (the world's second biggest silicon wafer foundry, after Taiwan's TSMC) formed a new subsidiary, UMC New Business Investment Corp — capitalized at an expected NTD$1.5bn ($46m) — to invest in the solar and LED industries. The firm is also establishing a New Business Development Center, headed by senior VP Wen-Yang Chen, who is currently responsible for operations and sales at UMC's 8" and 6" wafer fabs.

Wen Yang Chen will evaluate various investments, focusing on industry sectors with high growth and profit potential. UMC New Business Investment Corp will target timely strategic investment based on these evaluations.

UMC reckons that its expertise and technologies are highly applicable to the fundamentals of renewable energy and LEDs. In the short-to-mid term, it plans to complete the development of related technologies and establish a preliminary scale of operations. For the long term, as key proficiencies mature and resource integration is complete, the new energy business is expected to become core for UMC.

In mid-June, TSMC announced plans to explore business opportunities in the renewable energy sector (including LEDs and solar energy) with the formation of New Business Development Organization. Dr Rick Tsai (CEO over the past few years) was made its president (reporting to Dr Morris Chang, TSMC chairman and now also CEO). Chang targets US$2bn in revenue from the green energy sector by 2018 (while its foundry revenue should rise to US$14–15bn by that time).

**www.umc.com**

**www.tsmc.com**

# LED backlight penetration in LCD TVs to surpass CCFLs in 2014

The LED backlight market has rapidly emerged in the TFT liquid-crystal display (LCD) industry and will continue to grow for the next five years, according to DisplaySearch's most recent Quarterly LED & CCFL Backlight Report. Specifically, the penetration rate of LED backlights for LCD TVs should grow from less than 3% in 2009 to 40% in 2013 and more than 50% in 2014, surpassing CCFL backlights.

Meanwhile, large-area LED backlight shipments for all applications will grow from 84.9 million units in 2009 to 434.8 million units in 2013, when LED backlights will be used in 54.3% of 10"+ TFT LCD panels. LED backlights will thus become mainstream in the TFT LCD industry.

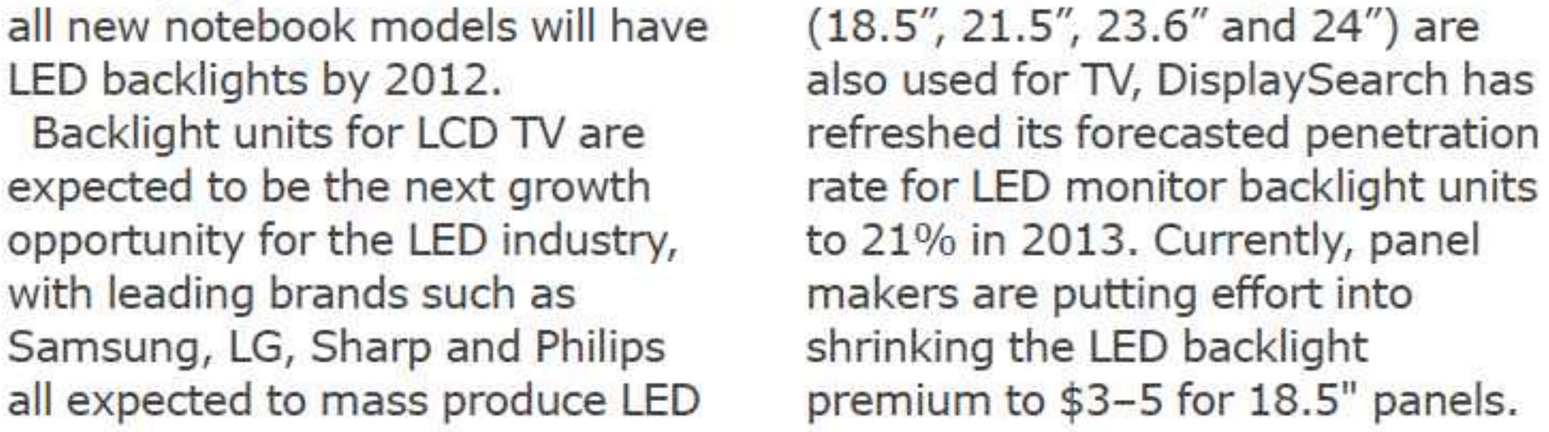
While LED backlights for LCD TVs are growing rapidly, notebook PCs are the leading application for large-area LED backlight units, and DisplaySearch forecasts that all new notebook models will have LED backlights by 2012.

Backlight units for LCD TV are expected to be the next growth opportunity for the LED industry, with leading brands such as Samsung, LG, Sharp and Philips all expected to mass produce LED backlit LCD TVs in 2010. As a result, LED backlight units for TVs are forecast to grow to 3.6 million units in 2009 and 15.1 million units in 2010.

Firms like Samsung are focusing on the development of edge-lit LED backlights, which can reduce the bill of materials by 30–40% compared to direct-lit models. "Edge-lit LED backlight units for LCD TV are a temporary solution to drive costs down to open market acceptance for 'LED TV' as a short-term marketing strategy," notes DisplaySearch research director Luke Yao. "Consumers want a low-cost solution with acceptable picture quality, but aren't always willing to pay a higher premium, making edge-lit LEDs an ideal near-term solution," he adds.

For the monitor segment, cost and performance remain bottlenecks for panel manufacturers creating LED-backlit monitors. Taiwanese panel makers like AUO and Innolux have been the most aggressive in developing LED monitor panels. Because LED monitor panel sizes (18.5", 21.5", 23.6" and 24") are also used for TV, DisplaySearch has refreshed its forecasted penetration rate for LED monitor backlight units to 21% in 2013. Currently, panel makers are putting effort into shrinking the LED backlight premium to $3–5 for 18.5" panels. From 2010, LED backlight monitors will be developed and supported by brand-name makers, expects DisplaySearch.

**www.displaysearch.com**




| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| LED Backlight in Notebook | 16% | 52% | 81% | 97% | 100% | 100% | 100% | 100% |
| LED Backlight in Monitor | 0% | 1% | 4% | 8% | 15% | 21% | 34% | 54% |
| LED Backlight in LCD TV | 0% | 3% | 10% | 22% | 32% | 40% | 50% | 66% |

**Large-area LED backlight unit penetration rate by application.**

IN BRIEF

## Samsung cuts Vizio's lead in US LCD TV market

While Vizio Inc maintained its lead in the US LCD-TV market in second-quarter 2009 for the second consecutive quarter, second-ranked Samsung Electronics Co Ltd of South Korea closed the gap significantly as buyers gravitated toward its LED-backlit sets, according to iSuppli Corp.

Samsung's market share by unit shipments rose from 17.8% to 21.3% (the largest increase of any LCD-TV brand), cutting Vizio's lead from 3.6 to just 0.4 percentage points. Samsung was very aggressive in introducing and marketing its LED-backlit LCD-TVs, says Riddhi Patel, principal analyst TV systems.

Due to price reductions, LEDs have become a viable alternative to cold-cathode fluorescent lamp (CCFL) backlighting. Advantages include greater power savings and thinner form factors and the elimination of toxic materials used in manufacturing CCFLs.

"US consumers increasingly are warming up to higher-specification LCD-TV models, including those using new LED-backlighting technology," Patel adds. iSuppli estimates that 2.2% of LCD-TVs shipped in the USA used LED backlights, up from zero a year ago. In mature markets like the USA, while many consumers are moving up from their cathode ray tube (CRT) or rear-projection televisions, a growing number are replacing first-generation flat-panel sets and are gravitating toward higher-specification TVs, such as those with LED backlights.

iSuppli forecasts that global penetration of LED-backlight technology for LCD-TV panels will increase from 3% of all shipments in 2009 to 37% in 2013.

**www.isuppli.com**

## Fiber-optic analog IC market to reach $492m by 2013

The market for ICs used for analog functions in fiber-optic networks will grow to $492m by 2013, forecasts market research firm Strategy Analytics in its report 'Device Opportunities in the Fiber Optic Analog IC Market: 2008–2013'.

The uptake of devices such as high-speed laser drivers, post/limiting amplifiers and transimpedance amplifiers (TIAs) will grow with demand for bandwidth-intensive applications such as high-bandwidth video services like HDTV and video-on-demand as well as high-speed internet access, says the report.

Coupled with the increase in traffic due to higher-bandwidth backhaul from high-growth 3G and 4G wireless telecoms, the result will create a 're-birth of the fiber-optic market'.

Legacy networks (<2.5Gb/s) dominate, but will grow the slowest. Driven by continued demand for bandwidth, 10Gb/s will become the de-facto standard network speed, with a compound annual growth rate (CAGR) of 20% from 2011–2013. Augmenting this will be strong growth of 40Gb/s networks.

In the fiber-optic analog IC market, silicon, SiGe, GaAs and InP all have different strengths and will all benefit. However, the acceleration in network speeds demands higher-specification device performance, so the higher-value, higher-growth segments from 10Gb/s and above will offer more opportunity for high-speed devices based on GaAs and InP compound semiconductor technologies in particular. GaAs- and InP-based laser drivers and TIAs are expected to be key enabling technologies for the rollout of higher-speed 10, 40 and 100Gb/s networks.

InP also offers the ability to integrate large numbers of components on a single chip or device, in the form of photonic integrated circuits such as those made by Infinera of Sunnyvale, CA, USA.

www.strategyanalytics.com

## Semi-insulating GaAs substrate market to shrink just 1% in 2009

The strong inventory corrections in fourth-quarter 2008 and first-quarter 2009 will prevent the severe sharp decline seen in the semi-insulating (SI) GaAs bulk substrate market in the 2001 downturn, reckons market research firm Strategy Analytics in its forecast 'Semi-insulating GaAs Substrate Markets: 2008–2012'. However, the year-on-year growth of 14% from 2007 to 2008 will be followed by the market shrinking 1% in 2009.

An examination of supply chain dynamics, coupled with analysis of end-demand drivers for SI GaAs bulk substrates, provides a demand scenario that suggests a compound annual average growth rate (CAAGR) over 2008 to 2013 of 5%. Demand should return in 2010, then grow steadily through 2013 to $174m.

"The slowdown in key market segments has not resulted in any significant paradigm shifts with respect to the use of GaAs technology in mainstream markets such as cellular handsets and personal computers," notes Asif Anwar at Strategy Analytics. "Indeed, usage trends point to increased GaAs device demand from these and other markets, which will result in sustained demand for substrate material," he adds.

In 2008, Freiberger Compound Materials GmbH of Freiberg, Germany remained the leading merchant supplier of SI GaAs bulk substrates. However, AXT Inc of Fremont, CA, USA was the market share winner, showing strong growth to grab the number three position from Japan's Hitachi Cable.

www.strategyanalytics.com

## Semi-insulating GaAs epitaxy market to return to growth in 2010

In 2008 the semi-insulating (SI) gallium arsenide epitaxial substrate market grew 22% year-on-year, but in 2009 it will be flat-to-negative, says market research firm Strategy Analytics in its report 'Markets for SI GaAs Epitaxial Substrates: 2008-2013'. However, growth is forecast to return in 2010, driven by multiple GaAs device insertions in next-generation cellular handset platforms, augmented by GaAs device demand from other markets.

Suppliers have traditionally focused on providing HBT (hetero-junction bipolar transistor), HEMT (high-electron-mobility transistor) and FET (field-effect transistor) epitaxial structures, but the market is seeing greater emphasis on solutions that allow multiple structures to be combined on the one substrate in order to provide BiFET (bipolar field-effect transistor) or BiHEMT (bipolar high-electron-mobility transistor) devices.

"We estimate that BiFET/BiHEMT structures accounted for 6% of the total SI GaAs epitaxial substrate market in 2008," says Asif Anwar of Strategy Analytics. "While still small, this segment will show the fastest growth through 2013 [at a CAAGR of 9%] as GaAs device manufacturers look to differentiate their products by offering integrated solutions."

The report concludes that GaAs epitaxial substrate demand will grow at a compound annual average growth rate (CAAGR) of 5% over 2008 to 2013, with the corresponding market for GaAs metal-organic chemical vapor deposition (MOCVD) and molecular beam epitaxy (MBE) substrates being worth $402m in 2013.

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IN BRIEF

## Handset shipments show recovery

Handset shipments reached 273 million units in Q2/2009, down 8% on 297 million units a year ago, according to market research firm Strategy Analytics. However, the year-on-year drop was less than the prior quarter, as the market showed tentative signs of stabilization.

Among the top-five brands, South Korea's Samsung and LG again outgrew their main rivals due to robust demand for touch-phones and QWERTY phones. Samsung reached a record 19% market share, and LG a record 11%. Meanwhile, Apple held steady with 2% marketshare.

However, operating profits among many major vendors continued to suffer, as marketing expenses were kept high to drive sales.

www.strategyanalytics.com

## DOE plans Municipal Solid-State Street Lighting Consortium

To leverage the efforts of multiple cities pursuing evaluations of LED street-lighting products, in late July the US Department of Energy (DOE) announced plans to form a Municipal Solid-State Street Lighting Consortium in September to collect, analyze and share technical information and experiences related to LED street-lighting demonstrations.

The consortium aims to provide a forum for entities with similar backgrounds and needs to share information, ask questions, and tap into a large body of knowledge and experience that can help to maximize the value of dollars spent evaluating LED street lighting.

Membership is open to municipalities, utilities, and energy-efficiency organizations.

www.ssl.energy.gov

# Cell-phone market returns to growth in Q2

After only two negative quarters prompted by the global recession, the market for mobile handsets has returned to a period of sustainable growth. That's according to a market report from iSuppli, whose analysts suggest that shipments of phones jumped nearly 5% sequentially in the second quarter of 2009 to reach 265m units.

The report also suggests that this growth will be sustained through the remainder of 2009, with increases in quarterly shipments accelerating to 281m units in the third quarter, and to 304m in the final three months of the year.

If that forecast proves accurate, total unit shipments for the year will hit 1.1bn, representing a contraction of just under 10% on the 2008 figure. Although the market now appears to have bottomed-out, the total of 265m for the latest quarter is still 15% lower than iSuppli's figure for the same period of 2008.

**Shipments of phones jumped nearly 5% sequentially in Q2/2009 to reach 265m units**

Of the major phone suppliers, Korea-based LG grew fastest in the second quarter. LG's unit sales reached nearly 30m, up more than 30% sequentially, propelling its market share to 11.2%.

According to iSuppli's senior analyst Tina Teng, that strong performance was largely due to LG's successful targeting of emerging markets in the Middle East and Africa.

Teng adds that LG has been able to profit from the strong demand for high-end phones with features such as touch-screen control. GaAs component maker Anadigics, which has strong ties with LG and typically targets the high-end sector, will have benefited from this trend.

Another trend noted by Teng is a continued consolidation towards the top-five handset makers, who dramatically outperformed the smaller players in the second quarter.

Combined sales for the top five — Nokia, Samsung, LG, Motorola and Sony Ericsson in descending order — grew 12.1%. In stark contrast, the smaller players witnessed an 18.1% plunge.

Nokia, the market leader and RF Micro Devices' key customer, stretched its lead at the top of the pile. "Nokia has been defending its dominant position since the third quarter of last year due to rising competitive pressure from Samsung," says Teng. "The company has also faced rising competition from smart phone players including Research in Motion and Apple."

Nokia's unit shipments rose to 103.2m in the quarter, sufficient for the Finnish company to register a 2.1% gain in market share.

Samsung, ranked second, is on track to surpass its target of shipping 200m handsets in 2009, while even long-suffering Motorola enjoyed a slight increase in unit shipments compared with the first quarter of the year.

**Of the top-five suppliers, only Sony Ericsson sold fewer handsets in second-quarter 2009 than in the first-quarter**

Of the top-five suppliers, only Sony Ericsson sold fewer handsets in second-quarter 2009 than in first-quarter 2009. Teng attributes that to the firm's focus on the mid-range market, at a time when the fastest-growing sectors are smart phones and ultra-low-cost handsets for developing markets.

www.isuppli.com

*By Michael Hatcher*

# Ericsson to add LTE muscle with Nortel deal

Ericsson has gained court approval for its proposed $1.13bn takeover of Nortel's wireless networking division, a deal that will give the communications giant increased presence in North America, and continue Nortel's initial development of the Long-Term Evolution (LTE) protocol.

The Swedish company, which outbid rival networking giant Nokia Siemens Networks (NSN) and private equity group Matlin Patterson in an auction of Nortel's wireless assets, will take on at least 2500 ex-Nortel staff, of which 400 are working on LTE development.

Following approval by Canadian and US courts, the Nortel assets should be transferred to Ericsson later this year without any additional balance-sheet cash or debt implications.

Completions of the deal is not yet certain, however. Blackberry maker Research in Motion (RIM), which did not take part in the Nortel auction, is likely to be pressing the Canadian government to block the deal.

Before the auction took place, when it appeared more likely that NSN would win the bid for Nortel's wireless assets, RIM released a statement criticizing Nortel for restrictions it had placed on the sale. It also suggested that the development of LTE technology, funded in part by Canadian tax-payers, ought to remain under Canadian, rather then foreign, ownership.

RIM's co-CEO Jim Balsillie said: "RIM is extremely disappointed that Nortel's world-leading technology seems destined to leave Canada and that Canada's own Export Development Corporation is preparing to help by lending $300m to another bidder."

Balsillie had expected that other bidder to be NSN, not Ericsson, and the Swedish company has not yet said whether it will receive the same financial incentive. But Ericsson is convinced that it has picked up a key asset at a good price: "The acquisition significantly expands Ericsson's footprint in North America, particularly as this region is emerging as an early adopter of LTE technology," the Swedish company said. "The acquisition also provides Nortel's customers with a strong and reliable supplier for the future, many of which have expressed support for this acquisition."

GaAs and GaN device makers including TriQuint Semiconductor (already a supplier to both Ericsson and Nortel) and RF Micro Devices are looking to LTE network deployment as a future opportunity for RF devices in wireless infrastructure applications.

At the 3GSM trade show in Barcelona earlier this year, high-end power amplifier maker Anadigics even revealed early devices for future LTE-enabled mobile phones. Although the precise timing of any LTE network launch remains uncertain, US operator Verizon has said that it will offer the first such service at some point in 2010. In April, it released an initial set of technical specifications for LTE devices.

According to Ericsson's CEO Carl-Henric Svanberg, wireless voice traffic should migrate from CDMA to LTE as voice-over-IP technology becomes dominant, although he also believes that CDMA will continue to carry voice traffic for at least another seven years.

Hans Vestberg, Ericsson's CEO-in-waiting (Svanberg is destined to take charge of the energy giant BP early next year), said in an investor call that the Nortel deal would "add LTE muscles" to its existing development efforts in that area, describing it as a 'step increase' in its LTE investment.

**www.nortel.com**
**www.ericsson.com**
*By Michael Hatcher*

# Mobile infrastructure market to fall 10% in next five years

Mobile infrastructure market revenue will fall almost 10% over the next five years, forecasts Dell'Oro Group's 'Mobility 5-Year Forecast Report'. The retreat will be greatest in the first two years, when the market is forecast to reach revenue levels not seen since 2004. The market is then expected to recover slowly, with low yearly single-digit growth through 2013.

"The market has been experiencing and will continue to experience very steep price erosion," says Scott Siegler, senior analyst of Mobile Infrastructure research. "Competition among vendors, particularly in India and China that have increasingly become instrumental market drivers, is putting a tight squeeze on vendors' margins," he adds. "As over 300 million new subscribers are added per year and the consumption of mobile data traffic begins to grow in leaps and bounds, operators will deploy the necessary capacity to keep up with the demand. However, offsetting our forecast of high double-digit growth in total base-station shipments over the next five years is a 40% decline in base-station average selling prices."

**eNode B shipments in 2013 will represent nearly 10% of the 2 million worldwide base-station shipments**

Also, initial long-term evolution (LTE) rollouts are expected in 2010, and eNode B shipments in 2013 will represent nearly 10% of the 2 million worldwide base-station shipments.

**www.DellOro.com**

# Greater-than-expected revenue returns RFMD to profit

For fiscal first-quarter 2010 (ended 27 June), RF Micro Devices Inc of Greensboro, NC, USA has reported better-than-expected revenue of $212.5m, up 23.3% on $172.3m last quarter (though still down 11.6% on $240.5m a year ago).

The firm says that both its Cellular Products Group (CPG) and Multi-Market Products Group (MPG) — which represented 75% and 25% of revenue, respectively — outpaced growth in their primary end markets.

In particular, CPG outpaced cellular component market growth, driven by market share gains. Consolidation seems to be happening around the top three front-end providers, says CPG president Eric Creviston. Sales of 3G power amplifiers grew sequentially by more than 50%, while revenue related to 3G smartphones increased significantly as a percentage of CPG revenue.

MPG experienced increased customer activity in multiple markets, including 3G cellular infrastructure in China, WiFi, WiMAX, defense and commercial power. In addition, sales related to smart grid applications, including automatic meter reading (AMR), grew more than 50% sequentially.

"Despite the reduced year-over-year demand environment, we are pleased to have delivered on our commitment to significantly improved financial performance," says chief financial officer Dean Priddy.

Gross margin has rebounded from a low of 17.3% last quarter to 34.8% (up on 30.1% a year ago), including about 50% for MPG. "We anticipated substantial and sustainable improvement in gross margin as a result of the higher utilization rate [recovering from an unusually low 25% last quarter to a more normal 70%] and the effect of previously announced cost-reduction efforts," says Priddy. Operating expenses were $54.5m, cut from $82.9m a year ago. Reflecting the increased revenue, gross profit and expense management, net loss of $26.5m a year ago and $58.7m last quarter has been turned into net income of $4.8m.

Cash flow from operations rose from $29.4m last quarter to $36.4m. Capital expenditure was $1.9m (tracking to the low end of the forecast $10–20m for this fiscal year). Such reduced levels of capital investment are sustainable, as revenue increases and end-markets return to growth, says Priddy.

**Sales related to smart grid applications, including automatic meter reading, grew more than 50% sequentially**

"For the foreseeable future we can maintain low levels of capital investment," he adds, citing three main reasons:

- outsourcing most of the supply chain for MPG;
- reduced-die-size products have been ramping for less than a year and will effectively increase fab capacity by up to 50% (becoming a larger percentage of revenue); and
- implementing a hybrid manufacturing model for assembly.

"We intend to make capital investments only in cases where the return on invested capital and payback period are compelling," Priddy stresses.

Free cash flow (cash flow from operations minus property and equipment expenditures) was $34.5m, up 36% sequentially, even as RFMD ramped production. This is ahead of the $80–120m free cash flow guidance for the full fiscal year. Total cash, cash equivalents and short-term investments rose by $45.3m to $311.8m.

The results demonstrate the earnings power in RFMD's operating model, says president & CEO Bob Bruggeworth. "We made significant progress in the June quarter toward our financial model, and RFMD today is structured for significant financial leverage."

Regarding orders, RFMD says that it is seeing improved visibility in its primary markets. Design-win momentum for CPG's new GSM/GPRS transmit modules continued to increase significantly across top-tier handset OEMs in Korea and Greater China. The group won new component qualifications on reference designs from Qualcomm and Infineon. It also introduced 12 new products and continued to expand its content opportunity across cellular front ends, sampling switch duplexer modules to leading customers, and receiving first production orders for GPS LNA/filter modules (which should ramp from less than 2% of CPG revenue currently to replacing revenue from low-margin Polaris transceivers — which represent about 10% of overall revenue — over the period of the latter's phase-out in the next fiscal year). MPG received its first production orders for electronic toll collection (ETC) applications in China. The group launched 18 new RF components and 51 derivative products during the quarter, and is on track to release more than 250 products this fiscal year.

On the strength of customer design activity across both MPG and CPG, RFMD expects continued market share gains in the September quarter. Specifically, it is booked for sequential revenue growth in both MPG and CPG (in excess of the projected handset

industry growth rate for CPG), driven by the increasing RF content opportunity in 3G smart-phones and market share gains. "Smaller players that just don't have the broad portfolio won't be able to keep up as we continue to see the growth in the complexity of the 3G smart-phone markets," says CPG president Creviston.

RFMD forecasts factory utilization rates level with the June quarter (although the introduction of reduced-die-size products into production effectively increases throughput). Operating expenses are projected to remain level. Gross margin should be boosted by the proportion of inherently higher-margin smaller-die-size products growing (from less than 10% of shipments currently to about a third of the product portfolio by the end of the fiscal year) as well as the outsourcing in the MPG supply chain. Although MPG's revenue growth in the June quarter was not as high as CPG's (with cable TV and some broadband markets still to recover), this is expected to increase, boosting margin further.

"RFMD's business model is structured to enable us to grow revenue rapidly, improve earnings significantly and generate substantial free cash flow," says Priddy.

**For the foreseeable future we can maintain low levels of capital investment**

"We expect continued strong return on invested capital (ROIC) as our reduced-die-size products represent a greater percentage of revenue, thereby reducing the need for significant additional capital expenditures into the foreseeable future," he adds. CapEx is targeted to be $3m or less. "As we continue to utilize our factories and these reduced-die-size products continue to represent a greater percentage of our revenue, and as we use our supply chain strategically and competitively, I don't see any reason why we can't begin to converge on our long-term model of 40% gross margins," adds Bruggeworth.

Also, after launching its gallium nitride (GaN) Foundry Services business unit in June, RFMD expects its high-power GaN process technology, which uses its existing high-volume manufacturing facilities, to contribute to improved ROIC this calendar year, continues Priddy.

www.rfmd.com

## RFMD's WCDMA/HSDPA PAs power new Samsung 3G handsets

RF Micro Devices says that its RF3267 and RF6266 3G cellular front ends are supporting the ramp of Samsung's Tocco Ultra Edition and GT-S8000 'Jet' 3G handsets.

The Tocco Ultra Edition is a full-touch mobile with a 2.8-inch AMOLED display. The slim 12.7mm-wide design includes GPS navigation, Bluetooth, an FM radio with RDS, and 7.2Mbps HSDPA performance. The GT-S8000 Jet has 3.6Mbps HSDPA performance, GPS, Wi-Fi, Bluetooth, and an AMOLED full-touch WVGA display. RFMD forecasts that volume shipments of its RF3267 and RF6266 will increase throughout 2009 in support of these and other Samsung 3G handsets.

The RF3267 and RF6266's current consumption and integration enable smartphone manufacturers to deliver WCDMA/HSDPA devices with extended battery life as well as multimedia functions, claims Eric Creviston, president of RFMD's cellular products group (CPG). "We expect to support additional Samsung 3G handsets launching later this year."

The RF3267 is a Band 1 (1920–1980MHz) WCDMA/HSDPA power amplifier (PA) that provides a balance of efficiency and linearity, resulting in up to 15% less peak current consumption and a digitally controlled low-power mode that allows the handset to operate with reduced current consumption across a broader power range. This translates into longer battery life in data-centric mobile devices, the firm claims. Also, an integrated coupler allows handset designers to eliminate the external coupler traditionally placed at the PA's output. The additional functionality is achieved without growing the ultra-compact 3mm x3mm x 0.9mm package, which matches the prior-generation RF3266 PA. By maintaining pin-for-pin compatibility, the RF3267 assists handset original equipment manufacturers seeking to shrink RF sections in support of more compact and thinner devices.

The RF6266 WCDMA/HSDPA PA operates in Band 5 (824–849MHz) or Band 8 (880–915MHz) and has a similar feature set to the RF3267, with the same 3mm x 3mm x 0.9mm package. Used in combination, the RF3267 and RF6266 provide a compact solution for multi-band, multimode 3G handset designs targeting the North American and/or European Union markets.

RFMD says that it is introducing new 2G and 3G standard products to the open market and gaining market share at top-tier handset makers and platform providers. Compared to 2G devices, its 3G product portfolio captures 3–5 times more dollar content per phone, as increasingly complex 3G multimode handsets require additional content, such as duplexers, filters and front-end power management.

RFMD reckons that it is gaining market share in 3G front ends and claims an advantage in 3G handset design activity, given its product portfolio, manufacturing scale, systems-level expertise and packaging & assembly capabilities, which enable it to minimize complexity, reduce component count and optimize the RF design of multi-band, multimode WCDMA/HSDPA handsets and smartphones.

IN BRIEF

## TriQuint recognizes top suppliers

At its annual Supplier Day Conference educational and networking event, TriQuint announced the recipients of its 'Top Supplier Awards for 2008', which recognize suppliers for overall performance, including innovation, operational excellence, service levels, and industry leadership.

The categories and winners (selected by members of TriQuint's Supply Chain and Business Unit organizations) are:

- Top Supplier of the Year: Taiwan's MOCVD-based Visual Photonics Epitaxy Co Ltd (VPEC), which manufactures HBT and PHEMT epiwafers for wireless communication applications.
- Top Supplier of the Year–Florida: Yoshikawa High Precision (Kimitsu Plant), which uses stamping technology to supply electronic parts including lids and rings for SAW devices, ultra-small laminated cores for pager motors in mobile phones, terminals for liquid-crystal backlight electrodes, various drawn products, and transfer-pressed products.
- Top Suppliers of the Year–Oregon: Ambit Microsystems of Zhongshan, China (a subsidiary of EMS provider Foxconn Technology Group), a turnkey provider of assembly & test services; ASE Korea, founded by Taiwan's ASE Group (which provides assembly & testing of customer-specific semiconductors including amplifiers for wireless telecoms).
- Top Supplier of the Year–Texas: Unisem Malaysia, a provider of assembly & test services offering an integrated suite of packaging and test services such as: wafer bumping; wafer probing; wafer grinding; leadframe and substrate IC packaging including leaded, QFN, BGA and flip-chip packages; and high-end RF and mixed-signal test services.

# TriQuint's revenue rises 42% sequentially

For second-quarter 2009, RF product maker and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA has reported greater-than-expected revenue of $169.1m, up 42% on $118.9m last quarter and up 33% on $127m a year ago.

Revenue was split between Asia (59%), Americas (35%) and Europe 6%, compared to 53%, 38% and 9%, respectively, last quarter. By application sector, 65% came from handsets, 23% from networks, and 12% from defense.

Sequential growth in handset and defense revenues was 56% and 25%, respectively. Networks revenue grew 16%, but remained below historic levels as 3G expansions in China was offset by conservative inventory management and slow capital spending on infrastructure worldwide. Networks business is suffering the most from the impact of the economy, notes chief financial officer Steve Buhaly. Revenue mix hence contained more handset and less network revenue than usual.

On a non-GAAP basis, gross margin rose significantly from 21% last quarter to 33.2% (as improved factory utilization of 66% and improved handset margins offset the low mix of networks products). However, this is still down on 37% a year ago, impacted by inefficiencies associated with the very high sequential revenue growth as well as ramping the new RF filter line.

Non-GAAP operating expenses have risen 19% from last quarter's $37.3m to $44.3m (26.2% of revenue). However, this is just back to historic levels, due mainly to the end of temporary cost-control measures imposed in Q1/2009 (which included mandatory time-off, restrictions on discretionary spending etc).

Compared to a net loss of $11m last quarter, non-GAAP net income was $11.5m, up on $9.6m a year ago. Cash flow from operations was $9.6m, while cash, cash equivalents and investments remained constant at $99.4m. Capital spending was $12.5m (roughly equivalent to depreciation and amortization).

"Sales and earnings exceeded expectations on the strength of handset and defense & aerospace product revenue," comments president & CEO Ralph Quinsey. "The company responded well to a roller-coaster ride of uncertainty and demand volatility," he adds.

"I see sustained demand in the second half of 2009 for handset and defense products and continued recovery in the health of our networks market," says Quinsey. "I expect solid handset revenue in Q3 supported by the popularity of smart-phones."

For Q3/2009, TriQuint expects revenue of $170–180m (flat to up about 6.5% on last quarter, driven by renewed shipments of wireless LAN products). It also expects non-GAAP operating expenses to rise to $46–48m, but gross margin to rise to 35%. Cash is expected to increase by $10m. As of 22 July, TriQuint was 89% booked to the midpoint of revenue guidance. In addition, Q4 should be slightly stronger than Q3.

TriQuint's long-term goals are non-GAAP gross margin of 40%, operating expenses of 25% of revenue, and operating margin of 15%. "Demand volatility and the softness of our networks market have been headwinds to these goals," says Quinsey. But, despite uncertainty in the macroeconomic outlook, he is confident TriQuint is growing its share of the networks market. "I anticipate steady and improved demand throughout 2009–10 and beyond as the optical and cable markets recover and we execute our ramp of TriQuint products."

www.triquint.com

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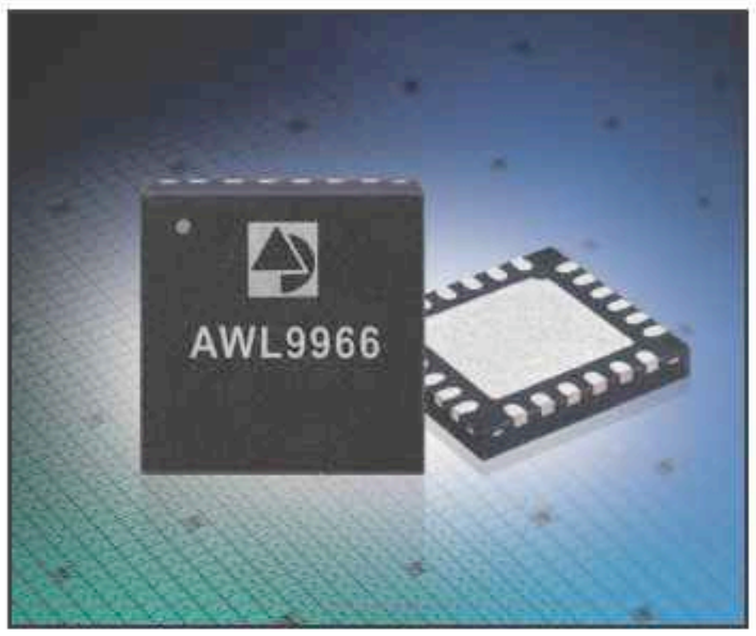
# High-power, dual-band FEIC for Wi-Fi-enabled handsets

Anadigics Inc of Warren, NJ, USA has made available samples of a high-power, dual-band front-end integrated circuit (FEIC) designed to address the growing demand for WiFi capability in size-constrained mobile electronics.

Supporting the 802.11n (MIMO) WiFi standard, and optimized for transmit and receive applications in both the 2.4GHz (802.11b/g) and 5GHz (802.11a) bands, the highly integrated AWL9966 incorporates dual-band power amplifiers, low-noise amplifiers (LNAs) and RF switches in a single 4mm x 4mm x 0.6mm package. The LNAs include a bypass feature to support wide-dynamic-range operation in receive mode, and the device is fully matched at all RF input and outputs to 50Ω, eliminating the need for external matching components. The AWL9966 also integrates a Bluetooth RF switch path to enable both Bluetooth and WiFi operation from a shared antenna with no external switching devices. The high level of integration and small packaging greatly simplifies the design of size-constrained WiFi-enabled products, the firm adds.




**Anadigics' AWL9966 front-end IC.**

Anadigics claims that the AWL9966 delivers the noise figures, RF gain and linear output power to enable the WiFi solutions required for the rapidly growing WiFi-enabled wireless handset market. Specifications include: 18dBm of linear output power for 802.11a at 3% EVM with 160mA total current and 20dBm of linear output power for 802.11g at 3% EVM with 190mA total current; 31dB of linear power gain at 2.4GHz and 5GHz; 2.6dB total noise figure at 2.4GHz with 12dB gain and 3.0dB total noise figure at 5.5GHz with 14dB gain; and ultra-low insertion loss of 0.8dB in the Bluetooth Tx/Rx path.

A recent report from ABI Research forecasts that shipments of Wi-Fi-enabled cellular handsets will double in volume from January 2008 to the end of 2010, and that this growth curve will continue through 2013. In addition, In-Stat reports that cellular/Wi-Fi handsets will surpass mobile PCs as the largest category of WiFi-enabled devices by 2011. "With our technology and design capabilities, Anadigics is extremely well positioned to capitalize on this market growth," reckons director of product marketing Glenn Eswein.

"The AWL9966 was developed to give WiFi system designers a highly integrated, easy-to-use, high-performance front end for size-constrained mobile products," says Dave Cresci, senior director of Anadigics' WiFi Product Line. "Low noise figures in the receive paths, together with high gain and high linear output power in the transmit paths, translate to greater WiFi range and higher data throughput," he adds, emphasizing that video and other high-data-rate applications are becoming more prevalent in handsets.

www.anadigics.com

# WCDMA PAs used in Samsung's Omnia HD and Memoir handsets

Anadigics says that two of its WCDMA power amplifiers (PAs) have been chosen by Samsung to power two of its highest-profile new 3G multimedia handsets: the Omnia HD and the Memoir. The AWT6224 3G PA has been selected for use in the full touch-screen Omnia HD, the first mobile handset to offer HD video recording. The AWT6282 has been chosen to power the 8 megapixel Memoir.

The 3mm x 5mm x 1mm AWT6224 is a 900/IMT dual-band PA that addresses the demand for greater integration in dual-band handsets for EGSM network deployments. The AWT6282 is a 4mm x 4mm x1.1mm AWS-band PA developed for WCDMA handsets.

**Samsung's Omnia HD.**

Launched in May in Asia and Europe, the Omnia HD is already one of Samsung's top selling phones. In addition to being the first mobile handset to offer 720p 23fps HD video recording, the Omnia HD has a 3.7", full touch-screen display and supports both Wi-Fi and Bluetooth operations. The Memoir (unveiled at February's Mobile World Congress in Barcelona) is a 3G, full touch-screen handset that closely resembles a point-and-shoot camera in both design and functionality. As well as capturing 8 megapixel images, it offers 16x digital zoom, five different shooting modes, and is driven by Samsung's new TouchWiz user interface.

"Both of the Anadigics PAs chosen by Samsung incorporate our proprietary HELP3 technology, which lowers current consumption by up to 75% to provide the additional power needed for the highly innovative multimedia features offered in both these new phones," says Anadigics' president & CEO Mario Rivas. Both WCDMA PAs use Anadigics' InGaP HBT MMIC technology.

# Samsung helps Anadigics to revenue gain

GaAs-based wireless and broadband communications component maker Anadigics Inc of Warren, NJ, USA has reported a small sequential increase in sales, thanks largely to growing business with Korea-based mobile phone makers Samsung and LG. Anadigics, which is striving to rebuild its formerly very strong customer relationship with Samsung, said that revenues grew 3% in the second quarter to $31.5m.

Previously, it had indicated that sales would slump by up to 10%, but the return of Samsung as one of its top customers helped to deliver the turnaround, and it now anticipates 5–10% growth in Q3.

However, Q2's marginal sales improvement still represents a year-on-year drop of 61%, and it resulted in a quarterly net loss of $14.3m for the three months ended 4 July.

So far in 2009, Anadigics has made a cumulative net loss of $36.2m.

CEO Mario Rivas, who replaced Bami Bastani after manufacturing problems led to a dramatic slump in business with Samsung last year, says that the firm is concentrating on rebuilding customer relationships and operational excellence.

"We were able to serve [Samsung] well in the second quarter," said the CEO in Anadigics' latest investor conference call. By the end of this year, he expects sales to the Korean giant to reach up to half of their earlier peak.

Central to the operational strategy is maintaining a cycle time of less than 40 days between order placement and delivery, and a device yield of more than 90%. Its previous difficulties saw that cycle time extend beyond 80 days, pushing some of its key customers to rival suppliers.

As part of its recovery plan, Anadigics will also implement a hybrid wafer production strategy. Currently, it is evaluating a second supplier of GaAs wafers and Rivas declared himself "quite satisfied with the results".

Although Anadigics' own fab utilization remains low — increasing from around 30% to 50% through the summer months — Rivas is confident that new design wins and increasing uptake of 3G connectivity in phones and netbooks will put more pressure on Anadigics' fab capacity by mid-2010. Samsung has said that it will source wideband-CDMA power amplifiers from Anadigics for use in its new Omnia HD and Memoir handsets.

Another key customer, Intel, is also now evaluating its power amplifiers for a new mobile platform, while mobile computing specialist Palm has placed Anadigics in the wideband-CDMA version of its new flagship 'Palm Pre' device.

**To help avoid any repeat of the capacity problems seen previously, Anadigics is upgrading its fab systems to eliminate production bottlenecks**

To help avoid any repeat of the capacity problems seen previously, Anadigics is upgrading its fab systems to eliminate production bottlenecks.

Rivas is also excited about the new availability of the 800–900MHz spectrum in the US, a space vacated by analog TV signals, and Anadigics is already working on 3G products suitable for the low-frequency slots.

The CEO believes that Anadigics already fills around half of all 3G power amplifier slots globally, and is well positioned to take advantage of future demand for fourth-generation protocols like LTE.

www.anadigics.com

IN BRIEF

## Skyworks signs worldwide distribution agreement with Digi-Key

Skyworks Solutions Inc of Woburn, MA, USA, which manufactures linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, has entered into a global distributor agreement with Digi-Key Corp, one of the world's fastest growing electronic component distributors.

Digi-Key carries a number of Skyworks' analog components and modules including amplifiers, attenuators, demodulators, diodes, mixers, power dividers and combiners, synthesizers, and switches (now in stock and slated to feature in upcoming print and online catalogs).

"Feedback from our engineering customer base supports our belief that the RF and wireless segment will continue to grow at a faster rate than the overall market," says Dave Doherty, VP of semiconductor products for Digi-Key. "Skyworks' broad range of high-quality RF products makes this company a good match for Digi-Key's global customer base," he adds.

"Digi-Key's position as an established market leader in online electronics distribution will provide Skyworks with greater product exposure and access to an even larger customer base, particularly those preferring to order online," says David C. Stasey, Skyworks' VP of analog components. "We are now able to better address the vast pool of engineers across a broad range of markets who require immediate shipment and access."

www.digikey.com
www.skyworksinc.com

# Skyworks rebounds by 11% from March-quarter dip

For its fiscal third-quarter 2009 (to end June), Skyworks Solutions Inc of Woburn, MA, USA, which manufactures linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, has reported revenue of $191.2m (75–80% from handsets and 20–25% from linear products). Though still down 11% on £215.2m a year ago, this is up 11% on last quarter's $173m, and exceeds guidance of 5% growth to $182m. Samsung, Sony Ericsson, Motorola and LG were all 10% customers; Nokia was in the high single digits.

After on 22 January announcing a restructuring plan (costing $19.4m) to cut staffing by 4% (150 jobs), operating expenses have been cut from $68.6m in fiscal Q2 to $48.9m. Operating income was $21.5m, almost back to $22.8m a year ago and a big improvement on a loss of $3.7m last quarter.

On a non-GAAP basis, operating margin was 14.9%, up on 14.1% a year ago. Gross margin was 40.5% (up slightly on last quarter's 40% and almost level with 40.6% a year ago), driven by improved fab equipment efficiencies, progress on yield improvement initiatives, and ongoing material cost reductions.

Net income was $19.8m, a big improvement on last quarter's loss of $4.6m and almost level with net income of $20.5m a year ago. Cash flow generated from operations was $44m (compared to $26.2m a year ago). During the quarter, cash and equivalents rose by $40m to $308m, even after $11m of depreciation, $6m in capital expenditure, and June's cash acquisition of Axiom Microdevices Inc of Irvine, CA (the only volume supplier of CMOS silicon-based power amplifiers for mobile handsets).

Despite the economic downturn, Skyworks exceeded all key financial and operating targets, driven by program strength spanning analog, smart-phone, netbook, 3G infrastructure, mobile video and energy management applications, comments president & CEO David J. Aldrich.

During the quarter, Skyworks:

- introduced several high-linearity ultra-low-noise amplifiers to address demanding receiver applications, including the GPS, satellite radio, and WCDMA and LTE infrastructure markets as well as ISM hubs repeaters and access points;
- secured the firm's first wireless local-area networking (WLAN) design wins at Intel (for their 802.11b/g/n chipsets);
- ramped front-end solutions supporting Broadcom's 802.11n WLAN reference designs (capturing three of the world's top four netbook and notebook OEMs);
- powered Samsung's latest smart-phones and touch-screen platforms with EDGE and WCDMA front-end solutions; and
- ramped production for ESCO Technologies and Neptune (joining existing customers Itron, Badger Meter, Landis & Gyr and Sensus, some of the first movers in deploying new and retrofitted smart water, gas and electric meters).

"Although we remain cautious on the macro-economy, our expanding product, market and customer footprints are setting the stage for a much stronger back half of 2009," says VP & chief financial officer Donald W. Palette. "Specifically, we expect revenue for the September quarter [fiscal Q4] to be up 10% sequentially [to $210m] with a 17% operating margin [based on operating expenses of $50m]." Skyworks expects gross margin to grow to 40.5–41%. "We also anticipate another strong quarter of cash flow generation," says Palette.

The 17% operating margin puts Skyworks on track to achieve its target model earlier than expected, comments Aldrich. The firm previously targeted 18–20% at $250m in quarterly revenue, but the business model now has the leverage to achieve 20% at $240m in quarterly revenue. "Our strategy of diversifying into a broader set of analog semiconductor sectors, consolidating share in core markets and leveraging our scale advantages is increasingly reflected in our improving financial performance," he adds. "We have never been better positioned to outperform our addressable markets to achieve our long-term financial targets... Given our product pipeline and the success of our fab-lite strategy and our leaner cost structure today, we now see a path to 20% operating margins at revenue levels significantly less than the $250m quarterly model."

www.skyworksinc.com

## Skyworks wins 2Wire's 2008 Silver Gateway Supplier of the Year award

Skyworks has received the 2Wire Silver Gateway Supplier of the Year award in the Catalog Semiconductor category in recognition of its excellence in product quality and service.

Broadband solutions provider 2Wire has been a customer since 2006 and uses Skyworks' vertical market solutions and analog component products including power amplifiers, switches and diodes for its wireless intelligent gateways.

"Over the years Skyworks, through its innovative devices and excellence in product quality and service, has played an important role in helping us deliver intuitive and reliable user experiences to millions of broadband users," says Marty Novak, 2Wire's VP of corporate quality. "We are delighted to be supporting the 2Wire global footprint with linear product solutions that support excellence in broadband access equipment," adds Liam K. Griffin, Skyworks' senior VP, sales & marketing.

# Kopin invests in Taiwan foundry as GaAs demand returns

GaAs epiwafer foundry Kopin Corp of Taunton, MA, USA is investing an additional $6.3m in its Asian foundry venture, Kopin Taiwan Corporation (KTC).

The move, which increases the US company's equity stake in the foundry to 87%, came on the back of rapidly improving financial results for its III-V business.

In second-quarter 2009, Kopin posted III-V revenues of $10.4m, up 51% on Q1 as demand for its transistor epiwafers rebounded strongly.

Overall, the firm recorded sales of $28.2m (up 30% sequentially and 9% on a year ago) and a net income of $3.7m, as sales of its display products remained robust amid the global recession.

"We expect that demand will continue to improve in the second half of this year," says CEO John Fan of the III-V business, as well as suggesting that the turnaround 'perhaps indicated that the recession was beginning to ease.

Fan estimates that Kopin's transistor epiwafers ultimately show up inside power amplifier (PA) components in approximately one-third of all mobile phones currently. With sales of smartphones growing quickly, along with the migration to 3G connectivity around the world, more and more of those amplifiers are going to be required.

**The most challenging portion of 2009 is behind us... The cell-phone market is strengthening**

Fan also said that Kopin was growing its customer base in the wireless communications market, although its largest customer remains the PA giant Skyworks Solutions. Skyworks was recently identified by market research company Strategy Analytics as the largest supplier of cellular PA devices by market share.

With the anticipated need for more GaAs-based amplifiers, Kopin has sensed an opportunity to capitalize on demand for what it described as "Taiwan's fast-growing foundry services".

In two transactions, Kopin has purchased 19.7m additional shares in KTC, and says that the investment will aid a transition from 4" to 6" GaAs epiwafer production.

Fan predicts that Kopin will post full-year 2009 sales of $90–110m, depending on the pace of any economic recovery. "We continue to believe that the most challenging portion of 2009 is behind us," he says.

"The cell-phone market is strengthening, as many of our III-V customers have reported over the past couple of weeks, which should result in continued growth of our III-V revenue in the second half of 2009," Fan concludes.

**www.kopin.com**

*By Michael Hatcher*

# IXYS launches pHEMTs, HBTs and MMICs in surface-mount packages

IXYS Corp subsidiary MicroWave Technology Inc (MwT) of Fremont, CA, USA, which manufactures GaAs-based devices, MMICs, and amplifier modules for microwave and wireless communications, has launched six AlGaAs/InGaAs pHEMT- and InGaP HBT-based high-frequency products and broadband MMIC amplifier products in surface-mount packages:

- The MMA-020624-L3 is a 2–6GHz wideband linear driver in a 3mm x 3mm QFN package with 25dBm linear output power, 15dB of gain, and linearity of 40dBm OIP3.
- The MMA-011015-C5 is a 1–10GHz broadband driver in a 5mm x 5mm QFN package, which provides 15dBm linear output power and 15dB of gain.
- The MMA-061829-10 is a 6–18GHz broadband power amplifier in a 10mm x 10mm ceramic package, which has 30dBm (1 watt) of saturated power and 8dB of gain.
- The MMA-121630-S7 is a 12–16GHz power amplifier in a 7mm x 7mm package, which provides 32dBm (1.6 watts) of saturated output power and 26dB of gain.
- The MMA-022028-S7 is a 2–20GHz distributed power amplifier in a 7mm x 7mm ceramic package, which has 29dBm of saturated output power and 8dB of gain across the band.
- The MHA-051023D-88 is a 50–1000MHz linear driver in a SOIC-8 package with excellent linearity. The push-pull amplifier provides 24dBm of linear output power, 16.5dB of gain, 42dBm of OIP3, and 76dBm of OIP2.

Hermetically sealed packages are also available for these MMIC products.

"We continue to develop and optimize the performance of high-frequency and broadband MMIC parts in various surface-mount packages targeted at a wide range of applications including broadband military electronic warfare and defense communications, wireless infrastructures, point-to-point microwave radios, instrumentation, CATV/FTTH and others," says MicroWave Technology Inc's general manager Dr Greg Zhou. "These fully matched MMIC amplifiers housed in surface-mount packages are designed for ease of use by our customers in terms of assembly and RF system integration," he adds.

**www.mwtinc.com**

# Hittite revenue rebounds, driven by China 3G roll-out and microwave

For second-quarter 2009, 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 revenue of $39.7m: 36.3% ($14.4m) from customers in the USA and 63.7% ($25.3m) from outside the USA (although this is expected to return to a more typical 40:60 split in future). Revenue is down 11.9% on $45m a year ago but up 3.9% on last quarter's $38.2m.

"The business climate has stabilized relative to Q1," says chairman, president & CEO Stephen Daly. "It was a solid quarter with sequential growth driven primarily from the cellular infrastructure and microwave communication markets." Of the firm's eight markets, three (cellular infrastructure, microwave & millimeter-wave communications, and military) accounted for 82% of revenue.

Compared to just two in Q1, in Q2/2009 four end markets grew sequentially, including double-digit increases for cellular infrastructure and microwave & millimeter-wave communications. Cellular infrastructure growth was related to the 3G (TD-SCDMA) rollout in China; microwave communications growth was due to new back-haul radio-linked bandwidth requirements in international markets, and to some degree due to minor inventory restocking required by customers.

Though one of Hittite's smaller markets, fiber-optic revenue more than doubled, driven by design wins and new products and product lines. The firm is winning sockets in traditional 10Gb/s and newer 40Gb/s transceiver modules due to the engineering focus in its product development, Hittite reckons.

A recent report forecasted that the fiber-optic transceiver market will fall in 2009, suggesting that revenue growth is being driven by market share gains.

Broadband revenue was flat sequentially, while automotive, military and space revenues fell. Space dropped the most (by 25%), due mainly to typical lumpiness of production lot shipment, and to some extent because of following a strong Q1. However, overall, space business is robust: "We continue to expand our capability and offerings in this area," comments Daly.

"We continue to experience strong customer demand," Daly adds. "In light of the current economic environment, we believe that Q2 declines in certain areas of our business were not due to market-share losses or competition, but were rather end-demand driven."

Gross margin was 70.4%, down from 70.8% a year ago and 71.5% last quarter due to factors including product mix, production cost, and pricing. Though down from $13.5m a year ago, net income of $10.6m was up on last quarter's $10.2m. During the quarter, total cash and cash equivalents rose by $13.4m to $197.9m.

**3G infrastructure in China may be facing a multi-quarter pause while operators digest the equipment that they have bought**

Also, during the quarter, Hittite introduced 21 new products, including 13 amplifiers, four mixers, two phase-locked loops (the 16-bit fractional-N synthesizer ICs HMC701 and HMC702: the second and third products in the new PLL product line, joining the HMC700), and one new product each in the switch and digital high-speed logic product lines. This brings the standard product portfolio size to more than 765.

Since the beginning of 2006, Hittite has launched 10 product lines and over 360 new products.

Correspondingly, the firm has increased R&D spending annually by 30–50%: from about $10m in 2005 to $15m in 2006, $18.5m in 2007, $24.5m in 2008 and, so far, $11.2m year-to-date in 2009 (and about the same as last year by the end of 2009). Consequently, during 2009, the firm will increase the size of its existing 20 product lines, and expand its portfolio by adding new product lines to address new applications. "We expect to launch a similar number of new products and product lines in 2009 as we did in 2008," says Daly. "We will continue to enter new product areas and new markets."

Order backlog grew during Q2. Recently, orders from all regions have been steady, although the firm expects some short-term weakness from Europe. For Q3/2009, Hittite expects net income of $10–10.9m on revenue of $40–41m (sequential growth of 3.4% at the high end of this range).

"Some of our core markets will get stronger, specifically military and microwave, and those are two of our four largest markets," says Daly. "We also believe we'll see continued growth coming from the fiber-optic markets... fiber-optic growth will come from our improved ability to address the 10 and 40 Gigabit Ethernet, SONET and DWDM transceiver module markets." Broadband business will also begin to improve, he reckons. However, he categorizes the cellular market as 'neutral': "We've had some tremendous growth in the first half, primarily coming out of Asia. We think that our cellular business in the second half is going to be just a bit more tempered." Specifically, 3G infrastructure in China may be facing a multi-quarter pause while operators digest the equipment that they have bought. Meanwhile, the test & measurement and automotive sectors are categorized as 'generally weak'.

www.hittite.com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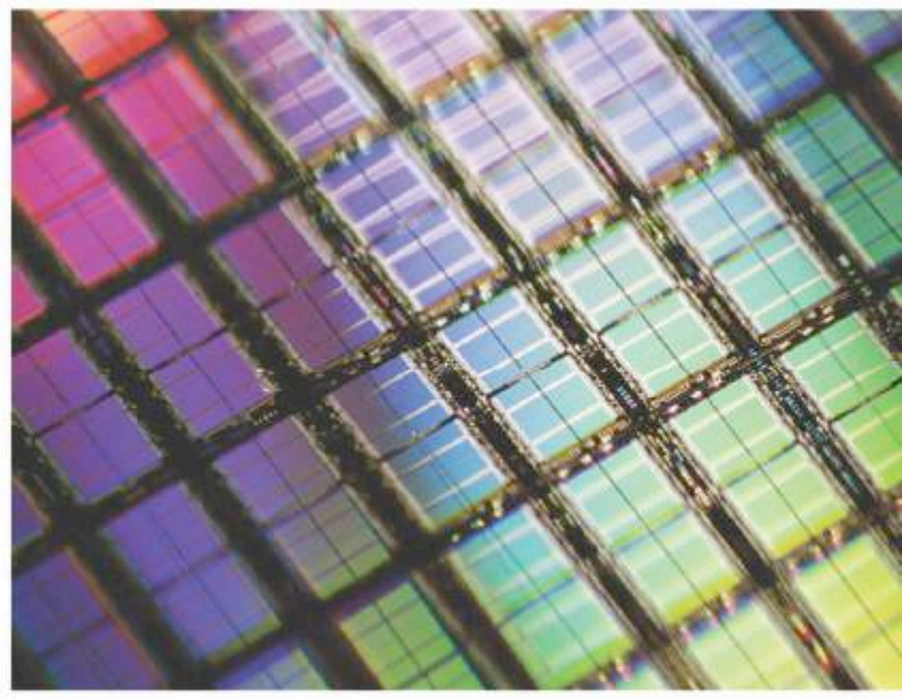

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# Vubiq launches low-cost SiGe-based millimeter-wave waveguide modules for unlicensed 60GHz spectrum

Vubiq Inc of Aliso Viejo, CA, USA has announced the commercial availability of its 60GHz waveguide modules, enabling low-cost, high-speed applications using the globally unlicensed 60GHz spectrum.

The fully integrated radios are capable of Gigabit-speed file transfer and video streaming through a standard WR-15 (UG-385/U) waveguide interface. The modules can be attached to any waveguide component, allowing developers to leverage the power, speed, and cost-effectiveness of the 60GHz band with their own system configurations.

"Until now, 60GHz development has been severely constrained by the high cost of the radios, which typically utilize gallium arsenide or indium phosphide semiconductors," says CEO Adam Button. "Vubiq's waveguide modules use silicon-germanium-based radios, allowing us to offer them at a fraction of the price of GaAs and InP," he adds. "Given this huge cost advantage, a host of markets can now capitalize on the massive bandwidth available in the spectrum. We are now speaking with customers in telecommunications distribution, telecommunications backhaul, point-to-point data communications, and uncompressed high-definition video transmission."

Vubiq's waveguide modules complement its other millimeter-wave products, which include 60GHz micromodules featuring a built-in antenna for short-range applications, and the VL300 video link, which can transmit pure, uncompressed HD video hundreds of meters.

"Current 60GHz waveguide offerings use technologies that were designed for aerospace — with the associated cost, power and size preventing any meaningful penetration into commercial markets," comments chief technology officer Mike Pettus. "Our focus is in bringing millimeter wave to volume applications; by utilizing a combination of silicon-based radios along with our proprietary packaging technologies, we have developed a product that can compete head-to-head with anything out there on performance, but at a fraction of the cost," he claims.

Vubiq is now accepting orders for its waveguide modules, as well as a complete waveguide development system that allows for easy setup and operation.

www.vubiq.com

# SemiSouth's SiC JFETs help drive Fraunhofer ISE's photovoltaic inverters to world record efficiency

Fraunhofer Institute for Solar Energy Systems (FhG-ISE) in Freiburg, Germany has set a record of 99.03% for the efficiency of inverters used in photovoltaic systems. By using new components and improving circuit technology, ISE researchers have reduced losses compared to their own previous top-level performance by a third.

"We now use junction field-effect transistors (JFETs) made of silicon carbide (SiC) manufactured by SemiSouth Laboratories Inc of Austin, TX, USA. This is the main reason for the improvement", said professor Bruno Burger, leader of the Power Electronics Group at ISE. "In addition, we have optimised the gate units and many other details of the circuit."

The record was measured for a complete PV inverter, including its internal power supply, a digital signal processor for controls, an LCL grid filter and a relay for connection to the grid.

According to the researchers, further advantages result when the improvements are transferred to series production, where higher efficiency means lower thermal losses, smaller cooling devices and a more compact construction. These savings also help to compensate for the higher price for the new components.

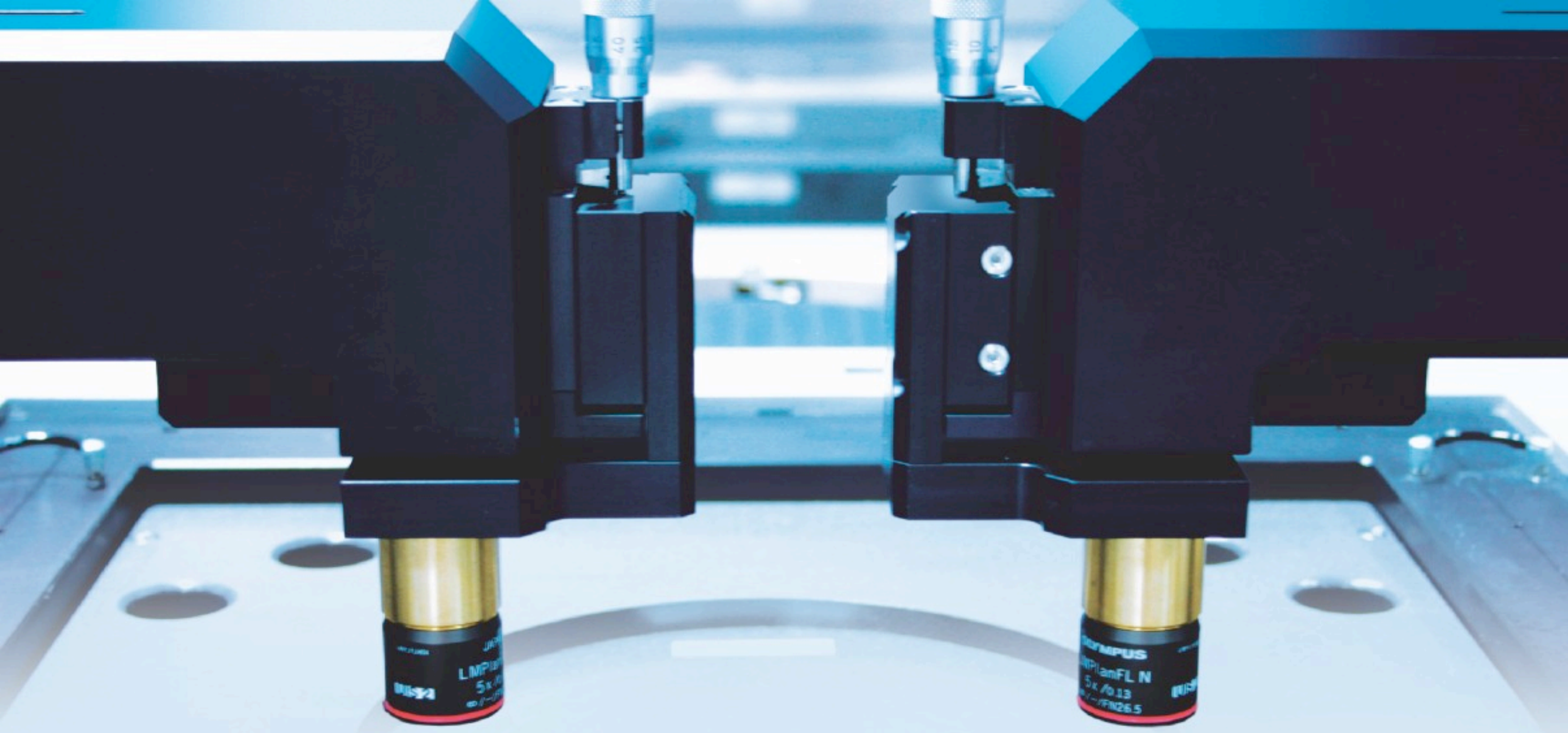
"I see enormous potential for the new silicon carbide transistors. They are constantly becoming better and less expensive, whereas the costs for passive components, which contain significant amounts of copper and other metals, are rising continuously," says Burger.

The researchers add that SiC transistors are significantly better than conventional silicon (Si) IGBTs, particularly for higher reverse voltages. The main reasons are the breakdown field strength, which is ten times higher for SiC than silicon, and the band gap, which is three times larger for SiC than for silicon.

Inverters convert the DC current generated by photovoltaic systems into AC current and feed it into the public AC electricity grid. The higher the inverter efficiency, the higher is the system yield. For a 30kW system, an efficiency value which is 1% higher results in an additional yield over ten years of 3000kWh or EUR1300.

The work was supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) within the project titled 'Ultra-compact PV inverters with silicon carbide semiconductors and high efficiency values'.

www.semisouth.com

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IN BRIEF

## REC co-founder & former CEO to join Voltaix board as Novus invests $9m

Specialty chemicals manufacturer Voltaix LLC of North Branch, NJ, USA, which provides silicon, germanium and boron materials that enhance the performance of semiconductor chips and solar cells, says that Reidar Langmo, founding partner & CEO of Novus Energy Partners and co-founder & former CEO of Renewable Energy Corp (REC) of Oslo, Norway, has joined its board of directors. Voltaix also recently concluded a $9m investment by Novus, a transatlantic investment fund focused on emerging companies in the renewable energy industry.

"Reidar Langmo is one of the most accomplished executives in the clean tech industry," says Voltaix's chairman Dr Peter deNeufville. He and his colleagues at Novus bring to Voltaix both an exceptional base in semiconductor materials and a track record of successfully industrializing energy technologies."

Langmo co-founded Renewable Energy Corp and its predecessor entities in 1994 and played a key role in developing the firm as an integrated solar energy company. In 2006 REC raised more than $1bn in what was the largest clean energy IPO to date.

Voltaix is poised to leverage its semiconductor expertise to facilitate the growth of the thin-film PV market, says Langmo. The firm aims to use the funds from the Novus investment to further develop its manufacturing capabilities to meet growing demand for thin-film-based solar power and advanced CPU and DRAM products.

www.voltaix.com

# IMEC launches industrial affiliation program on GaN-on-Si technology

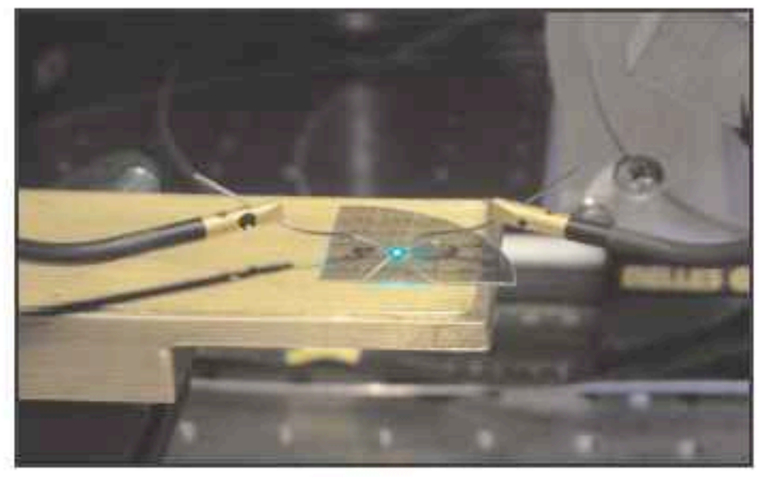
International research center IMEC of Leuven, Belgium has launched a new industrial affiliation program (IIAP) focusing on the development of gallium nitride technology for both power conversion and solid-state lighting applications. A key goal is to lower the cost of GaN technology by using large-diameter (up to 200mm) silicon wafers and hence leveraging silicon's scale of economics.

Due to their unique combination of excellent transport properties and high electrical field operation capability, GaN-based devices can overcome the intrinsic material limits of silicon MOSFET structures which, for some applications, are being reached in traditional high-voltage power devices.

The few GaN devices on the market are based on AlGaN/GaN high-electron mobility transistor (HEMT) structures and are normally-on devices, designed for RF applications, e.g. in wireless communication. The IIAP envisages the next generation of power electronics components, requiring the development of normally-off devices (for safety reasons) with high-voltage breakdown (600–1000V) and low on-resistance, operating in enhancement mode.

The scope of the IIAP is therefore to develop high-voltage, low-loss, high-power switching devices based on large-diameter GaN-on-Si technology. Potential applications include high-power switching in solar converters, motor drives, hybrid electrical vehicles or switch-mode power supplies.

A second sub-program of the IIAP will exploit GaN-on-Si technology for the development of high-efficiency, high-power white LEDs. Key issues are enhancing the external and internal quantum efficiencies and enabling high-current operation. III-nitrides in general exhibit excellent light-emission properties in a very broad range of the visible and



**IMEC's green LEDs on sapphire.**

ultraviolet (UV) spectrum. However, LED illumination using these devices can only become broadly acceptable if new high-volume manufacturing technologies are developed that yield LEDs with luminous efficacies of 150lm/W. IMEC says that its proprietary thin-film texture LED technology will be used on GaN-on-Si LEDs to enhance the external quantum efficiency.

A common challenge for both power electronics and optoelectronics is cost reduction. "GaN on large-diameter Si wafers (from 100mm and 150mm towards 200mm) in combination with CMOS-compatible processes offers the best perspective to create economically viable solutions," says GaN program director Marianne Germain. While very few players can currently process GaN on large-diameter Si wafers, IMEC — in collaboration with Aixtron — has recently demonstrated crack-free GaN growth on 200mm wafers. "Also, for other challenges the IIAP can build on IMEC's 10 years' experience in GaN technology, including unique skills in epi-layer growth, new device concept, device integration and a thin-film textured LED technology for high-efficiency III-nitride LEDs," adds Germain.

IMEC says it invites both integrated device manufacturers and the compound semiconductor industry to join the program, enabling partners to build on IMEC's expertise in GaN and benefit from a sharing of cost, risk, talent and intellectual property.

www.imec.be

# IQE sees sharp order pick up as destocking ends

In a trading update for first-half 2009 (ended 30 June), epiwafer foundry and substrate maker IQE plc of Cardiff, Wales, UK says that it achieved a strong operating performance despite the industry-wide destocking that adversely affected sales in Q4/2008 and Q1/2009.

As anticipated in the 2008 preliminary announcement on 24 March, destocking ran its course in early Q2/2009 and orders picked up sharply in May and June. IQE's board therefore expects that the firm's first-half performance will be at least in line with market expectations, with earnings before interest, tax, depreciation and amortization (EBITDA) of at least £1.2m on revenue of about £20m (compared to £60.5m for full-year 2008, though still down on £30m for first-half '08).

IQE says that the sound financial performance during an extremely tough economic environment demonstrates the resilience of its business model. The action taken by management during Q4/2008 ensured that the business remained EBITDA positive even in January and February, at the lowest point in the cycle. IQE stresses that, as the business resumes rapid growth, it should continue to benefit from the lower costs and higher margins resulting from structural efficiencies achieved.

The increase in trading activity towards the end of the first half has seen some absorption of cash into working capital, reflecting higher trading volumes. Net debt is expected to be better than market expectations of about £20m as at 30 June, leaving more than £5m funding headroom. IQE says that it has been operating well within its banking arrangements, and the board expects net debt to decrease in second-half 2009.

Despite the continuing backdrop of global economic uncertainty, in second-half 2009 IQE expects continued strong growth in sales volumes, reflecting its strong position in high-growth markets, principally wireless communications (including 3G and feature-rich smartphones).

In addition, new product development continues, with progress in solar activities (where customers are achieving world-record efficiency results) and in ultra-low-power LED products. Also, further progress on next-generation electronic materials was demonstrated by the recent release of new engineered substrates such as germanium on insulator (GeOI) for next-generation ICs and devices.

"We are seeing indicators of strong growth returning to a number of the high-end markets in which IQE operates and, as anticipated in the March trading outlook, it is the smartphone products that have been amongst the first to resume growth amongst our customer base," says chief executive Dr Drew Nelson. IQE is confident that strong demand will resume in second-half 2009. "We are achieving optimal production efficiencies with lean operations across the group and expect to benefit from our high operational gearing as sales growth recovers."

www.iqep.com

# IQE commences Phase II of DARPA's COSMOS contract

Epiwafer foundry and substrate maker IQE has commenced Phase II of the US Defense Advanced Research Projects Agency (DARPA) contract led by Raytheon Integrated Defense Systems (IDS) to develop Compound Semiconductor Materials on Silicon (COSMOS). IQE's involvement is to develop the epitaxial growth processes.

Phase I of the contract started in September 2007 with the goal of developing and demonstrating a viable process to integrate compound semiconductor materials with silicon in order to improve linearity, dynamic range and bandwidth of radio frequency devices. With Phase I completed, Phase II aims to improve both the yield and density of the heterogeneous epitaxial growth of indium phosphide (InP) HBTs in conjunction with conventional, silicon-based complementary metal oxide semiconductor (CMOS) processes.

Overall, the aim of the project is to integrate high-performance compound semiconductors with low-cost commercial CMOS silicon wafers to achieve superior cost-benefit performance compared with either technology on its own.

"Selective placement of semiconductor compounds on silicon is an important achievement because it proves that optimal circuit performance can be produced through a heterogeneous, high-yield, monolithic integration process," says Dr Tom Kazior, program manager at Raytheon IDS.

"IQE's continued role in this programme demonstrates our reputation for expertise, experience and quality in advanced semiconductor materials manufacturing processes for both current and future applications and maintains our position at the forefront of leading-edge semiconductor materials technologies," says Steve Gergar, VP & general manager at IQE's manufacturing facility in Bethlehem, PA, USA, where development of the epitaxial processes for phase II is being undertaken.

Other partners in the COSMOS project include: Raytheon Systems Ltd in Glenrothes, Scotland, UK; Teledyne Scientific Imaging Company in Thousand Oaks, CA, USA; Massachusetts Institute of Technology in Cambridge, MA, USA; Paradigm Research LLC in Windham, NH, USA; Soitec in Grenoble, France; and Silicon Valley Technology Center in San Jose, CA, USA.

www.darpa.mil/MTO/Programs/cosmos

IN BRIEF

## IQE hires director of North American sales

Epiwafer foundry and substrate maker IQE plc of Cardiff, UK has appointed Brian VanOrsdel as director of North American sales & strategic accounts for its opto-electronic product portfolio.

VanOrsdel has more than 20 years of sales management experience in optoelectronic and telecom technologies at firms such as Epitaxx and JDSU and, most recently, at Bookham Inc as strategic accounts manager.

He will be based in New York and be responsible for expanding business in the USA and Canada, offering IQE's epitaxial services in wafer applications using InP, InGaAs, GaAs, GaN, AlInGaAs, AlInGaP, InGaAsP, SiGe and silicon (using MOCVD, MBE, and CVD growth at IQE's plants in the USA, UK, and Singapore).

www.iqep.com

# AXT sees improving market conditions

AXT Inc of Fremont, CA, USA, which manufactures gallium arsenide, indium phosphide and germanium substrates and raw materials, has posted total sales of $13.1m for second-quarter 2009, up from $7.7m in the first quarter.

Morris Young, who recently returned to his former position as CEO of the company, said that market conditions had improved significantly since the start of the year, with inventory in the GaAs supply chain now largely cleared.

Sales of GaAs substrates specifically doubled to $10.1m compared with the first quarter, although they remain substantially lower than that seen during the same period of 2008.

Orders for germanium wafers also rebounded strongly, reaching $1.2m in the second quarter thanks to production orders from a newly qualified customer in Europe.

Young, who co-founded AXT in 1986 and served as CEO between 1989 and 2004, said: "Our qualification efforts in both GaAs and germanium substrates have been very successful and we are pleased with our increasing diversification in these areas."

The improving revenue picture delivered a much-improved bottom line, with AXT posting a net loss of only $1.3m in the second quarter, down from $5.5m in the preceding three months.

Revenue for InP wafers also grew sequentially, from $0.49m to $0.68m but, despite the improving environment, AXT declined to issue revenue guidance for the rest of the year.

One problem area that remains for AXT is its raw materials business, located largely in China. Young said that this was the one part of the supply chain where excess inventories were yet to clear. "[They] are not expected to recover until later in 2009."

As a result, sales of raw materials dropped sequentially, from $1.5m to $1.0m, and are much lower than the $4.9m figure seen during the equivalent period of 2008.

www.axt.com

*By Michael Hatcher*

## AXT reappoints co-founder and ex-chairman Morris Young as CEO

AXT has appointed Morris S. Young as CEO. Young co-founded AXT in 1986 and served as its CEO from 1989 to 2004. He has been a director of AXT since 1989 and held the position of chairman of the board from 1998 to 2004. From 1985 to 1989, Young was a physicist at Lawrence Livermore National Laboratory. He holds a B.S. degree in metallurgical engineering from National Cheng Kung University, Taiwan, a M.S. degree in metallurgy from Syracuse University, and a Ph.D. in metallurgy from Polytechnic Institute of New York University.

"Morris has extraordinary technical expertise and a vast amount of knowledge and experience in compound semiconductors that was unequaled in our extensive CEO search," says chairman Jesse Chen. "While our process yielded several strong candidates, we felt that Morris was the most qualified to make an immediate positive contribution to the business, and to effectively carry out AXT's long-term vision to be the number one advanced semiconductor materials supplier of choice through high quality, effective cost of ownership and a customer-focused philosophy. Further, Morris' track record of ground-breaking technical innovation will be a tremendous asset to AXT as the needs of our customers become more complex in response to the increasingly higher performance requirements of next-generation devices," he adds.

"We would also like to express our gratitude to Wilson Cheung, AXT's chief financial officer, for his service as AXT's principal executive officer and to our senior management team for their dedication and commitment to ensuring a smooth transition for our customers and employees during our CEO search," continues Chen.

"The company is in an excellent position to emerge from this economic climate stronger than ever," says Young. "Our broad product portfolio, expansive manufacturing capability and strategic joint venture agreements allow us the flexibility to meet our customers' requirements as the demand environment evolves," he adds. "Further, our strong positioning in key strategic markets such as high-end mobile communications, high-brightness LEDs and photovoltaics allows us healthy opportunities for future growth."

# Riber's first-half sales up 14% on a year ago, driven by research reactors

For first-half 2009, Riber S.A. of Bezons, France, which manufactures molecular beam epitaxy (MBE) systems as well as evaporation sources and effusion cells, has reported sales of €5.9m, up 14% on a year ago.

Despite the economic difficulties surrounding the semiconductor industry, system sales remained strong over first-half 2009 compared with last year, the firm says. Growth was driven by sales of four MBE systems to research centers, including the new MPVD300 (a 300mm modular system for high-vacuum deposition that can be connected directly to a silicon production line).

Component and services sales fell back slightly, but Riber says that it offset the impact of the economic crisis in the industry by developing sales associated with installed research reactors, as well as with reactors of the VG brand (acquired in September 2008).

Order backlog is up 17% on a year ago to €6.1m, consisting of seven research systems (for delivery in 2009) as well as higher component and service sales.

**Riber says that it offset the impact of the economic crisis in the industry by developing sales associated with installed research reactors, as well as with reactors of the VG brand**

Full first-half 2009 results and sales guidance for second-half 2009 are due to be released on 2 September (following the close of stock market trading).

www.riber.com

IN BRIEF

## Plasma cleaning system for R&D

Plasma Etch Inc of Carson City, NV, USA has launched the PE-50, a low-cost benchtop plasma cleaning system designed for university and R&D applications.

A 6″ x 6″ x 4″ aluminum vacuum chamber accommodates wafers up to 5″ x 5″ with 3″ of height clearance. The system includes a 125W, 50KHz RF power supply with continuously variable power capability. A 13.56MHz RF power supply with automatic tuning is available as an option. It also includes two process gas rotometers for independent gas control or gas mixing introduction to the vacuum chamber and a 7cfm pump charged with Fomblin oil for oxygen compatibility.

The PE-50 includes PLC control for automatic process sequencing.

www.plasmaetch.com

# Aixtron lifts sales guidance on LED market recovery

Deposition equipment maker Aixtron AG of Herzogenrath, Germany has increased its 2009 revenue guidance significantly, thanks to a strong rebound in demand from LED manufacturing customers.

Total sales at the company, which are dominated by MOCVD systems, reached €56.7m in the second quarter of 2009. And, although this represented a 14% drop compared with the same period in 2008, the company's order book is suddenly looking a lot healthier.

Like its rival Veeco Instruments, Aixtron has seen a surge in orders, particularly from customers looking to manufacture LEDs for use in LCD TV backlights.

As a result of that surge, Aixtron's management has revised upwards its revenue expectations for the year to between €230m and €250m. The previous guidance, set at what turned out to be the bottom of the demand curve, was €200–220m.

"We have seen a remarkable improvement in outlook," remarked Paul Hyland, Aixtron's CEO, adding that he believed the turnaround to be a sustainable one.

Part of the reason for that confidence relates to the long-term commitment and financial strength of new entrants into the LED business. "The arrival of these strategically minded players has not only added momentum to this recovery cycle," noted Hyland. "They enter the market with substantial and sustainable balance sheets, [and] they are more likely to maintain a longer-term investment view."

In an investor conference call to discuss the latest results, Hyland illustrated the huge potential of the LCD TV application.

Currently, the largest single market for LEDs remains the mobile phone industry. With around 1 billion mobiles sold each year and an average of ten LEDs per phone, this translates to approximately 10 billion LED chips.

Estimating the number of LED chips that might be needed for TV applications is not so straightforward, however. One reason for this is that two different backlight configurations are made: edge-lit and directly back-lit.

**Aixtron has seen a surge in orders, particularly from customers looking to manufacture LEDs for use in LCD TV backlights**

In the edge-lit design, up to 600 white LEDs are needed, while in the alternative approach up to 1200 white or red/green/blue emitters would be required for a 42-inch TV.

Somewhere between 85m and 103m LCD TVs shipped in 2008, but only about 1% of those incorporated LED backlighting. But this means that the total addressable market in LCD TVs could already be estimated at approximately 100 billion LED chips per year.

However, total market penetration by LEDs is something that is not expected to happen until 2015 at the earliest.

Estimates of the likely market penetration by LEDs vary widely, but they average at about 25% in 2012. By that time, annual shipments of something like 175m LCD TVs are expected.

Using those figures and Hyland's estimate of an average 600 LEDs used per TV, annual demand would outstrip that from phones to reach just over 26 billion chips.

With that potential future impact on demand for production MOCVD equipment, and an order backlog that has now swelled to €109m, Hyland concluded by striking a positive note for the future: "We enter the third quarter of the year with a much more positive customer sentiment, increasing momentum of LED technology demand, very high utilization rates, and an improved visibility of demand from LED manufacturers."

**We enter Q3 with a much more positive customer sentiment, increasing momentum of LED technology demand, very high utilization rates, and an improved visibility of demand from LED manufacturers**

www.aixtron.com

# VPEC adds two more MOCVD reactors to meet demand

Aixtron says that, in second-quarter 2009, Taiwanese pure-play epiwafer foundry Visual Photonics Epitaxy Co Ltd (VPEC) ordered two AIX 2600G3 IC MOCVD reactors, to be delivered in Q1/2010 and installed at its production facility in Ping-Jen City, Taoyuan.

VPEC's main products are HBT, pHEMT and PIN diodes, including Zn-diffusion-ready and customized-structure epitaxial wafers for wireless and optical fiber communications.

"We already have a number of Aixtron mass-production MOCVD systems in operation for the high-volume manufacture of optoelectronic and microwave epiwafers... We have operated Aixtron systems for over ten years," says VPEC vice president Neil Chen. "Due to exceptional demand from our customers, we must further expand production capacity," he adds. In May, the firm's revenue was NTD142m, overtaking the revenue reported before the economic downturn in 2008, and in June it rose further to NTD177m.

www.vpec.com.tw

# Veeco orders double on booming MOCVD system demand

Despite posting another quarterly net loss, equipment vendor Veeco Instruments has seen a dramatic recent surge in orders for its TurboDisc MOCVD systems.

Detailing the latest financial results of the firm, which is based in Plainview, New York, CEO John Peeler said that booming demand for these tools from key LED manufacturers in Korea and Taiwan was the key reason behind a much healthier-looking order book at Veeco.

Orders for LED and solar applications, which includes MOCVD systems, doubled sequentially to $57m in the quarter that ended on June 30.

That order momentum has accelerated notably into July, too. During the investor call to discuss the latest results, Peeler said that Veeco had so far received more than $110m worth of orders for MOCVD equipment in the month of July alone.

The order boom is a result of the increasing demand for LED backlights in notebook PCs and televisions, and an anticipated need to expand manufacturing capacity to support that ramp.

Peeler now estimates that during the current quarter, orders for LED and solar manufacturing equipment will reach somewhere between $125m and $175m. The majority of those orders are for K465 GaN systems, which may be configured in either 12x4-inch or 45x2-inch wafer fabrication formats.

Peeler also expects this momentum to continue, along with the increasing penetration of LED backlight technology. "Assuming that 40% of PC monitor and television backlighting will be [based on] LEDs by 2012, we believe that the MOCVD tool market opportunity for this application alone could approach $1 billion over the next few years," the CEO said.

Current demand is being driven by both vertically integrated makers of LED backlighting systems, and by merchant suppliers of LED wafers and chips, he added.

The demand surge also raises the question of whether Veeco is taking market share from its key competitor in the MOCVD equipment space — Germany-based Aixtron.

The dramatic return to demand for MOCVD systems will now see Veeco hiring workers to support increased manufacturing. Headcount is now expected to be in the region of 1100 by the end of 2009, rather than the figure of 1000 that had been previously indicated.

Overall, Veeco reported a net loss of $14.7m on total revenues of $72m for the second quarter of the year. Third-quarter revenues are expected to be in the region of $80m to $88m, and Veeco expects to break even on a non-GAAP basis.

**www.veeco.com**

*By Michael Hatcher*

# ATMI and SAFC Hitech to co-market solid-source vaporizer to both silicon and compound sectors

At July's SEMICON West show in San Francisco, ATMI Inc of Danbury, CT and chemical manufacturer SAFC Hitech (a business segment of SAFC within the Sigma-Aldrich Group) announced plans to co-market ATMI's ProE-Vap system, a solid-source vaporizer designed for atomic layer deposition (ALD) that is currently in demand for volume production of high-k/metal gate applications. The ensuing marketing partnership will cover both the silicon and compound semiconductor markets. A definitive agreement is expected to be signed this summer.

"The ProE-Vap system removes a significant barrier to achieving successful ALD applications processes and overcoming manufacturing process challenges," claims Tod Higinbotham, ATMI's executive VP, Process Solutions. "In partnering with Sigma Aldrich, we will bring ProE-Vap technology benefits to a broader customer base and alleviate any single-source supply chain concerns."

ATMI developed the ProE-Vap to address challenges in vaporizing solid materials for ALD processes. Customers using conventional solid vaporization techniques reported problems with film uniformity, particles and process consistency. ATMI says that its exclusive tray technology in the ProE-Vap provides more solid precursor surface area and greater heat uniformity to enhance vaporization and process stability. By delivering a higher flux of materials, the system opens the door to the use of new classes of chemistries, the firm adds.

The system can also improve uniformity from wafer to wafer and extend ampoule lifetime, yielding process efficiency gains and cost of ownership reductions, ATMI reckons.

The partnership will see both ATMI and SAFC Hitech offer ProE-Vap to the mainstream semiconductor sector. SAFC will also make ProE-Vap technology available to the compound semiconductor market — which ATMI has not previously targeted — which could lead to new opportunities and uses. SAFC Hitech supplies specialty gases and metal-organics to the compound semiconductor market, including TMG, TMI, TEG, DEZ and other materials.

"ProE-Vap represents a proven, efficient way of delivering solid material in semiconductor applications," says SAFC Hitech president Barry Leese. "ProE-Vap technology may better enable the delivery and efficient use of compound semiconductor solid metal-organics, leading to better products and potential breakthroughs in the utilization of these materials in the LED marketplace."

Analyst firm Yole Développement forecasts that the materials segment of the compound semiconductor market is expected to grow from $800m in 2007 to more than $1bn by the end of 2010, driven by strong demand in the LED, solid-state lighting, optoelectronics and solar segments.

**www.safchitech.com**
**www.atmi.com**

# SAFC Hitech updates product roadmap for MOCVD & ALD materials

At SEMICON West, SAFC Hitech detailed its new materials roadmap for MOCVD and ALD processes on silicon substrates, outlining the development paths across memory and logic devices (including barrier layers, interconnects, dielectrics and metals) that it expects to see up to 2014.

SAFC Hitech last reviewed its semiconductor materials roadmap in mid-2007, but regular monitoring is needed to ascertain if the market has evolved as expected. "Numerous variables can affect the selection, timing of insertion point and volume demand for electronic materials," says Dr Geoff Irvine, VP of business development. "SAFC Hitech routinely analyzes external guidelines such as the ITRS roadmap [the International Technology Roadmap for Semiconductors], trends in device development and economic conditions, and performs evaluations of our own R&D programs, allied to what we are seeing in our partnerships with customers," he adds. "Through assessment, for example, if there are certain materials that have been adopted more rapidly than anticipated or adapted for an alternative application and, conversely, if there are some that may have seen a delay or reconsideration in use, our review process enables us to recast the materials requirements of the semiconductor industry and revise our roadmap accordingly."

The pace and breadth of new materials exploration and adoption beyond traditional materials still found in high-volume applications (e.g. silicon dioxide dielectric) is occurring at a rate not seen before in the industry: "Historically, the lifecycle of materials for semiconductors on a per unit process basis extended across multiple technology nodes," says Irvine.

"What we are experiencing now is a shortening of the lifespan of materials used across node generations as progress in the development of next-generation devices demands integration of new materials to meet performance criteria," Irvine adds. "The rapid adoption of materials such as aluminum, hafnium and zirconium oxides, and mixed silicates, in production processes for both memory and logic applications, is one such example."

# Tegal's revenue falls further, but orders and losses rebound

For its fiscal first-quarter 2010 (to end June 2009), Tegal Corp of Petaluma, CA, USA, which makes plasma etch and deposition equipment for fabricating MEMS, power ICs and optoelectronic devices, has reported revenues of $1.1m, down 42% on $1.9m last quarter and down on $4.7m a year ago. "Revenues during these past few quarters have been at their lowest level in many years, symptomatic of the condition of capital spending in our industry," says president & CEO Thomas Mika.

Gross margin has fallen further, from 49.2% a year ago and 26.3% last quarter to 8.6%, due mainly to unabsorbed overhead. However, though still up on $0.8m a year ago, net loss has been cut from $3.2m last quarter to $2.6m. During the quarter, cash reserves fell by $2m to $10.5m.

"We are beginning to see a light at the end of the tunnel, with an increase in both our systems backlog [which rose from $1.5m to $5.4m during the quarter] and an uptick in spares and service revenues," says Mika. "With additional cuts in expense levels [from $3.3m a year ago to $3.1m], and an increase in shipments, we expect to reduce our quarterly cash burn. Doing so will allow us ample time to consider our best strategic alternatives moving forward [which Tegal has previously said include the potential sale of the company as a going concern], which we continue to do with the assistance of Cowen and Company LLC."

**We are beginning to see a light at the end of the tunnel**

www.Tegal.com

IN BRIEF

## Tyndall's plasma ALD

To enhance its atomic layer deposition (ALD) research capabilities, Tyndall National Institute in Cork, Ireland has bought a Fiji Plasma ALD system from Harvard spin-off Cambridge NanoTech Inc.

"The Tyndall Institute is the largest micro/nano-electronics, photonics and microsystems research institute in Ireland," says the firm's European sales director Jeremy Davis. The Fiji system complements its materials research efforts to support the introduction of new materials into its device fabrication process.

"The dual chamber system provides excellent process versatility, more functionality, and fits in a very small footprint," says Tyndall process engineer Alan Blake.

www.cambridgenanotech.com
www.tyndall.ie

IN BRIEF

## k-Space integrates blackbody temperature monitoring into BandiT

k-Space Associates Inc of Dexter, MI, USA says it has developed its kSA BandiT product line with new technology. In addition to the existing band-edge based temperature capability, it can now simultaneously determine surface temperature directly from a sample's blackbody emission. This new, patent-pending approach collects sample radiation across a broad spectral range and fits this curve to Planck's equation in real-time.

"Having blackbody capability integrated within kSA BandiT now removes any past limitations on temperature monitoring with a band-edge only approach," says VP & general manager Darryl Barlett. "The two techniques are quite complementary."

kSA BandiT is not affected by changing viewport coating, stray IR light sources, reactor maintenance or system emissivity changes, adds the firm.

In addition to temperature monitoring, the latest kSA BandiT system also includes capabilities for monitoring sample thickness, growth rate, surface roughness, and optical band gap properties. Integration of other kSA product technology such as kSA MOS 2D thin-film stress is now possible with advanced optical hardware solutions for almost any deposition chamber.

The firm says that its next-generation kSA BandiT has already been selected by many MBE and MOCVD facilities worldwide. Configurations are available for all commercial MBE, MOCVD, and custom deposition systems.

www.k-space.com

# OIPT boosts HB-LED etch system from 20 to 27 two-inch GaN wafers

UK-based etch and deposition equipment maker Oxford Instruments Plasma Technology (OIPT) says that it has developed an evolution of its System133 RIE-ICP380 reactive ion etch inductively coupled plasma tool.

The new technology is an active spacer that improves the uniformity of the plasma across the electrode, boosting etch results both within wafer and cross-batch. A key benefit is that it allows an increase in batch size from 20 x 2" GaN wafers to 27 x 2" or 7 x 4" GaN wafers or 18 x 2" sapphire wafers, says the firm.

"OIPT's new spacer offers uniformity tuning at will, which simplifies the process," says principal applications engineer Dr Mark Dineen. "This allows enhanced process performance and higher throughput, which is essential for our production customers." The spacer is also retrofittable to systems in the field.

OIPT's proven System 133 process module is built on a 300mm platform, with multi-batch capability, and with processes guaranteed to ensure rapid start up during installation. The system can be clustered to combine technologies and processes, offering maximum flexibility, the firm says. With an installed base of over 2000 tools worldwide, OIPT tools have over 90% uptime, claims the firm.

www.oxford-instruments.com

## LED maker Bridgelux places order for OIPT's PECVD and etch tools

OIPT has received an order from Bridgelux Inc of Sunnyvale, CA, USA for a System800 Plus Batch PECVD and a System133 ICP 380 Batch Etch tool. Bridgelux manufactures LED chips and arrays.

"We have been using OIPT etch and deposition tools for some time, and have successfully established our fabrication processes using these systems," says Dr Frank Hu, Bridgelux director of Fab Operations. "Bridgelux is focused on enabling mass adoption of LED-based solid-state lighting by reducing the cost of light in the general lighting market. Oxford Instruments has proven to be a reliable partner, delivering process performance and a high degree of flexibility with low cost of ownership to help us deliver a quality product with the high performance levels demanded by our customers."

**System800 Plus Batch PECVD tool.**

"At OIPT we are constantly working to progress and to be involved in the latest technologies and applications, and are delighted to have received this important order from Bridgelux and to be instrumental in their future success", adds Stuart Mitchell, VP sales for OIPT USA.

www.bridgelux.com

# Aviza agrees sale to Sumitomo's SPS

After signing a non-binding letter of intent in May, etch and deposition equipment maker Aviza Technology Inc and its subsidiaries Aviza Inc and Trikon Technologies Inc have entered into a definitive agreement to sell certain assets to Japan's Sumitomo Precision Products Co Ltd (SPP).

These include substantially all assets related to its system, service, parts, spares and upgrade businesses for atmospheric-pressure chemical vapor deposition (APCVD), physical vapor deposition (PVD), chemical vapor deposition (CVD), plasma etch, and batch thermal products and technologies, as well as its service, parts, spares and upgrade business for atomic layer deposition (ALD) products and technologies.

Aviza's headquarters and batch systems manufacturing facilities in Scotts Valley, CA, USA — as well as the property on which they are located — are not included in the asset sale.

However, SPP, which is the parent company of plasma etch and deposition equipment maker Surface Technology Systems plc (STS) of Newport, Wales, UK, has agreed to assume certain liabilities of Aviza and its subsidiaries, including the lease for Aviza's facility in Newport, Wales and about $5m of operating liabilities.

In exchange for the above assets, SPP has agreed to pay Aviza about $15m in cash at closing (subject to certain adjustments), plus about $41.5m worth of promissory notes, comprising;

- a recourse promissory note with an aggregate principal amount of $10m that will bear interest at the prime rate, will mature 18 months after the closing date, will be secured by the purchased accounts receivable and inventory and certain purchased intellectual property, will be subject to mandatory monthly prepayments of principal to the extent that SPP's collection of accounts receivable and sales of inventory securing the note (subject to certain adjustments) exceed $10m, and will be guaranteed by SPP; and
- a non-recourse promissory note with an aggregate principal amount that will be finalized after the closing date but which Aviza currently expects to be about $31.5m that will not bear interest, will mature 18 months after the closing date, will be secured by the purchased accounts receivable and inventory, and will be subject to mandatory monthly prepayments of principal to the extent that SPP's collection of accounts receivable and sales of inventory securing the note (as adjusted) exceed $20m. On the maturity date, SPP will have the option of either repaying the outstanding principal amount of the non-recourse note in full or returning any remaining uncollected accounts receivable and unsold inventory to Aviza.

Aviza's board of directors has unanimously approved the agreement and the transactions (which are subject to approval by the US Bankruptcy Court and other customary closing conditions).

On 20 May United Commercial Bank sent Aviza a demand to pay an outstanding debt of about $29.5m. Aviza was in default of an April 2007 loan and security agreement that had already been amended twice last September/October.

Subsequently, on 9 June, Aviza Technology Inc and its subsidiaries Aviza Inc and Trikon Technologies Inc filed a voluntary petition under Chapter 11 of the US Bankruptcy Code.

Aviza expects that the proceeds of the sale will be used to repay the lenders under its secured credit facility and its unsecured creditors. However, the firm does not expect to be able to pay its unsecured creditors in full, so it does not believe that holders of its common stock will receive any proceeds from the transactions.

www.aviza.com
www.stsystems.com

IN BRIEF

## UV laser for high-throughput sapphire scribing

Coherent Inc of Santa Clara, CA, USA has launched a new frequency-tripled, diode-pumped, solid-state laser for cost-sensitive micromachining tasks such as scribing sapphire substrates used in the fabrication of gallium nitride (GaN) LEDs. The AVIA 355-5 is a Q-switched Nd:YVO4 laser that delivers 5W of 355nm-wavelength output at 50kHz, and is suitable for operation at repetition rates of up to 150kHz. Its combination of high repetition rate and short pulse length (<20ns at 5W) enables high-throughput processing with minimal heat affected zone (HAZ), says the firm.

The 355-5 is a cost-effective, compact, OEM (original equipment manufacturer) product that still offers many of the same features found on Coherent's more powerful AVIA model: ThermEQ, PulseEQ, and PulseTrack enable precise control of the delivered pulse energy, allowing the OEM to define and optimize its laser process. The laser also has an automated harmonic crystal shifter to maintain constant output power for >20,000 hours and help reduce the cost of ownership. In addition, its unique Posilock beam position sensor and feedback loop results in very high beam position stability over the life of the laser.

The AVIA 355-5 has been designed for easy integration with a laser head measuring just 491mm x 216mm x 141mm. Coherent says that the laser also delivers enhanced reliability and ease of maintenance through the use of a highly efficient single pump diode module that is field replaceable.

www.coherent.com

# Micropelt unveils 90%-efficient TECs

Micropelt GmbH of Freiburg, Germany, a 2006 spin-off from collaborative research between Infineon Technologies and Fraunhofer Institute IPM Freiburg that manufactures thin-film thermoelectric elements, has made available samples of the MPC-D40x series, a new generation of thermoelectric coolers (TECs).

Micropelt's proprietary scalable micro-electro-mechanical systems (MEMS) micro-structuring platform technology yields TECs with an electrical resistance of more than 30Ω on a single square millimeter footprint which, in combination with its controller system, can be driven at an efficiency of 90% and better. The firm says this new approach can impact the system architecture of applications using small TECs, including those where cooling is omitted due to system cost and power dissipation (e.g. cooling of lower-power laser diodes and other active or passive devices in the telecoms, photonics, optoelectronics and sensors markets).

The MPC-D403/404 TECs are fabricated using semiconductor manufacturing processes that yield what are claimed to be the world's smallest micro-coolers. Feature sizes of 45μm can accommodate 50 thermocouples per square mm (about ten times more than bulk Peltier technology can offer). "Our micro-structuring technology is able to scale to application-specific dimensions, electrical requirements and thermal properties," says chief technology officer Joachim Nurnus. "We measure drive currents 10 times smaller than those known for similar bulk TECs whose few thermocouples create an electrical resistance much below 1Ω and hence a drive current well above 1A."

The MPC-D40x series can pump over 600mW with a drive current of 200mA, as required for thermal management of low-power edge-emitting lasers or vertical-cavity surface-emitting lasers (VCSELs). At low drive currents the TEC's power efficiency increases. The design of the control circuitry can also be simpler, which translates to reductions in the bill-of-materials and circuit-board footprint.

"Everyone wants their transceiver modules to be smaller and more energy efficient," says Wladimir Punt, VP sales & marketing (who was recruited in June, and has previously worked at NXP, Microtune Holland, and Micronas). "We analyzed the thermoelectric system architecture and concluded that for very small TECs the drive current is key to solving the prevailing power consumption and heat dissipation issues," he adds. "Cutting the drive current by 90% can improve the overall cooling system efficiency by 50%, because the drive voltage remains at a level where buck regulators can provide good efficiencies. This will help photonic packaging and system designers to develop components consuming less energy, producing less heat, and fitting into smaller packages."

Micropelt says that its wafer-based production technology brings economies-of-scale to the high-volume manufacture of TECs. The TEC control system not only benefits from standard, inexpensive, readily available, and ultra-small TEC control circuit components, but its overall power efficiency results in greatly reduced power consumption and heat dissipation on densely packed line cards, it is claimed. Micropelt's micro-cooler suits use with products not normally exposed to active cooling, but which would benefit from higher performance, tighter specifications, and further miniaturization.

The firm says that standard products from its pilot-production plant are being evaluated by and incorporated into the products of more than 40 customers. A large-scale production facility currently under construction in Halle, Sachsen-Anhalt, Germany will raise capacity to 10 million devices per year by mid-2010.

www.micropelt.com

# Nanometrics launches system for PV thin-film thickness control

Nanometrics Inc of Milpitas, CA, USA, a supplier of process control metrology systems primarily for manufacturing semiconductors, solar photovoltaics and high-brightness LEDs, has launched its Trajectory Solar Monitor (TSM) integrated metrology system.

The latest in the Trajectory product line, the TSM is designed to rapidly measure the thickness of thin films to enable fast feedback and excursion prevention in the manufacture of all types of photovoltaic (PV) cells.

"Every solar PV cell manufacturing line has unique process control challenges due to the engineered films that are deposited," says Tom Ryan, director of the firm's Materials Characterization business unit. "The launch of the TSM system expands our addressable market into the textured and rough films segment of the solar PV industry," he adds. "The TSM is optimized for film measurement on high-throughput processes, enabling control on textured crystalline silicon cells, complex multi-junction thin-film silicon cells, and high-roughness CIGS (copper indium gallium (di)selenide) and cadmium telluride (CdTe) films."

Leveraging Nanometrics' experience in integrated process control solutions, the TSM enables direct integration in solar cell manufacturing lines to enable process control of critical layers, the firm says. The Trajectory system has been optimized to provide robust and precise metrology on complex thin-film solar materials, and can be incorporated for measuring in both atmospheric and vacuum systems. Its rapid measurement time can keep pace with any type of cell manufacturing line, enabling measurement of 100% of the products at many points throughout the flow, including junction, buffer and absorber layers, anti-reflective coatings, and transparent conducting oxides (TCO), says the firm.

www.nanometrics.com

# Bentham launches PV device and material characterization system

In response to what is described as growing demand for an integrated solution for PV device and material characterization, light-measurement equipment maker Bentham Instruments Ltd of Reading, UK has developed the PVE300 system, which provides direct determination of device spectral response (SR, A $W^{-1}$), external quantum efficiency (EQE/IPCE, %) and internal quantum efficiency (IQE, %).

The system consists of a light-tight measurement chamber, chopped monochromatic probe, dual-source input, one or two variable intensity bias sources, lock-in detection electronics and temperature-controlled vacuum mount. The system can be used with substrate, superstrate and packaged devices.

**Bentham's new PVE300 system.**

The PVE300 is modular and can be configured to cover both desired the spectral range (from 250–2500nm) and device type.

The new system will be showcased at the 24th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) in Hamburg, Germany (21–25 September).

www.bentham.co.uk

# Orders received for HB-LED metrology

Nanometrics has received orders for one VerteX and multiple RPMBlue photoluminescence (PL) mapping metrology systems. The VerteX system is expected to be qualified into a new HB-LED development line, and the RPMBlue systems are expected to be qualified into the high-volume manufacturing line of a different customer. All systems are expected to be qualified in the third-quarter 2009.

"Customers are leveraging the increased capability of the VerteX system to address challenges in the rapidly-growing HB-LED market," says Tom Ryan, director of the Materials Characterization business unit. "New end-device deployments in area lighting, LCD back-lighting and an increased understanding of the performance and cost-of-ownership benefits of high-brightness LEDs are driving HB-LED development." he adds. "Our PL mapping products are well-positioned to support increased development and rapid production ramps as new high-brightness LED manufacturing technologies come online."

The VerteX PL mapping system provides a combination of metrology technologies to support both process development and production control. It can support epilayer metrology on many substrate types and sizes and, due to the illumination system options, can cover the entire spectrum of LED technologies from UV-LEDs through the visible colors to infra-red.

The RPMBlue is Nanometrics' newest product for HB-LED process control, and is targeted at production control of gallium nitride-based blue HB-LEDs, which are increasingly used in LCD back-lighting. The system has been optimized for throughput of up to 80 two-inch GaN wafers per hour.

Nanometrics believes its PL mapping systems are used by over 90% of the top-tier HB-LED manufacturers in development and production.

IN BRIEF

## Kyma announces staffing changes

Kyma Technologies Inc of Raleigh, NC, USA, which provides crystalline gallium nitride (GaN) and aluminum nitride (AlN) materials and related products and services, has recently made several key staffing changes as it heads into its third consecutive year of growth and profitability.

Recent additions include:

- Anthony Graham (wafering specialist);
- Ron Jacobs (safety officer & crystal growth specialist);
- Doug Kipp (wafering manager);
- Greg Mulholland (director of engineering);
- Dr Bob Metzger (chief engineer);
- Dr Tanya Paskova (chief scientist);
- Ms Tamara Stephenson (technical sales & crystal growth engineer); and
- Kevin Udwary (senior production engineer).

Former chief technology officer Dr Drew Hanser left Kyma earlier this year.

"Our current year commercial revenues have already surpassed our 2008 numbers, and our government support is also at a record level," says Dr Edward Preble, chief operating officer & VP of finance. The market for nitride semiconductor devices is expected to surpass $9bn by 2010, and the combined addressable market for GaN and AlN substrates is expected to surpass $500m by 2010. However, the sector requires constant attention to a multitude of threats and opportunities, comments president & CEO Keith Evans.

The firm expects to add several more new hires later this year, and in 2010 as it aims to add several new products to its portfolio and to expand its capacity for several existing products.

www.kymatech.com

# Rubicon banks on LED displays boom to push larger wafers

In the second quarter of 2009, Rubicon Technology Inc of Franklin Park, IL, USA, which makes sapphire substrates and products for the LED, RFIC, semiconductor and optical industries, increased sales to LED-manufacturing customers as demand for applications in notebook, netbook and TV backlights filtered through the supply chain.

That demand pushed Rubicon's total sales to $3.2m for the period, up from $2.3m in first-quarter 2009, but still a huge decrease on the $11.5m in sales that it posted in the second quarter last year. The weak sales and pricing environment resulted in a net loss of $2.9m, compared with the $2.2m profit Rubicon made this time last year.

Much of that decline results from much lower sales of large-diameter sapphire to Peregrine Semiconductor for RFIC applications, while sales of smaller material to LED makers have improved in recent months.

CEO Raja Parvez attributed that strengthening demand to the proliferation of LED backlights in large-area displays. "There has been a rush to deploy LED-lit TVs," he said.

The problem for Rubicon is that the customers who need more sapphire substrates right now are largely based in Taiwan, where LED backlights are manufactured mainly, and where 2-inch wafer production is still used almost exclusively.

Because many suppliers can produce sapphire material at this size, Rubicon's expertise in larger wafers does not present any competitive advantage.

Illustrating this point, 2-inch material represented 76% of Rubicon's sales to the LED market in the latest quarter, with only 24% attributed to larger wafers. In the immediately prior quarter, 80% of LED-related sales were generated by the larger sizes.

But Parvez is confident that demand for 4-inch and even 6-inch material will pick up over the next 12–18 months. "Several LED manufacturers are investing in 4-inch wafer capacity," he said.

Echoing suggestions from MOCVD equipment maker Veeco Instruments of a recent pick-up in demand, Parvez predicted that the final quarter of 2009 would see improving sales of 4-inch sapphire material.

**LED makers are now beginning initial qualification of 6-inch wafers... one customer has begun early-stage development of an 8-inch process**

The CEO added that some of the leading LED makers are now beginning initial qualification of 6-inch wafers, and that one customer has begun early-stage development of an 8-inch process.

"We expect to see production orders for 6-inch sapphire to begin in late 2010, going into 2011," Parvez explained. "In the last 18 months, companies have progressed significantly."

If the difficulties associated with uniform epiwafer production at those larger diameters can be ironed out by then, Parvez believes that Rubicon's 'ES2' crystal manufacturing process will result in a significant competitive advantage over rivals using the more traditional vertical-gradient freeze (VGF) and Czochralski techniques.

"To get respectable yields and throughput [with 6-inch production], you need ES2," he said. The technological barrier with the other techniques is significant."

But until production-level demand for that larger material emerges, Rubicon will remain under competitive pricing pressure. For the third quarter, it expects revenues to increase to $4.5m, with an accompanying net loss of $2.5m.

www.rubicon-es2.com

*By Michael Hatcher*


# Flawless, The Ultimate Sharpness, Tecdia Scribers

## TECDIA's Scribing Tool Selection

**TD-3YGP**
For sapphire, GaN or SiC wafers

**TD-3P**
Mostly for InP wafers

**TD-4PB**
Toe-cut type, used mostly for silicon wafers

**TD-420**
Heel-cut type, used primarily for GaAs or glass wafers

**TD-4L**
Mostly for silicon, GaAs, or glass wafers

**TD-2P**
Custom made, for semiconductor wafers or thin film photovoltaic modules

**TD-8P**
Custom made, for R&D use (both toe and heel cut types)

**TD-8D**
Mostly for silicon, GaAs, or glass wafers

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TECDIA

WWW.TECDIA.COM

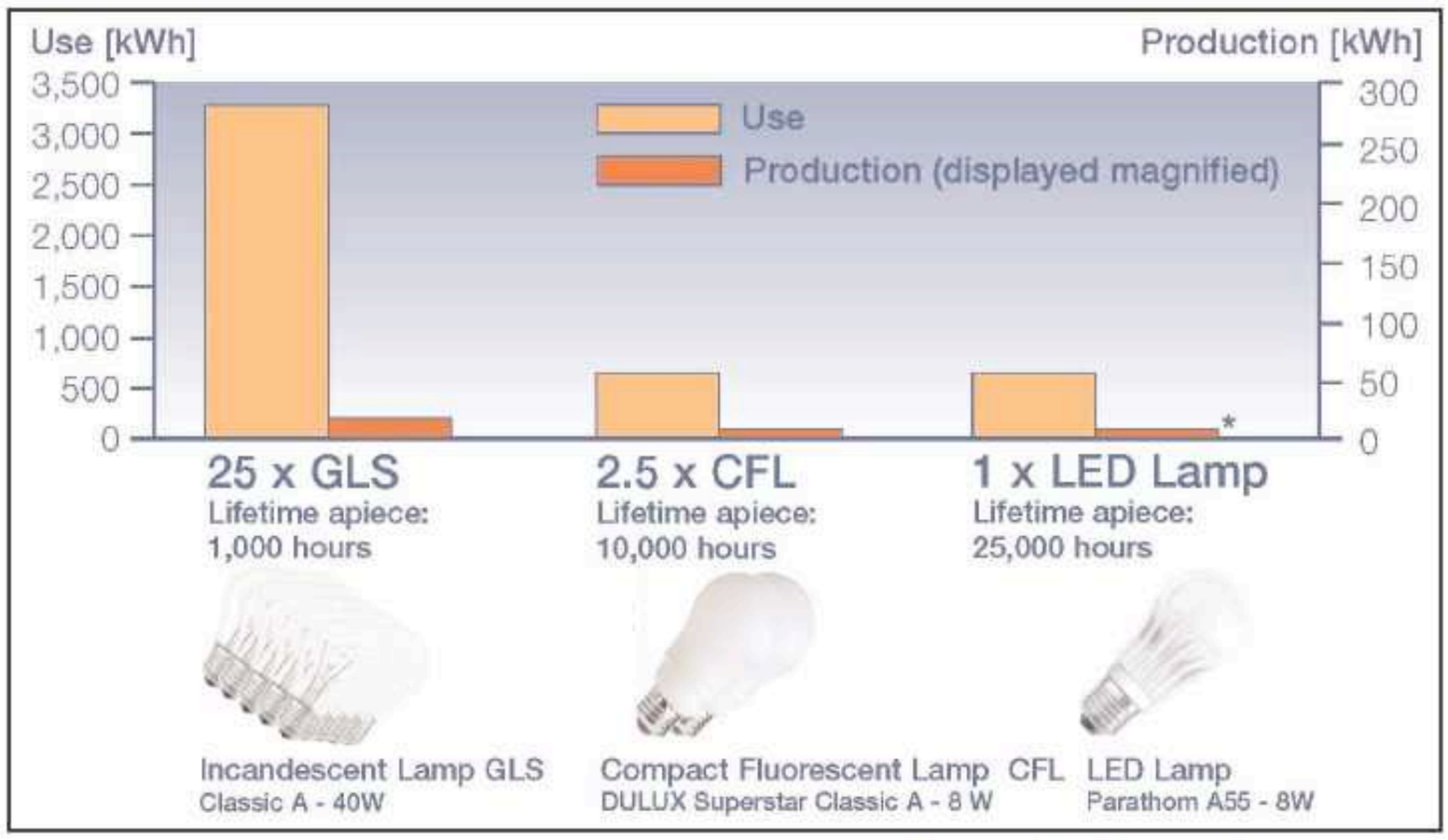
# Life-cycle assessment shows LED lamps equal to CFLs

LED maker Osram Opto Semiconductors GmbH of Regensburg, Germany says that it has conducted a life-cycle assessment (LCA) — involving studying energy and raw materials consumption in terms of production, use and disposal, and the environmental impact involved in processing — which shows that the latest generation of LED lamps achieves a very high score for environmental friendliness, with LCA values equal to compact fluorescent lights (CFLs) and far superior to conventional incandescent lamps.

The firm says that, in order to evaluate lamps and how they actually deal with energy and resources, it is not enough just to consider energy consumption while they are in use. The aim of the LCA is therefore to analyse the environmental impact of an LED lamp over its entire life. The relevant material and energy supplies were determined in detail for all the lamp's components and production processes. As well as a detailed analysis of each individual production stage (e.g. for LED chips and lamp housings), this also includes all necessary transport, such as from the lamp's production site in China to installation in Europe.

Apart from the direct input of raw materials, the energy input, materials and emissions associated with the retrieval of resources are recorded. The results allow conclusions not only on resource consumption and primary energy input but also acidification, eutrophication, the greenhouse effect, ozone depletion and toxicity.

In the first LCA, Osram Opto says that it has shown that LED lamps are a genuine alternative to incandescent lamps, even when considering the cumulative energy input and environmental factors. Often these fundamentally different lamps are compared on the basis of their wattage. Conventional lamps with filaments are well behind diode lamps: a 40W incandescent lamp can either be replaced by an 8W CFL or, for some applications, by an 8W LED lamp (giving an energy saving of 80%).




**Comparison of primary energy in kWh over a lifetime of 25,000hr for incandescent lamps (GLS), compact fluorescent lamps (CFL) and LED lamps.**
*** For LED lamps, less than 2% of total energy demand is used for manufacturing.**

In order to guarantee the comparability of results in the LCA, a lifetime of 25,000 hours was chosen as reference. The latest generation of LED lamp (Parathom Classic A55 with Golden Dragon Plus LED) achieves precisely this rating. Therefore, 25 incandescent lamps (Osram Classic A 40W) with a lifetime of 1000 hours and 2.5 fluorescent lamps (Dulux Superstar Classic A 8W) lasting 10,000 hours have to be used for a comparison.

**Parathom Classic A55 lampshave a lifetime of 25,000 hour (equal to 25 incandescent lamps).**

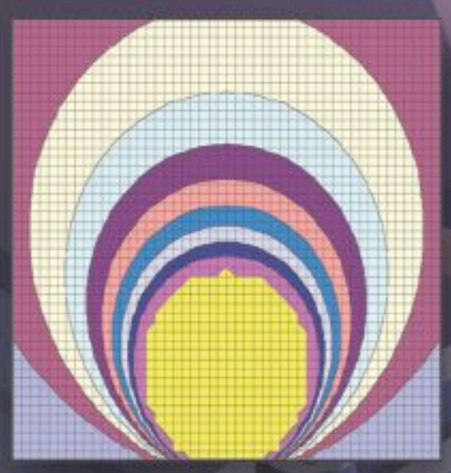
The study was performed in collaboration with experts at Siemens Corporate Technology, Centre for Eco Innovations. It shows that — similar to CFLs — with LED-based lamps over 98% of the energy used is consumed to generate light. Less than 2% is allocated to production. Osram Opto says that this dismisses any concerns that manufacturing LEDs might be very energy intensive.

Also, in contrast to the primary energy consumption of incandescent lamps of about 3300kWh, LED lamps use less than 700kWh and are therefore more efficient than conventional incandescent lamps. Apart from this, the ratings that indicate the lamps' effects on the environment are consistently better than those for incandescent lamps. Osram Opto reckons that, as LED efficiency continues to increase, LED lamps can achieve even better LCA results in future.

Three independent experts are currently verifying the findings of the internal study. A summary will be available in October.

www.osram-os.com/

# No Guesswork...



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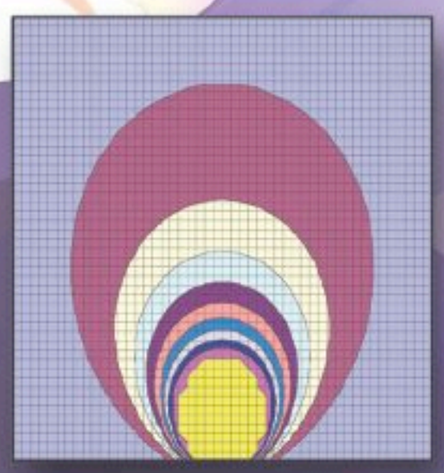

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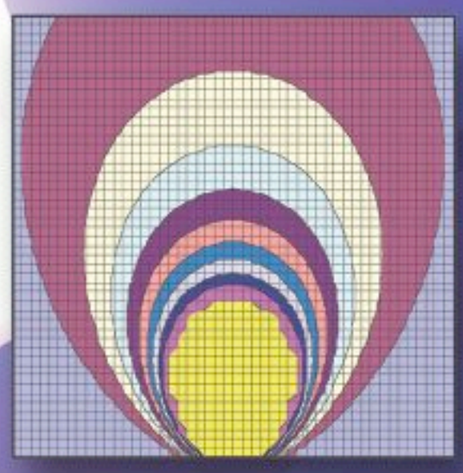

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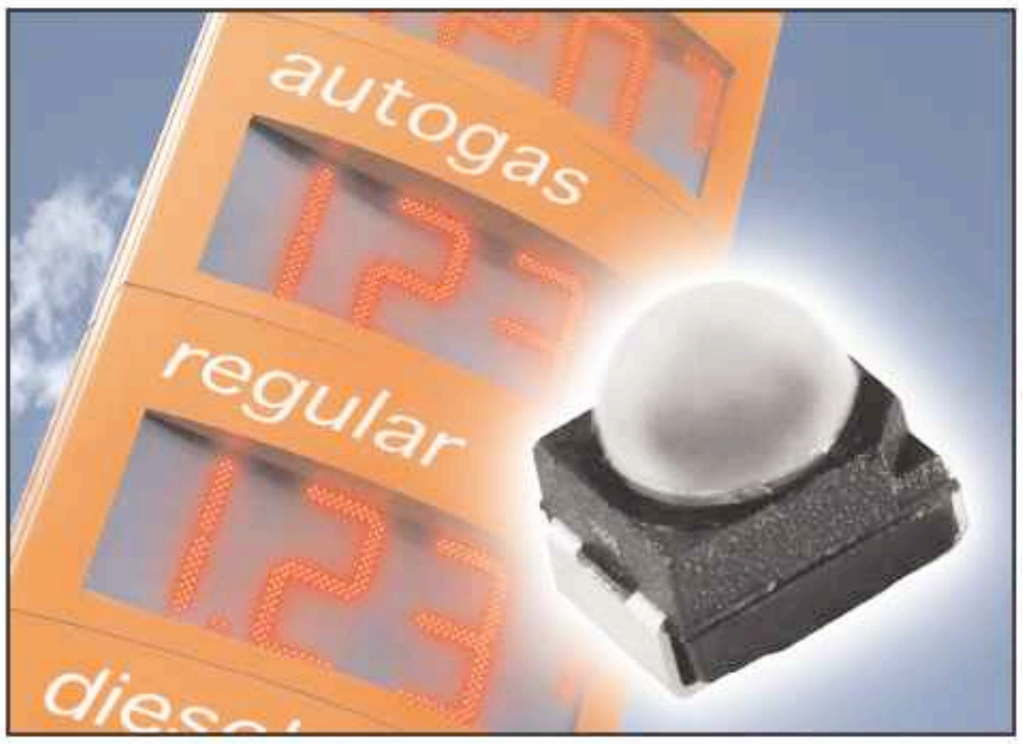
# Osram launches TopLED Black Series medium-power LED in black package for display applications

Osram Opto Semiconductors GmbH of Regensburg, Germany says that its new TopLED Black Series with lens is a range of medium-power LEDs mounted in a matte black, industry standard package. According to the firm, the black package offers higher contrast with lower reflectivity than comparable white-package devices without compromising overall luminous intensity, making the series ideal for display applications where contrast is key for legibility.



**Osram's new TopLED Black Series.**

The TopLED Black is the first TopLED in a black package that can achieve a typical luminous intensity of 1.9cd (at 20mA) and is to date the only LED in a black package that provides the same luminous intensity as a comparable LED in a white package, adds the firm. Applications include information displays for traffic and public transportation systems and price changing displays, such as fuel price totem pole signs.

The 60° beam angle of the new LED has been optimized for display applications, so the light is focused for excellent distance legibility.

Initially available in red and yellow, the TopLED Black Series will be equipped with a thin-film chip that the firm says guarantees high luminous efficiency. As "surface emitters", thin-film LEDs emit almost all their internally generated light from their surface.

The new LEDs are SMT components suitable for automatic handling, and they provide high placement tolerances for highly uniform light dispersion.

**The black package offers higher contrast with lower reflectivity than comparable white-package devices**

The new TopLED Black Series displays price information so clearly that even from a distance, while driving at high speed and with the sun shining directly on the numbers, drivers can see whether it is worth stopping to fill up.

www.osram-os.com

# Lensed 3mm x 3mm OSLON SX LED launched for industrial signage, warning lights and tail-lights

After launching the 1W-class ultra-white OSLON SSL LED for solid-state lighting applications in May, Osram Opto Semiconductors GmbH of Regensburg, Germany has added to its OSLON family by launching the OSLON SX (available in red, green, blue, yellow or white), providing what is claimed to be a quick, simple and reliable lighting solution for industrial signage, warning lights or tail-lights.

The small bright SX has been developed specifically for signal lamps, providing sufficient light to read by. Even reading lights in vehicles can benefit from the LED's properties, says the firm. Fitted in vehicle reading lights, the OSLON SX provides bright light without disturbing the driver or other passengers.


**Warning lights fitted with Osram's new OSLON SX LED.**

Like the other members of the OSLON family, the SX is housed in a compact 3mm x 3mm package. With an optical efficiency of typically 73lm/W for cool white, it belongs in the 0.5W class and lasts at least 50,000 hours.

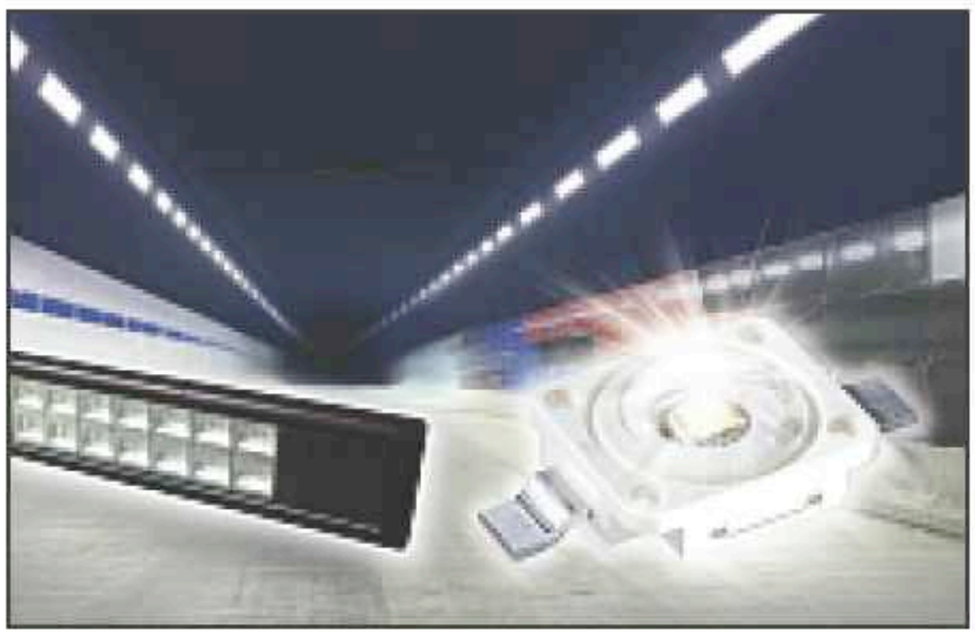
An integrated silicon lens guarantees the correct beam angle, says Osram Opto. At 60° the focused beam suits signal and warning lamps.

The long lifetime means that it can easily handle working day in, day out on long-term motorway construction sites, for example, and still have the capacity to keep on working long afterwards.

The connections for all OSLON versions are the same, so they can be easily exchanged for one another as required.

# China's Yangzi River tunnel lit by Osram LEDs

Osram Opto Semiconductors GmbH of Regensburg, Germany says that its Golden DRAGON Plus LEDs are being used by Guangzhou ZhongLong Communications Technology Co Ltd of Guangdong Foshan, China for the Yangzi River tunnel luminaire project in mainland China, making it the longest tunnel in the world to be lit by LEDs. With an internal diameter of 12.7m, the tunnel is 8.9km long in a twin-tunnel complex, and each bore contains three lanes of traffic.



**ZhongLong's tunnel lamps, incorporating Osram Golden DRAGON Plus LEDs.**

The two bores will be equipped with 5886 tunnel luminaries incorporating more than 410,000 Osram Golden DRAGON Plus LEDs.

The project marks a new era of LED luminaries being used widely for tunnel lighting in China, says Bin Chen, president of Guangzhou ZhongLong Communications Technology, which was founded in 2004 to manufacture highway lighting. With 40–50% of total energy consumption in the tunnel due to illumination, it is expected that the average annual energy savings from the LED-based tunnel lamps is over 35%.

**The project marks a new era of LED luminaries being used widely for tunnel lighting in China**

With pressure from the rising price and short supply of energy, the Chinese government has begun instructing local governments to comply with energy-saving policies in all infrastructure development, with LEDs for road/tunnel lighting becoming one of the main focuses.

"We are proud to help move forward the energy-efficiency initiatives in China by providing LED technologies to our business partners," says Dr Alfred Felder, president & CEO of Osram Opto Semiconductors Asia Ltd. "Our cooperation with Guangzhou ZhongLong is a vital landmark for high-performance LEDs as a tunnel lamp light source in China," he adds.

www.osram-os.com

# Osram LEDs used in street-lighting project in Fürth

A total of six lamps incorporating LED technology from Osram Opto Semiconductors GmbH of Regensburg, Germany are being used to demonstrate street lighting in Fürth near Nuremberg, Germany. The city's traffic and energy supply company infra fürth GmbH, luminaire manufacturer Schréder and lighting manufacturer Osram have set up an LED test unit on the road to the airport north of the town to provide information about LED performance in street lighting. The results of the practical test will help to determine whether more LED luminaires will be used in the town.

Schréder has designed and constructed for infra fürth six LED lamps of P186 type, in which Osram LEDs have been fitted. A total of 96 Osram Golden Dragon Plus LEDs with an output of 1.2W each are shared between two lamp sections. These have been mounted at a light spot height of 8m.

**At night brilliant white light illuminates the airport road in Fürth.**

Even though the light yield in the test luminaires of about 75 lumens per watt corresponds to that of a conventional street light, it appears to be much brighter. Because of the directional characteristics of the LEDs (which emit light through lenses), there is less stray light than with discharge lamps. In addition, their white light is perceived to be far more luminous than normal street lights.

**Results of the practical test will help to determine whether more LED luminaires will be used**

The test facility is intended to provide information about how suitable the LED technology is for practical use in urban areas. The systems' temperature and efficiency readings are under constant observation.

infra fürth expects to gain experience from the project of the ability to use the technology in future as well as knowledge about operational procedures and the energy and operating costs of LED luminaires. "The findings we obtain from this will certainly help us decide on further possible applications," says Elmar Eckl, who is in charge of street lighting at infra fürth. "We also would like to share our experiences with the city of Fürth and other local authorities."

www.infra-fuerth.de

# Cree grows 15% to record annual revenue of $567m

For its fiscal 2009 (ended 28 June), LED chip, lamp and lighting fixture maker Cree Inc of Durham, NC, USA has reported record revenue of $567.3m (up 15% on fiscal 2008's $493.3m). The two greater-than-10% customers were Seoul Semiconductor (13%) and Arrow Electronics (11%), which has become Cree's largest distributor.

Fiscal Q4 revenue was a record $148.1m, up 9% on $135.9m a year ago and 13% on last quarter's $131.1m. This is also up on the original guidance (given on 21 April) of $136-143m (and at the high end of the revised target of $143–150m). Product revenue was $143.7m (up from $129.4m last quarter) and contract revenue was $4.4m (down from $6.5m).

LED product revenue grew 12% on a year ago and 17% sequentially to $131.3m, driven by higher XLamp and high-brightness LED sales for lighting-related applications, higher LED chip sales due to increased demand in notebook backlighting, and sequential double-digit growth in LED lighting product sales. Non-LED product revenue (power and RF devices) and contract revenue combined was $16.8m, down 12% on a year ago and 9% on last quarter. In particular, contract revenue (which is mostly power and RF related) is down to about $4m (just 2% of total revenue).

"Our strong Q4 results were an outstanding finish to a very good year and reflect the success of our strategy to drive growth in LEDs and LED lighting applications," says chairman & CEO Chuck Swoboda.

On a non-GAAP basis, net income for fiscal year 2009 was $59.2m, up on fiscal 2008's $47.2m. This included a greater-than-expected $16.3m in fiscal Q4 (up from $14.5m last quarter).

Gross margin has risen from last quarter's 34.2% to a better-than-expected 40.3%, taking fiscal 2009 to 38.1%, up from fiscal 2008's 34.2% (and just above the targeted 36–38%). The rise is due to: better cost leverage as a result of higher factory utilization; better-than-planned progress in using 4-inch substrates (the conversion from 3-inch is now more than half through, and should be almost complete by the end of calendar 2009); a more stable pricing environment in LED chips; and improved yield performance in the power and RF product lines (more than offset pricing declines in LED components due to increased competition in lighting applications).

During fiscal 2009, Cree generated $177.9m of operating cash flow (up from $103m in fiscal 2008). Q4 operating cash flow was $43m (down on last quarter's $49.9m) and free cash flow (operating cash flow minus capital expenditure of $14.7m) was $28.3m (down from $40.5m). Cash and investments grew by $42.3m to $447.2m.

Entering fiscal 2010, record order backlog is being driven by increasing demand across Cree's LED product lines. Factories are hence operating near maximum capacity.

Despite perhaps being capacity constrained for some product lines, for its fiscal Q1/2010 (ending 27 September 2009) Cree targets revenue of $160–166m (up 8–12% sequentially), driven by double-digit growth in LED lighting products, LED components for lighting, and LED chips for notebook and TV backlighting. Non-GAAP margin should remain about 40%, as increased volume and improved yields are offset by the continued aggressive pricing environment for LED components.

In contrast, LED chips pricing has stabilized. The rapid adoption of LED backlighting for notebook computers and TVs has changed the market dynamics for small chip-based white LEDs and increased demand for high-end blue LED chips, says Swoboda. This has created near-term supply constraints, extended lead times across the industry, and resulted in a more favorable LED chip pricing environment.

"We are well positioned to benefit from the worldwide growth in LED lighting, which remains our strategic focus," says Swoboda. "As such, we continue to invest in the new products, channels and technical support needed to accelerate the LED lighting revolution," he adds.

**Cree targets increased capital expenditure of $25–30m, mainly for LED component capacity**

The growth in LED demand has shifted Cree's near-term focus to factory execution, which it is addressing through increased capital spending at its factories in both the USA and Asia. For fiscal Q1, Cree targets increased capital expenditure of $25–30m, mainly for LED component capacity increases in China and LED chip capacity in the USA. The firm plans to roughly double LED component capacity over the next year, says Swoboda.

Cree is also targeting slightly higher R&D operating expenses (to accelerate new LED product development) and $3m higher spending in sales & marketing (to staff new global customer service and application centers, as well as higher sales commissions and increased compensation expense).

www.cree.com

# LED City program recruits Gwangju and Fairview

In addition to Fairview in Texas, USA, Gwangju has become the first city in South Korea to join the LED City initiative, an international community of government and industry parties initiated by LED maker Cree Inc of Durham, NC, USA in December 2006 to evaluate, deploy and promote LED lighting for municipal infrastructure. The two cities join existing program members Raleigh, NC, Ann Arbor, MI, Austin, TX, Anchorage, AK and Indian Wells, CA in the USA; Toronto and Welland in Canada; Tianjin in China; and Torraca in Italy.

Gwangju (South Korea's center for the advancement of photonics, and the main city of its Honam region) is home to 180 firms and organizations working on the development and manufacture of optical communication components, light sources including LED technology, and optical precision devices. By focusing on optical communication components and LED industries, the city aims to be among the world's top five photonics clusters by 2010.

Already, in Gwangju, a wide variety of LED light fixtures illuminate the Kimdeajung Convention Center, World Photonics Expo 2009, KEMCO Honam Energy & Climate Change Center, and the Gwangju Metropolitan City underground parking lot. By replacing fixtures from parking indicator lights to streetlights, the city calculates that the LED lights should use about 30% less energy than existing fluorescent lamps, which could save the city up to 234,000kWh and reduce carbon emissions by as much as 8465kg annually, it is reckoned.

Gwangju will highlight its LED lighting installations and participation in the LED City program when it hosts the World Photonics Expo from 9 October to 5 November.

"A tremendous amount of investment and effort has been put toward various photonics industry technologies locally, and we are proud to demonstrate the energy and maintenance cost savings that can be gained with LED lighting," says mayor Park Kwang-Tae. "Through our participation in the LED City program we hope to help other cities throughout the world adopt LED lighting and to draw attention to the high-quality LED lighting products produced here in South Korea," he adds.

**Gwangju's Kimdeajung Convention Center.**

"For the last eight years, we have worked to develop the highest-quality LED lights," says Dr Eun-Young Yu, president of the Korea Photonics Technology Institute. "Our goal is to bring this highly energy-efficient and low-maintenance technology to neighborhoods, offices, schools and public places throughout South Korea."

In Fairview, TX, USA, the newly constructed, four-lane Fairview Parkway — designed specifically to be lit with LEDs — features 82 LED street lights from EvoLucia Inc, a division of Sunovia Energy Technologies Inc of Sarasota, FL, becoming the first new street in Texas lit entirely by LED street lights. "The quality of light is superior even to what we anticipated and is far better than what could have been provided by traditional lighting," says mayor Sim Israeloff. "The town can reduce maintenance costs, improve safety, practically eliminate light pollution and dramatically reduce energy consumption," he adds.

**Fairview Parkway, the first new street in Texas lit entirely by LEDs.**

The Sunovia fixtures, designed with Cree XLamp MC-E LEDs, are designed to last an average of 12 years (depending on use) with a 50% electrical-energy cost saving compared to traditional metal-halide lights. Fairview will save $250,000 due to lower energy and maintenance costs over the anticipated lifetime of the LED lights, reckons Israeloff. Switching to LEDs should also reduce the town's carbon emissions by 1000 pounds per year compared with the high-intensity discharge fixtures initially planned for the new roadway. Additionally, the street lights feature advanced optics that, coupled with the directional capabilities of the LEDs, allow light to be aimed precisely where needed, providing even illumination of the street (eliminating dark spots and unwanted light pollution).

Following the Fairview Parkway LED conversion, the town plans to install more LED fixtures at the new Fairview Fire Station later this year and in the new town hall in mid-2010. Also, in addition to using solar-charged storm warning sirens, Fairview is investigating solar-powered irrigation and vegetation water-filtration systems.

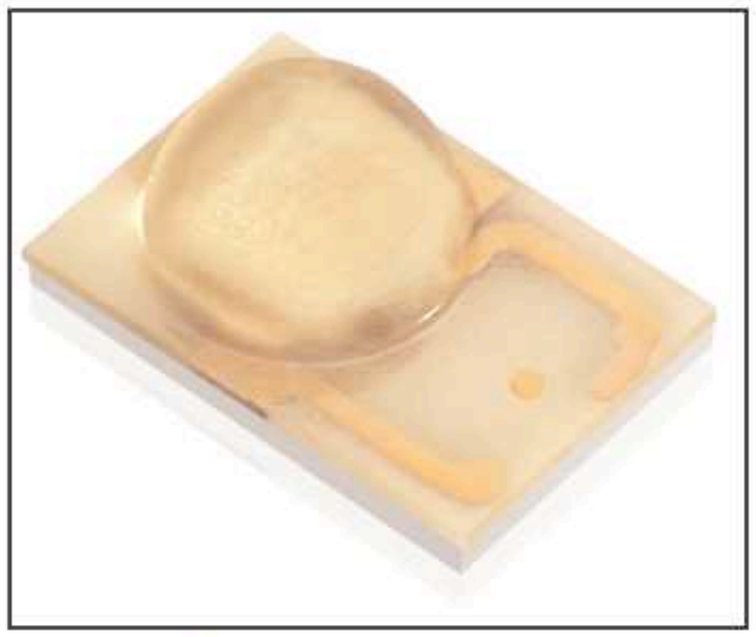
"Fairview's initial venture into LED street lighting was driven by Fairview's aggressive stance on dark-skies compliance, and switching to LEDs serves as a great complement to the town's ongoing eco-friendly initiatives," says Cree LED programs manager Deb Lovig.

**www.ledcity.org**
**www.gjcity.net**
**www.fairviewtexas.org**

# Lumileds launches first LUXEON Rebels for illumination

Philips Lumileds of San Jose, CA, USA has expanded its LUXEON Rebel family of LEDs with nine new emitters designed specifically for illumination solutions such as recessed lighting, street lamps and retrofit bulbs. The new LEDs have been optimized for specific color temperature and color rendering index (CRI) combinations and deliver performance that makes them qualified to meet ENERGY STAR requirements and similar programs for a broad range of illumination applications, the firm claims.

The result of collaboration with lighting companies and designers, this first set of LUXEON Rebel LEDs created specifically for illumination applications provides the flexibility to meet varying illumination requirements in the highest growth segments, Lumileds adds. In outdoor area and street lighting for example, a warmer light might be specified for a downtown shopping area whereas roadways might be specified for cooler color temperature light. Likewise, there are dramatic differences in the lighting solution requirements for merchandising in stores compared to lighting office areas or even what's preferred in classrooms.



**LUXEON Rebel LED.**

The nine new LUXEON Rebels are binned according to ANSI standards and all have minimum specified color rendering. Each delivers light output and lumen maintenance that enable ENERGY STAR and similar lighting efficiency and performance programs.

"This is only the first set of LUXEON Rebel LEDs we're developing specifically for the illumination market, and we plan to continue to develop new products in line with our customers' needs," says executive VP of sales & marketing Steve Barlow. "With literally hundreds of potential applications to be addressed, our white LUXEON portfolio will continue to expand with a variety of different product configurations and performance characteristics," he adds.

**www.philipslumileds.com**
**www.futurelightingsolutions.com**

# Seoul Semiconductor grows European sales of Acriche for GU10-based lamps

Korean LED maker Seoul Semiconductor says that it is supplying its Acriche LED for GU10-based lamps to European lighting manufacturer Elgo Lighting Industries S.A. of Poland. "Acriche has already gained substantial popularity in the European lighting market," says Elgo.

Compatible with commercial voltages of 110–220V, the GU10 is one of the most widely used lamps for interior lighting in Europe, and is the predominant lamp type where halogen bulbs are used for interior lighting sources. Currently, the annual GU10 market is over 300 million bulbs, worth about $1.2bn globally. Recently, GU10-based lamp products using LEDs have come to prominence.

Seoul Semiconductor's Acriche can be used in commercial AC voltage applications without an AC–DC converter, and is attracting attention as an LED light source for GU10-based lamps. Acriche GU10 bulbs can be used for up to 30–40,000 hours (the LED's average life-span). Most LEDs can only be driven by a direct current and hence require an AC–DC converter. In some cases, using an AC–DC converter can reduce the bulb lifetime if the converter has a shorter average life than the LED. Considering the long life of the Acriche GU10 compared to a typical halogen GU10 (which has an average life of only 2000 hours), the Acriche GU10 lifetime matches or surpasses 15–20 halogen GU10 bulbs. It also uses much less power, saving 75% of the electricity compared to a halogen GU10. Despite the LED bulb having a higher initial cost, up to 70% savings can be realized over the lifetime of the product.

**Acriche LED-based GU10 bulb.**

"As lighting solutions using Acriche begin to be sold in Europe, we are moving into full-scale commercialization of the AC-driven product," says Seoul Semiconductor. "Acriche is expected to be used for lighting products manufactured by global leading lighting companies [for example, Molex] within the third quarter of this year, and we expect Seoul Semiconductor's share to increase even more in the European market," the firm adds.

**www.acriche.com**

# North Carolina's first eco-friendly McDonald's lit with Cree LED lights

McDonald's has opened a new, more energy-efficient restaurant in the Saltbox Village shopping center in Cary, NC that features LED lighting from Cree Inc of Durham, NC. The new building is on-track to be the first LEED (Leadership in Energy and Environmental Design) certified McDonald's in the state.

The site's original McDonald's was demolished early this year and rebuilt specifically to achieve LEED certification from the US Green Building Council. Franchise owner/operator Ric Richards hopes to be LEED-gold-certified by October. The store is lit 97% with LEDs and consumes 78% less electricity for lighting compared to the standard lighting packages.

"My efforts in building this store are two-fold — to be economically sound with energy-efficient methods and, at the same time, to provide a modern space for the enjoyment of customers," Richards explains. "Cree's LED lighting products are an important element in our ability to reach our energy-efficiency targets."

The Cary McDonald's uses a fully automated, intelligent lighting-control system that combines light from Cree LED lighting and daylighting from Solatube skylights with a photo sensor to maintain the desired light levels on work surfaces (e.g. if it rains and daylighting is reduced, the LED light levels are increased to compensate). The dimming capability of LED lighting provides the flexibility needed for this system to work effectively. Cree's LED products are featured throughout the restaurant, including dining areas, kitchen, hallways and restrooms, as well as the parking lot, drive-thru and entryways.

"By seeking LEED-gold certification, this McDonald's demonstrates the importance of LED lighting as a crucial component for green building," says Cree LED Lighting president Neal Hunter. "The full line of Cree LED lights is in use in this building, from our recessed downlights to our new LED bulb."

www.CreeLEDlighting.com

IN BRIEF

## SemiLEDs' chips to light ITRI's campus

SemiLEDs Corp of Boise, ID, USA, which fabricates LED chips in Hsinchu Science Park, Taiwan, has begun a joint pilot program with Taiwan's Industrial Technology Research Institute to convert part of its campus street lighting from metal halide to LED systems.

Based on ITRI's own optical lens design and light-weight thermal solution, the 24W LED systems use P2 lamps containing SemiLEDs' high-power chips packaged by Helios Crew Corp (HCC).

"ITRI's campus is the open environment for new pilot technologies. Therefore, we decided to adopt the latest and most advanced systems in LED lighting technology to illuminate our campus," says Dr Ian Chan, ITRI's VP & general director.

The LED systems use less than 10% of the 240W of power required for the metal halide systems, claims SemiLEDs.

www.semileds.com

# Bridgelux recruits ex-Lumileds chief financial officer

Bridgelux Inc of Sunnyvale, CA, USA has recruited Neil Bostock as chief financial officer, responsible for managing all finance and administrative functions and reporting directly to CEO Mark Swoboda.

Bridgelux designs and makes power LED chips based on ITO/InGaN (indium tin oxide/indium gallium nitride), and this year expanded into solid-state lighting products.

"Neil brings deep LED industry experience and the vision to help grow Bridgelux into a world-class solid-state lighting company," says Swoboda. "Since expanding our product portfolio this year to include solid-state light sources incorporating LED technology, we face the challenge of growing our resources and global infrastructure to support expanding market demand in fast-growing interior and exterior application areas such as street lights, track and downlights... Neil is uniquely qualified to help us manage through the high-growth changes."

Bostock has more than 35 years experience in finance and 19 years of experience with LED and semiconductor manufacturing. Prior to joining Bridgelux, Bostock served as CFO at Philips Lumileds, joining in 1999 when it was a newly constituted joint venture between Philips and Hewlett Packard/Agilent. He helped to build its infrastructure and identity as an independent company and transition the organization from steep losses to profitability. Bostock continued at Philips Lumileds through the acquisition of the joint venture by Philips, remaining until the end of 2008.

From 1994 to 1999, Bostock was business group controller for Philips Semiconductor's Multi Market business group (in Sunnyvale), which grew to annual revenues of about $1bn (with worldwide markets and wafer fabs in North America, Europe and Asia). Previously, he worked as business group controller at Philips Semiconductors' Power Division in Hazel Grove, UK, responsible for the worldwide activities of the $200m business unit (with a wafer fab in the UK and assembly in the Philippines). Between 1970 and 1989, Bostock served in senior finance positions at several electronics and engineering companies.

www.bridgelux.com

# Osaka University claims first red electro-luminescence from MOCVD Eu-doped GaN LEDs

Researchers at Japan's Osaka University have demonstrated what is claimed to be the first low-voltage operation of current-injected red light emission from a p-type/Eu-doped/n-type GaN LED at room temperature (Nishikawa et al, Appl. Phys. Express 2 (2009) 071004).

Trivalent ions of the rare-earth element europium ($Eu^{3+}$) have been widely used as phosphors (doped into an insulator) to yield red light emission (by optical excitation) in cathode ray tube and plasma display panels. Previous researchers have doped Eu into the gallium nitride by using ion implantation with post-thermal annealing or molecular-beam epitaxy, and then used optical excitation to stimulate red light emission in LEDs. Such rare-earth-doped semiconductors are expected to produce highly efficient electroluminescent devices as a result of the specific optical properties of the materials (e.g. sharp, intense and temperature-independent emission due to the intra-4f shell energy transitions of electrons in the atom).

Red electroluminescence has been obtained from indium–tin-oxide (ITO)/Eu-doped GaN/undoped GaN grown on p-type silicon substrates and metal–insulator–semiconductor (MIS) structures of indium (In)/Eu-doped GaN/undoped GaN grown on n-type silicon. However, the applied voltage was as high as 46V for the ITO/Eu-doped GaN sample and the emission efficiency was low for the In/Eu-doped GaN sample because the impact excitation of the $Eu^{3+}$ ions by hot carriers was thought to be dominant. To reduce the operation voltage, it is necessary to use a p–n junction diode structure to inject current into the active layer.

Since MOCVD has been used widely to fabricate commercially available blue LEDs, MOCVD-grown Eu-doped GaN inserted into a p–n junction diode structure should


**Osaka University's Eu-doped GaN LED, which emits red light with a wavelength of 621nm.**

yield high electroluminescent efficiency. A difficulty in MOCVD growth of Eu-doped GaN is the lack of a suitable metal-organic source for the Eu-dopant. However, the vapor pressure of most candidate Eu sources is generally much lower than that of conventional metal-organic sources so, when transporting the Eu source to the reactor chamber, special precautions are needed (e.g. high-temperature heating of the transfer lines to avoid condensation and/or low-pressure control of the cylinder to supply a certain amount of the source).

Now, led by Yasufumi Fujiwara (professor in the Graduate School of Engineering's Division of Materials and Manufacturing Science) the Osaka group says that it has overcome these problems and used MOCVD to grow light-emitting Eu-doped GaN layers in a p-type/Eu-doped/n-type GaN LED structure on a sapphire substrate. The growth temperature was optimized at 1050°C (the same as for the undoped GaN layer between the LED structure and the GaN buffer/sapphire substrate) but a lower V/III ratio of 320 was required to obtain strong emission intensity (compared with 1600 for the undoped GaN layer).

Electrical current injection using an applied voltage as low as 3V yielded red emission that was easily visible to the naked eye under normal lighting conditions. At a dc drive current of 20mA, the output power — integrated over the dominant $^5D_0$–$^7F_2$ intra-4f shell transition in $Eu^{3+}$ ions (about 621nm) — was 1.3μW. The corresponding external quantum efficiency was 0.001%.

The excitation mechanism for $Eu^{3+}$ luminescence is thought to involve the excitation energy being transferred from the host GaN material to the $^5D3$ state of the $Eu^{3+}$ ion and successive nonradiative (phonon) relaxation occurring from the higher $^5D_{J>0}$ states to the $^5D_0$ state. No GaN-related luminescence was observed, indicating that the excitation energy of the GaN host material was effectively transferred to the $Eu^{3+}$ ions for Eu-related luminescence.

Increasing the applied voltage caused the emission intensity to increase. However, the color also changed slightly from red to orange (attributed to color mixing of the main emission peak with an emerging emission peak at 543nm, due to the higher spectral sensitivity of the human eye for emission at 543nm).

Although the optical output is still small, Fujiwara reckons that it is possible to boost the output by optimizing the electrode structure and other features of the LED.

The researchers say that their result suggests a novel method for realizing GaN-based red LEDs (an alternative to conventional toxic As-containing AlGaInP/GaAs red LEDs). In addition, such red GaN-based LEDs could be integrated monolithically with existing green and blue GaN-based LEDs on the same substrate to form red-green-blue (RGB) devices, for use in solid-state lighting or full-color displays (e.g. with smaller pixel size and a higher resolution).

**http://apex.ipap.jp/link?APEX/2/071004**
**www.mat.eng.osaka-u.ac.jp**

# LBO adds $15m to Series 'A' funding to accelerate product development

Light Blue Optics (LBO) of Cambridge, UK, which develops and supplies miniature holographic laser projection systems, has closed a $15m extension to its Series 'A' funding round (which raised $26m in October 2007). Robert Bosch Venture Capital GmbH (RBVC) led the extension, joined by existing investors 3i Group plc, Earlybird Venture Capital, Capital-E and NESTA.

The new funds will enable LBO to accelerate its product development roadmap across multiple markets including automotive, industrial and consumer electronics. The firm's first product — a projection engine suitable for integration into an accessory pico projector — is scheduled for release to OEM customers in fourth-quarter 2009.

Founded in 2004, LBO's projection technology uses laser light sources and patented holographic techniques to deliver large, full-colour, high-quality video images that remain in focus at all distances (without needing a projection lens), whilst maintaining the Class 1 laser safety classification essential to consumer electronics applications. Uniquely, the projection system can be touch-enabled, meaning any flat surface such as a table can instantly be transformed into a touch-sensitive display, eliminating the need for a screen and allowing users to interact with multi-media content.

"RBVC has a remit to invest in technologies of ground-breaking strategic importance, and LBO has all the characteristics of a great investment," says Robert Bosch Venture Capital's managing director Dr Claus Schmidt. "The company impressed us with their potential to create and capture a new product category of mobile, energy-efficient, interactive displays," he adds. "Their proprietary technology will open up entirely new applications and revenue opportunities in markets such as consumer electronics."

**Touch-interactive display using laser-based projection system.**

LBO has also recruited Paul Goodridge as chief financial officer. Goodridge has 20 years of financial management experience and a track record for company growth, says the firm. Prior to joining LBO, he was director of Finance at CSR plc for eight years, managing its migration from being venture-backed through to its floatation on the London Stock Exchange and subsequent promotion to the FTSE 250. "It's rare to find an early-stage company with the high-growth profile of LBO," says Goodridge. "The company has clear competitive advantage, excellent customer traction and a vast market opportunity," he adds.

"This $15m financing round will enable LBO to accelerate its product development roadmap and address a wider range of applications," says CEO Dr Chris Harris, "not least in the consumer electronics space, where the market for pico projectors has been forecast to exceed $1bn within 5 years. We now have the world-beating technology, experienced team and strong investor syndicate in place to realize that opportunity and become the world's leading supplier of miniature projection systems," he reckons.

**www.lightblueoptics.com**

IN BRIEF

## MAZeT becomes certified partner in 'LED Light for you' network

MAZeT GmbH of Jena, Germany, a development and manufacturing service provider specializing in opto-ASICs, spectral and color sensors as well as embedded computing solutions, is now a member of the 'LED Light for you' (LLFY) network of LED maker Osram Opto Semiconductors of Regensburg, Germany.

"Together with 70 other certified partners in the LED Light for you network, we provide high-quality, comprehensive support to our customers who are implementing both highly complex and standard LED color light applications," says managing director Dr Fred Grunert. "Our vast expertise in developing and supplying mixed-signal ASICs for optoelectronic applications, our ever-growing number of reference designs for controlled LED color light, and our high-performance embedded computing solutions are the main reasons why MAZeT was given Osram certification," he adds.

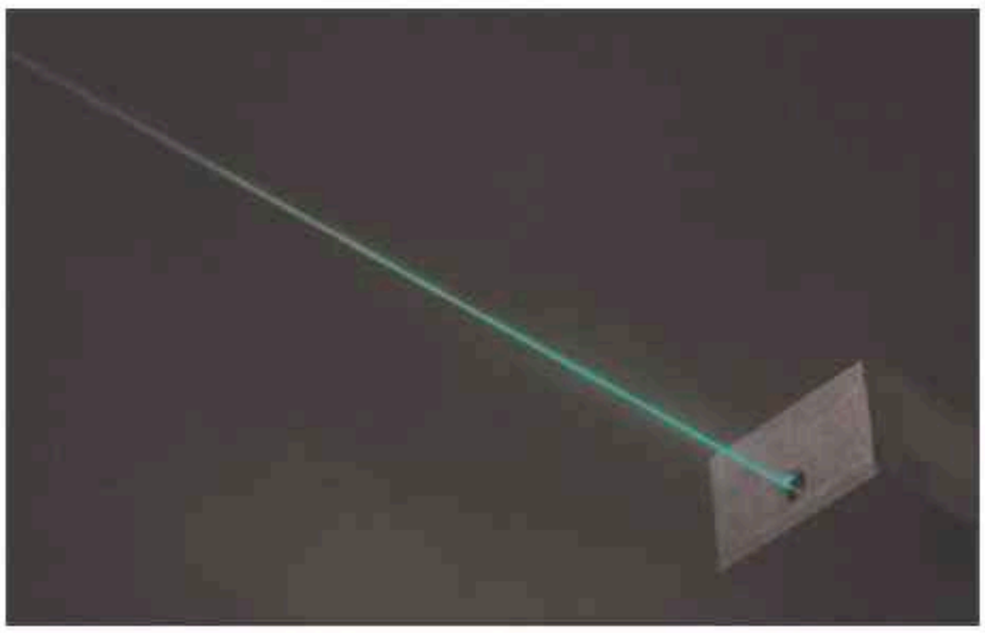
As part of the global LED technology partner network, MAZeT can offer manufacturers and designers of solid-state light applications its expertise in optics, heat management and electronics for LED light solutions.

MAZeT says that its customer service package covers the entire product life cycle, including development. As a full-service provider, MAZeT designs and manufactures complete opto-electronic modules for LED applications. Its engineers provide customer support throughout all phases of a project — from selecting a cost-efficient solution through to after-sales services.

**www.ledlightforyou.com**
**www.mazet.de**

# Sumitomo Electric claims first pure-green semiconductor laser

Sumitomo Electric Industries Ltd's Semiconductor Technologies R&D Laboratories in Itami, Japan have developed what is claimed to be the first semiconductor laser diode emitting in the pure-green region of the spectrum — at a wavelength of up to 531nm under pulsed operation at room temperature (Enya et al. Appl. Phys. Express 2 (2009) 082101, 17 July).



**Green laser light emitting from an oscillator.**

Light sources using lasers for display applications, such as laser TVs and pocket laser projectors, are expected to have superior properties in terms of size, weight and power consumption. However, up to now, only red and blue semiconductor laser diodes have been commercially available. Commercial green lasers (e.g. for use in laser pointers) work by down-converting the frequency of light emitted from a 1064nm infrared laser and re-emitting it at a green wavelength of 532nm. R&D targeting commercialization of green-emitting semiconductor laser diodes has therefore expanded rapidly in the past several years.

Gallium nitride (GaN), used for blue light-emitting devices, is expected to also be key for green light-emitting devices. However, up to now GaN has been plagued by the luminance efficiency declining sharply as the wavelength increases (e.g. from blue towards green). This is a combined result of the internal field effects as well as the deterioration of the crystal quality of the active layer. The main reason for the low luminous efficiency of GaN-based green light-emitting devices is the polarization of charge carriers due to the piezoelectric field caused by the large distortion in the GaN crystal structure (which has a larger effect on green lasers than on blue lasers).

Several organizations are trying to alleviate this problem by using various crystal orientations.

Previously, in late February Osram Opto Semiconductors GmbH of Regensburg, Germany demonstrated the first gallium nitride (GaN)-based laser with an emission wavelength of 500nm (blue–green), and at the end of May Japan's Nichia Corp reported blue–green lasing at 510–515nm (both using InGaN quantum wells grown on a c-plane GaN substrate).

Now, Sumitomo Electric says that it has inhibited the drop in efficiency by developing GaN crystal grown on the semipolar {2021} plane of a free-standing GaN substrate. This has weakened the internal field effects and yields improved-quality homogeneous InGaN quantum wells (QWs) in the laser's light-emitting active layer, even at the high indium composition required for green wavelengths. Also, the spectral width of spontaneous emission from the laser is narrower than that on other planes, the researchers claim.

**Sumitomo Electric has inhibited the drop in efficiency by developing GaN crystal grown on the semipolar {2021} plane of a free-standing GaN substrate**

The firm also says that, by designing the active layer appropriately, it has succeeded in covering the entire range of the green lasing spectrum. While the lasing wavelengths of conventional frequency-converted lasers are locked at a specific wavelength, Sumitomo Electric says that its new laser can be tuned to any wavelength in the green region.

For the average laser emission wavelength of 520nm, the typical threshold current was 491mA and the threshold current density was 8.2kA/cm$^2$. For the longest lasing wavelength achieved (531nm), the threshold current was 924mA.

**For the average laser emission wavelength of 520nm, the typical threshold current was 491mA and the threshold current density was 8.2kA/cm$^2$**

Furthermore, the lasing frequency remains almost unchanged even in the high-current range, so the firm believes that its device has advantages in high-power applications. Another advantage is that the dependence of the wavelength on ambient temperature is minimal, it is claimed.

The development of a green laser diode could enable red–green–blue (RGB) laser light sources and lead to new applications. Sumitomo Electric says that it has applied for over 60 patents related to the technology.

http://apex.ipap.jp/link?APEX/2/082101
http://global-sei.com

# Direct-emitting green laser hits 50mW

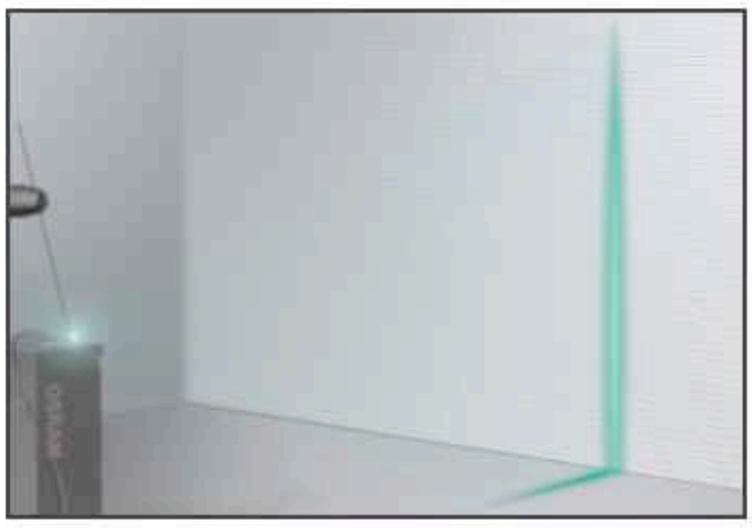
Osram Opto Semiconductors GmbH of Regensburg, Germany has reported what it claims is the first direct-emitting 'true green' InGaN laser diode — emitting light at 515nm — with high optical output power (50mW) .

Osram already offers blue-emitting InGaN laser diodes for commercial applications. But, in the true green 515–535nm wavelength range, efficient high-quality semiconductor lasers have been commercially available only as frequency-doubled versions, where you take a material that lases at 1060nm and double the frequency to produce a laser emitting at the green wavelength of 531nm. The highest output power for a frequency-doubled green laser is currently about 1.5W.

Compared with semiconductor lasers based on existing frequency doubling technology, direct-emitting green lasers are more compact, offer greater temperature stability, are easier to control, and have higher modulation capability at several hundred megahertz, says the firm. Although the new laser is just at the pre-development stage, in the medium term direct-emitting green lasers could replace frequency-doubled lasers for many applications.

The laboratory prototype achieved optical output power of 50mW in pulsed mode at room temperature. The threshold current density was about 9kA/cm$^2$. "With this demonstrator we have shown that green lasers can be manufactured from indium gallium nitride," claims chief technology officer Dr Christian Fricke. "We are therefore on course to produce compact, cost-effective, high-quality green laser light sources," he reckons.

Previously, in late February Osram Opto demonstrated the first InGaN-based laser with an emission wavelength of 500nm (blue–green),



**Light from Osram Opto's direct-emitting green laser.**

then at the end of May Japan's Nichia Corp reported blue–green lasing at 510–515nm. In mid-July, Japan's Sumitomo Electric Industries reported what it claimed was the first semiconductor laser diode emitting pure green light (a wavelength of up to 531nm under pulsed operation at room temperature — see opposite). Although threshold current density was 8.2kA/cm$^2$ at the laser's average emission wavelength of 520nm, output power was just 28mW at a current of up to 1240mA.

Green lasers are used in many medical and industrial applications, as well as light sources in mobile mini-projectors. A direct-emitting green laser could help to make these projectors smaller and with even better performance. Osram Opto is developing efficient InGaN-based laser light sources as part of the MOLAS research project (sponsored by the German Ministry for Education and Research, and running until March 2011), which involves technologies for ultra-compact and mobile laser projection systems.

Osram Opto adds that the great advantage of laser projectors — a consistently sharp, true-color, high-contrast image irrespective of the projection distance and projection surface — should some day also be available to users of cell phones and cameras.

**www.osram-os.com**

IN BRIEF

## Oclaro and Newport exchange New Focus and Spectra Physics high-power laser diode businesses

On 6 July, Oclaro Inc of San Jose, CA, USA closed the transaction announced on 3 June under which it has acquired the high-power laser diode business of Newport Spectra Physics in exchange for laser and photonics components supplier Newport Corp of Irvine, CA acquiring its Advanced Photonics Solutions division's New Focus business (which makes photonics products including tunable lasers, opto-electronics, high-resolution actuators, stable opto-mechanics, vacuum and ultra-clean solutions, and OEM-engineered solutions). In addition, Oclaro has received $3m in cash proceeds, which is expected to fund related transition and integration costs.

Oclaro believes that it is now the largest merchant supplier of high-power laser diodes. The Newport transaction complements the number 1 or number 2 position in the long-haul and metro markets that Oclaro has achieved as a result of the firm's creation through merger in late April of Bookham Inc of San Jose, CA (which has expertise in optical components) and Avanex Corp of Fremont, CA (which has expertise in modules and subsystems). Oclaro says that its market position helps to ensure its ability to invest in R&D.

The Newport transaction also boosts utilization of Oclaro's wafer fabs, which should benefit the gross margin performance of products in the metro and long-haul business as well as in the high-power laser diode business.

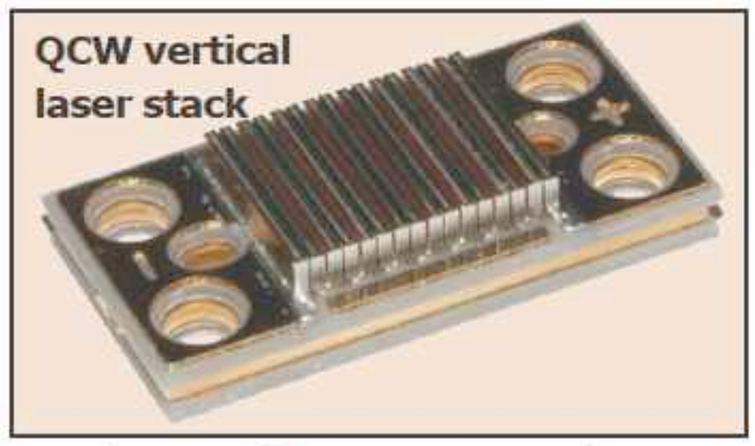
www.newfocus.com
www.newport.com
www.oclaro.com

# DILAS launches 300W QCW vertical diode laser stacks

DILAS of Mainz, Germany has announced its new compact design of quasi-continuous-wave (QCW) high-power vertical diode laser stacked arrays, available in wavelengths ranging from 808nm to 9xxnm with output power of up to 300W QCW per bar and optional fast-axis collimation.

The compact, completely gold–tin (AuSn) soldered vertical stacks are designed specifically for operation in high-temperature environments for applications such as diode-pumped solid-state lasers and defense, requiring QCW lasers in the kilowatt power range, in a compact, easy-to-integrate package.

The conduction-cooled vertical stacks are available in 1-bar, 7-bar or 8-bar configurations with up to 4% duty cycle at 200W per bar. Under the toughest environments, the packaging and high-precision optic mounting give full control, allowing fast-axis stack divergence as low as 6mrad, the firm says.


QCW vertical laser stack

Custom solutions are available upon request. In addition, standard models can be customized to fit specific requirements for interfaces, beam propagation, mechanical dimensions, etc.

www.dilas.com

# AMS' distribution for QPC expanded to UK/Ireland, France and Spain

European component distributor AMS Technologies of Martinsried near Munich, Germany has expanded its distribution agreement with Laser Operations LLC of Sylmar, CA, USA (which manufactures the QPC Lasers high-brightness product line) to add UK/Ireland, France and Spain. The firms says that the new agreement emphasizes Laser Operations' commitment to the region and leverages AMS' strength in providing local, knowledge-based sales support backed up with a pan-European marketing and administration.

Laser Operations acquired Sylmar-based QPC Lasers Inc (which manufactures high-power diode lasers for the consumer electronics, industrial, defense, and medical markets) in May after QPC defaulted on loan interest payment last Autumn.

"AMS Technologies has successfully distributed QPC Lasers for several years, even through uncertainties," says Thomas Moritz, European sales manager for AMS Technologies' OptoTech Division. "AMS Technologies has developed business in a wide range of applications, becoming one of QPC's most important partners. This agreement builds upon that foundation," he adds.

"AMS Technologies has been very instrumental in developing a strong presence in Germany and neighbouring countries for the QPC high-brightness diode laser products over the years," concurs Laurent Vaissie, Laser Operations' VP sales & marketing. "As we enter a new stage of growth as part of Laser Operations LLC, we are pleased to recognize AMS Technologies' contribution to our growing leadership in European medical and industrial markets as well as unwavering support during our recent restructuring efforts," he adds.

www.ams.de
www.qpclasers.com

# Auto makers offer hope for IPG Photonics

Fiber-laser system specialist IPG Photonics is hopeful that orders from beleaguered car manufacturers will boost its revenues in 2010 as recessionary pressures ease.

However, the Massachusetts-based firm, which uses MBE to manufacture the semiconductor lasers that lie at the heart of its high-power systems, must first withstand a much weaker economic environment.

IPG announced sales of $40.4m for the second quarter of 2009, down 28% year-on-year and also down from $45.4m in the opening three months of this year. That slump in revenue resulted in a net loss of $1.2m in the second quarter, compared with a net profit of $8.6m one year ago.

"The materials processing market is especially weak in Europe and Asia, which had a significant effect on our sales," reflected CEO Valentin Gapontsev.

Despite the gloomy results, Gapontsev and his colleagues remain confident that IPG's high-power lasers in particular are showing signs of significant growth in the future: "We believe demand for our high-power lasers for a variety of material processing applications remained resilient primarily due to market share gains," said the CEO. "High-power laser markets represent a substantially larger market opportunity with fewer competitors than pulsed laser markets."

Recent activity in the high-power segment has seen IPG ship a 20kW laser to an un-named customer in the energy sector for what IPG described as 'leading-edge research'.

Crucially, the up-front cost of fiber lasers is now approaching parity with carbon dioxide lasers, the traditional competitor to IPG's technology. When added to the comparatively low running cost of fiber lasers, this should mean that IPG will take an increasing share in laser cutting applications when markets rebound.

Encouragingly, IPG has seen shipments to automotive companies increase over the past year, even as the sector has endured its worst period in living memory.

IPG says that existing customer BMW has placed an additional order, along with the Ford Motor Company. Meanwhile, the German operations of Daimler and Audi have shown an interest in IPG's lasers.

Although that interest is unlikely to result directly in any extra sales revenue before the end of 2009, it should lead to significant orders in 2010. The auto makers are expected to need at least 40 laser systems to meet manufacturing requirements.

But with markets remaining generally subdued until then, IPG's near-term outlook remains conservative. For third-quarter 2009, it expects revenue of $39–44m, which should allow a near break-even performance on the bottom line.

**www.ipgphotonics.com**

*By Michael Hatcher*

# Despite revenue drop, Advanced Photonix returns to underlying profit due to cuts and high-value product focus

For its fiscal first-quarter 2010 (ending 26 June 2009), Advanced Photonix Inc of Ann Arbor, MI, USA (which designs and makes silicon, InP- and GaAs-based photodetectors, high-speed optical receivers, and terahertz instrumentation) has reported revenue of $5.9m, down 3% on $6.1m the prior quarter and down 24% on $7.8m a year ago.

"As we stated in our year-end conference call [in late June], the first half of the year would be a slow start with a drop in revenues from the prior year due primarily to the current economic conditions," says chairman & CEO Richard Kurtz. "The first quarter results were in line with this guidance," he adds.

"The good news is we have been able to improve our EBITDA [earnings before interest, taxes, depreciation, and amortization] and non-GAAP profit over the fourth-quarter of fiscal 2009, despite a revenue drop," says Kurtz. Though still down on $869,000 a year ago, non-GAAP net profit was $315,000, compared with a net loss of $884,000 the prior quarter. While still down on $1.04m a year ago, EBITDA was a positive $554,000, compared with negative $603,000 last quarter. Gross margin of 51% is up on 38% the prior quarter and 48% a year ago.

"This reflects the initial payoff from our long-term strategy over the past several years of investing in our high-value-added products targeted at growth markets and the streamlining of our operations [consolidation of the wafer fabs in Camarillo, CA and Dodgeville, WI into Ann Arbor and closure of the assembly facility in Dodgeville]," Kurtz comments. "In addition, our recent cost-reduction initiatives in response to the recession have helped control our operating expenses [cut to $3.2m, from $3.8m the prior quarter and $3.5m a year ago]," he continues.

"While we have instituted cost cuts this year, we are committed to continuing to make the strategic investments necessary to enable growth as the economic conditions improve," Kurtz says. "We remain cautiously optimistic that our reduced cost structure and gross margin improvements have positioned API for long-term profitability as revenue growth returns and the economic conditions improve."

**www.advancedphotonix.com**

IN BRIEF

## Huawei names Oclaro as strategic supplier

Optical component, module and subsystem maker Oclaro Inc of San Jose, CA, USA has received official designation as a strategic supplier by telecoms equipment maker Huawei Technologies Co Ltd of Shenzhen, China.

Huawei says that Oclaro was chosen as a strategic supplier due to the breadth of its product portfolio and enabling technologies, as well as the scale of the current business relationship between the two firms.

Oclaro was formed in late April through a merger that combined the optical component expertise of San Jose-based Bookham Inc (including its plant in Shenzhen, among others) with the module and subsystem expertise of Avanex Corp of Fremont, CA to create what is claimed to be one of the largest suppliers of optical components, modules and subsystems to the long-haul and metro optical telecoms markets.

The strategic supplier relationship is designed to enable more strategic collaboration on next-generation product developments. It is also aimed to encourage continued improvement in supporting existing business between the firms. To ensure success, a senior executive from each company has been designated to foster the relationship.

"This designation validates our view that Oclaro has the fab technology, capacity and design expertise to deliver products that extend our leadership in the long-haul and metro markets," says Oclaro's president & CEO Alain Couder. "All of us at Oclaro are committed to the continued success of this important relationship."

www.huawei.com

# Oclaro reports positive adjusted EBITDA in first post-merger quarter

For its fiscal fourth-quarter and fiscal 2009 (ended 27 June), Oclaro Inc of San Jose, CA, USA has reported revenue of $66.9m (up 62% on $41.2m for the March quarter). However, this includes two months of revenue from Avanex.

Oclaro was formed on 27 April through a merger that combined the optical component expertise of San Jose-based Bookham Inc with the module and subsystem expertise of Avanex Corp of Fremont, CA to create what is claimed to be one of the largest suppliers of optical components, modules and subsystems to the long-haul and metro optical telecoms markets.

Also, the March and June quarters exclude revenue from photonics products maker New Focus of $5.8m and $5.1m, respectively, after the business' transfer to Newport Corp of Irvine, CA in exchange for their Spectra-Physics laser diode business and $3m in cash in a deal that closed on 4 July. Including New Focus, non-GAAP revenue is up 53% from $47m in the March quarter to $72m in the June quarter.

Gross margin has risen from 21.5% to 24.8%. Adjusted earnings before interest, taxes, depreciation and amortization (EBITDA) was positive $0.7m, an improvement on negative $0.7m in the March quarter.

Net loss has risen from $13.3m in the March quarter to $14.6m. However, this included $5.2m of restructuring and related costs. Despite this, during the quarter, cash, cash equivalents, restricted cash and short-term investments rose from $38.3m to $58m.

"Being positive adjusted EBITDA in our first quarter together is an important milestone for Oclaro," says CEO Alain Couder. "Our integration is going smoothly, our synergies are on track... These results are a visual indicator of the progress taking place behind the scenes and with customers."

"We are also proud of having improved our annual gross margin and annual adjusted EBITDA, in spite of the current economic downturn that began in September," says Couder. For full-year fiscal 2009, gross margin rose from 20.1% to 22%, while adjusted EBITDA improved from negative $4m to negative $1m, and non-GAAP net loss was cut from $14m to $3.1m. Including the two months of Avanex revenue, fiscal 2009 revenue was $210.9m, up from $202.7m in fiscal 2008.

"Times continue to be challenging, and we expect only modest revenue growth in the remainder of calendar 2009," cautions Couder. "Over the upcoming quarters we will continue to focus to advance the profitability of Oclaro towards our ultimate operating model targets."

For its fiscal first-quarter 2010 (ending 26 September 2009), Oclaro expects revenue to rise 14–26% to $76–84m. Non-GAAP gross margin will fall to 19–23%, but this reflects 2–3% of temporary gross margin dilution from swapping New Focus for the Spectra-Physics laser diode business, due to additional costs while transitioning related fabrication activities in Tucson, AZ to Oclaro's fabs in Caswell, UK and Zurich, Switzerland in the next 6–12 months. Correspondingly, adjusted EBITDA should be negative $6m to breakeven.

**Being positive adjusted EBITDA in our first quarter together is an important milestone for Oclaro... These results are a visual indicator of the progress taking place behind the scenes and with customers**

www.oclaro.com

# Infinera's revenues rebound slightly as non-US customers grow

For second-quarter 2009, 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 reported revenue of $68.9m, up slightly from $66.6m last quarter but down 24% on $90.8m a year ago. Of total revenue, 36% came from Europe and Asia (compared to just 22% a year ago), with three of the top five customers coming from these regions (one from Europe and two from Asia).

Excluding non-cash stock-based compensation expense, non-GAAP gross margin was 31%, level on last quarter but down from 47% a year ago. Non-GAAP net loss was $18.2m, compared to $17.6m last quarter and net income of $10.7m on an adjusted GAAP basis a year ago.

"We saw a number of positive developments in the second quarter, with both existing and new customers," says president & CEO Jagdeep Singh. "There was a significant quarter-over-quarter increase in orders, including over 2000 TAMs [Tributary Adapter Modules] booked, and we continued our new customer win momentum, adding four new customers to our roster [including a win at COLT for a pan-European network, bringing customer count to 62]," he adds. Infinera also announced another tier-one win with NTT, the world's second largest service provider.

The new business at NTT is for its new IP backbone network in the Tokyo area. Wins over the last 12 months with tier-one service providers include Deutsche Telecom, OTE, and TeliaSonera. The firm also won a new sizeable submarine network build (its second in six months).

"These developments indicate that our strategy of winning new footprint during the economic downturn to generate growth once the economy recovers is a sound one," asserts Singh. "We believe that over time, as the economy improves and as our customers add capacity to existing footprint, our gross margins will continue to rebound."

www.infinera.com

# Infinera appoints VP of worldwide sales

Infinera has appointed Ron Martin as VP for worldwide sales.

Martin joins Infinera's sales executive team, including Scott Chandler and Howard Lukens, who led the firm to the number-one market share in the North American long-haul market (according to data from independent analyst firm Ovum).

During 30 years in the networking industry, Martin has experience of building and managing large international optical networking businesses.

From 1987 to 2001, he worked at Fujitsu Network Communications (ending as chief operating officer), which grew to become one of the largest suppliers of optical systems to leading US telecom firms.

From 2001 to 2007, Martin was at Cisco Systems, where he was VP & general manager of its optical business unit. He was involved in the consolidation of multiple international acquisitions into one unit.

From 2007 until July, Martin was at Adva Optical Networking, serving as chief marketing & strategy officer and president of the North American subsidiary, building the Adva brand in the US market and leading the creation of a US direct sales force.

# CEO to become executive chairman in January, replaced by COO

Chairman & CEO Jagdeep Singh (who co-founded Infinera in 2000 with chief marketing & strategy officer Dr Dave Welch and chief technology officer Drew Perkins) plans to step down as CEO and become executive chairman on 1 January, when chief operating officer Tom Fallon will succeed him as president & CEO.

Singh will remain actively involved, working with Fallon and the executive team on product strategy and long-term direction of the firm. "It is time to pass the baton of leadership for the day-to-day operations of the company," says Singh. "I look forward to continuing to work with Tom and other members of the team as we continue to capitalize on our unique opportunity to disrupt the optical transport industry."

"As an experienced operations executive, Tom has an exceptional background for the CEO role," says Singh. "He spent many years in management at Cisco, including his role as VP & general manager of Cisco's optical business unit. He is one of the veterans of the Infinera management team, having joined us early in our development, and has led an increasingly broad set of functional groups at our company over the years... I look forward to working with him on his transition into the CEO role over the next six months."

Fallon joined Infinera in 2004 and was VP, engineering & operations through 2006, when he was made COO. From 2003 to 2004, he was VP, corporate quality & development operations at Cisco Systems Inc. From 2001 to 2003, he was Cisco's general manager of the optical transport business unit. Fallon has a B.S.M.E. and M.B.A. from the University of Texas at Austin.

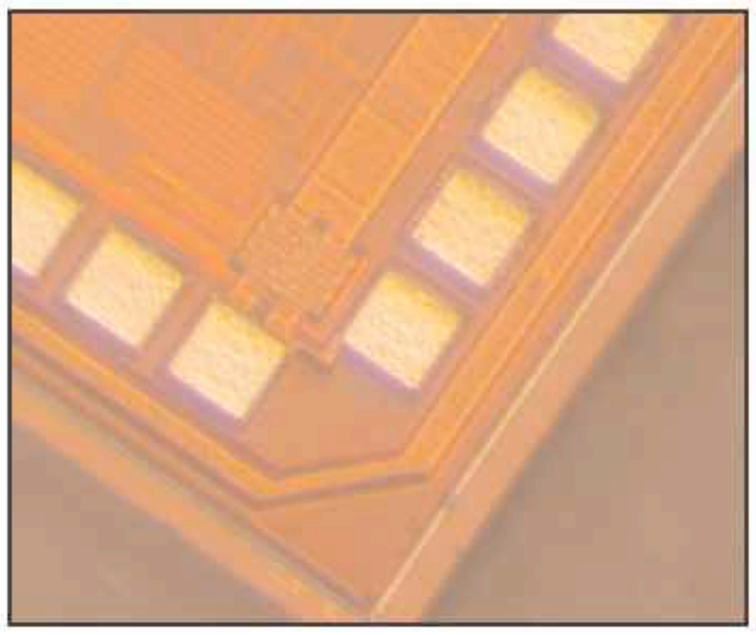
"We have a significant competitive advantage in the DWDM market with our PIC-based technology, a world-class team, and strong customer momentum, and we look forward to extending this lead in the years to come and delivering sustained profitable growth," says Fallon.

# GigOptix launches TIA portfolio for 10G, 40G and 100G

GigOptix has made available samples of a complete family of transimpedance amplifier (TIA) ICs that enables it to address all major 10Gb/s, 40Gb/s and 100Gb/s receiver applications.

The new family includes:

- GX3101, a high-gain limiting TIA for 10.3Gb/s Ethernet whose large dynamic range enables it to support all existing 10G Ethernet optical reaches (simplifying logistics by having one part spanning all reaches);
- GX3110, a linear TIA with automatic gain control (AGC) for 11.3Gb/s SONET whose total harmonic distortion figure is superior to current solutions on the market, it is claimed, enabling customers to improve product performance;
- GX3200, a limiting TIA for 100GBASE-LR4/ER4 receiver designs whose low power and compact form suit next-generation 100G Ethernet solutions; and
- GX3220, a balanced linear TIA with AGC whose bandwidth control function enables it to address the emerging 40G DQPSK (differential quadrature phase-shift keying) and 100G DP-QPSK (dual-polarization quadrature phase-shift keying) receiver markets.



**GigOptix's new GX3110 linear transimpedance amplifier chip.**

The new family strengthens GigOptix's portfolio of TIA solutions, which already includes the GX3440, which addresses the OC-768 40G DPSK (differential phase-shift keying) market, and the ultra-low-power HXR4104 and HXR4112 TIA array products, which address Infiniband QDR (quad data rate) and the emerging 40GBASE-SR4/LR4 and 100G-BASE-SR10 100G Ethernet standards.

"We are greatly expanding our addressable market and balancing our strong driver portfolio with an equally attractive and complete set of products for the receive side," says VP of marketing Julie Tipton. "This complete portfolio has been driven by our customers seeking better solutions than those currently available in the market. The opportunities are tremendous as there are few companies delivering these challenging designs," she adds.

"These demanding new designs were possible due to the close collaboration between the GigOptix-Helix team in Zurich and the high-speed design team in Palo Alto," says Joerg Wieland, VP & general manager of Swiss subsidiary GigOptix-Helix (acquired in January 2008). "We were able to blend the skill sets of both design groups... This demonstrates our successful and synergistic integration of the two entities under the GigOptix umbrella," he adds.

According to Ovum's Q209 Telecom and Datacom forecast, the annual total available market for this family of products is 8.8 million units in 2009 and should grow to 35 million units by 2014.

www.GigOptix.com

# UCLA Electrical Engineering professor joins advisory board

Professor Bahram Jalali of University of California, Los Angeles' Electrical Engineering Department has joined the advisory board of GigOptix Inc of Palo Alto, CA, USA, which designs optical modulators, drivers and transimpedance amplifier (TIA) ICs based on III-V materials.

Jalali has published over 350 scientific papers and holds seven US patents, and was made a fellow of the IEEE in 2003 and of the Optical Society of America in 2004. His research focuses on RF photonics, fiber-optic integrated circuits, integrated optics, and microwave photonics, including demonstrating the first silicon laser (cited by the MIT Technology Review magazine as one of the top 10 technology trends in 2005). Honors received by Jalali include the 2007 R.W. Wood Prize from the Optical Society of America and the BridgeGate 20 Award in 2001 for his contributions to southern California's economy. He also serves on the board of trustees of the California Science Center.

While on leave from UCLA from 1999-2001, Jalali founded Los Angeles based fiber-optic component firm Cognet Microsystems, where he served as CEO, president & chairman from its inception through acquisition in 2001 by Intel Corp (for which he was a consultant from 2001–2004).

"This is a great opportunity for me to get involved with a vibrant young company," says Jalali. "GigOptix not only has unique technology in the field of ultra-high-speed photonics but also a compelling vision to address real market needs and a consistent track record of providing innovative solutions," he adds.

"With his exceptional experience, he will be a valuable partner in helping us broaden the application of our technology," believes GigOptix's chief technology officer Andrea Betti-Berutto.

www.ee.ucla.edu/faculty-jalali.htm

# GigOptix grows by 9% as cost cutting yields first profit

For second-quarter 2009, GigOptix Inc of Palo Alto, CA, USA, which designs optical modulators, drivers and transimpedance amplifier (TIA) ICs based on III-V materials, has reported revenue of $4.5m, up 9% on last quarter's $4.1m and double $2.25m a year ago.

The latter reflects the consolidation over the last 21 months of the former GigOptix LLC together with Helix Semiconductors AG of Zurich, Switzerland (which makes TIAs, limiting amplifiers and VCSEL drivers) in January 2008 and Lumera Corp of Bothell, WA (which makes polymer electro-optic modulators) in December (when GigOptix Inc became a publicly traded company). On a non-GAAP basis, as if Lumera and GigOptix were operating together as of 1 January 2008, revenue rose by $705,000 (19%) year-on-year.

Gross margin has risen from 58% last quarter to 60%. On an adjusted consolidated non-GAAP basis, net income was $25,000, compared to a net loss of $879,000 last quarter and $2.4m a year ago. On the second anniversary of GigOptix LLC's formation as a restart of iTerra Communications LLC, and after eight quarters of revenue growth, this is the first profitable quarter on a non-GAAP basis for both GigOptix Inc and its predecessors iTerra, GigOptix LLC and Lumera.

This has been achieved by steadily growing revenue via an expanded, worldwide corporate customer base and enhanced product portfolio, while slashing costs, which has boosted the firm's high margins, says chairman & CEO Dr Avi Katz. Although up from $2.7m a year ago, operating expenses have been cut from $3.8m last quarter to $3.3m. "These cost savings were made without wholesale layoffs of vital employees, as has been seen often in today's struggling economy, but rather through diligent focus on our essential activities, smart and effective consolidation of all our merged assets, and meaningful contributions from the entire team," he adds.

"Though our cash balance at the end of the second quarter ($2.1m) was lower than the previous quarter ($4.6m), it is a reflection of the extended collection of our accounts receivable, which was dictated by some of our major customers and our decision to close our line of credit with Silicon Valley Bank earlier this quarter, which required payment of $500,000 within the second quarter," says Dawn Casterson, acting chief financial officer. GigOptix has since collected $2m on these receivables.

In terms of product delivery and development, Q2/2009 saw:

- transition from sampling to production shipments with the GX3440 45Gb/s differential limiting amplifier;
- rejuvenation of the iT family (RF products for the defense market), with the sampling of two new single-bias broadband power amplifiers;
- demonstration of low-power interconnect technology (8mW/Gb/s for error-free 10Gb/s optical links over 100m of multi-mode fiber);
- extension of a DARPA contract to fabricate low-driving-voltage broadband Mach-Zehnder (MZ) modulators using electro-optic (EO) polymer material for operation at very low temperatures in supercomputers;
- acceptance by Airbus Military A400M of a D-Lightsys transceiver containing the HX3401 TIA and HXT3101 VSCEL driver;
- first sales of the LX8400 and LX8900 EO polymer modulators (for 40 and 100Gb/s) to commercial, defense and academic customers.

"We are very encouraged by the advances that have been made by GigOptix during the second quarter, in terms of product development, products released to the market and the synergistic relationship between the merged entities," says VP of marketing Julie Tipton. "The release of our LX8900 and LX8400 is the result of the collaborative working methods established with the integration of the teams in Bothell and Palo Alto since the merger of Lumera and GigOptix," she adds. "The achievement of the HX product line demonstrating such low power consumption levels for a 10G optical link has generated much interest and is due, in part, to the close collaboration between engineers in Zurich and Palo Alto. Similarly, our ability to release a complete family of TIAs to the market was made possible by combining complementary skill sets and developing excellent working relationships after the merger of Helix and GigOptix," she reckons. "We are now working on numerous customer design-ins with our GX, HX, iT and LX products."

GigOptix aims to further boost its market share and profitability as it continues to deploy its consolidation model. "In just two years we have built a company that, as a component supplier to the optical communications industry, is now able to expand into additional markets," says Tipton.

Already, in Q3/2009, GigOptix has released a full range of TIAs under the GX product family (a result of the Helix acquisition, as their development came from collaboration between Zurich and Palo Alto).

Also, as part of its intensive cost-reduction effort, GigOptix has embarked on a project to sell a significant portion of its patent portfolio, found to be non-contributory to its major stream of business. The firm says it will retain and protect the patents and applications identified as most critical for its technology roadmap and platform strategy, but aims to expunge any unnecessary and monetarily distracting patents and applications that it holds.

"As we continue to shape our strategy to conduct business through these tough economic times, we are concentrating on continuous, real-time cash flow management, more so due to the fact that customers have reduced the lead-time of orders to just a few weeks, and stretched out account payable terms, which behoves us to better plan cash management and supply chain management," says Katz.

**www.gigoptix.com**

# JDSU sees component inventory levels burning off

For its fiscal fourth-quarter 2009 (ended 27 June), optical component maker JDSU of Milpitas, CA, USA has reported a slight sequential drop in sales, as customers in the fiber-optic networking sector continued to use up excess inventories. The firm saw total sales dip 1.3% sequentially to $277m. Compared with the same period in 2008, that figure represented a 29% decline, however, highlighting the effect of the global recession on sales.

Following a number of acquisitions over the past couple of years, JDSU's revenues are now dominated by its Communications Test & Measurement division. In the latest quarter, these were worth $135.5m, just under half of the overall total.

Revenue from its Communications and Commercial Optical Products division, which includes the advanced semiconductor components used in optical networks, dropped to $90.7m — down 46% on $167m a year ago.

That huge drop reflects the still-tough economic environment, although president & CEO Tom Waechter believes that the firm is now set to emerge from the recession in good shape: "We begin fiscal 2010 with a stronger balance sheet, an improved business model and a stronger product portfolio, well-positioned for growth when the economy rebounds."

With many customers still burning through product inventory, that rebound is yet to gather much momentum, but JDSU has high hopes for its new tunable XFP transceiver. A beta version of the tunable source, which promises to greatly simplify optical networks, has already been shipped to 12 customers, the firm says.

JDSU officially launched the tunable transceiver in March, and won an out-of-court settlement with rival Oclaro shortly afterward, following a patent dispute over the two companies' InP-based chip designs.

In the latest quarter, JDSU posted an operating loss of $61m. The company has also issued its full-year results for fiscal 2009, in which it made a net loss of $866m on sales of just under $1.3bn.

However, those loss figures include a huge write-down of $760m and a restructuring charge of $38.7m, as Waechter and colleagues took major cost-saving measures including the consolidation of its GaAs device production facilities.

For fiscal first-quarter 2010 (ending 3 October 2009), JDSU remains cautious about any major economic recovery, and expects a small sequential increase in revenues, to $283–300m.

**www.jdsu.com**

*By Michael Hatcher*

# Santur selects Kotura's silicon photonics multiplexer for 100Gb/s planar lightwave circuit platform

Kotura Inc of Monterey Park, CA, USA, which has been producing application-specific silicon photonics components for communications, computing, sensing, and detection for more than four years, has been selected by Santur Corp of Fremont, CA, a vertically integrated manufacturer of indium phosphide-based tunable lasers for metro and long-haul wavelength division multiplexed (WDM) systems, as a partner in its 100Gb/s platform. Using a silicon photonics chip, Kotura's 10-channel optical multiplexers combine multiple 10Gb/s channels onto a single fiber output, reducing the packaging complexity by an order of magnitude.

"Santur required a strategic partner for planar lightwave circuits (PLCs) who could meet our aggressive market entry requirements. Kotura had the team and the technology to deliver on schedule," says Santur's president & CEO Paul Meissner. Kotura is an active participant in the IEEE 802.3ba 40Gb/s and 100Gb/s Ethernet Task Force, the Video Electronics Standards Association (VESA) and the Silicon Photonics Alliance (the first formal Community of Interest within the Optoelectronics Industry Development Association). "We wanted to be the first company in the world to deliver 100Gb/s for client connectivity. Kotura played an essential role in our being first to market," he adds.

"Whereas traditional solutions rely on hundreds of discrete components and a dozen fibers, our integration in a small silicon photonics chip is a critical factor that reduces the assembly complexity and decreases the power consumption," says Kotura's president & CEO Jean-Louis Malinge.

The 100Gb/s market is coming much faster than many originally thought, believes Arlon Martin, Kotura's VP of sales & marketing. "To support high-bandwidth video demand, servers are migrating from 1Gb/s ports to 10Gb/s ports. This is creating a bandwidth bottleneck at the next level of interconnect, driving networking and data center companies to implement their 100Gb/s cards now in order to solve this problem," he adds.

**www.kotura.com**

**www.santurcorp.com**

# Opnext halves underlying losses as demand stabilizes

For its fiscal first-quarter 2010 (to end-June 2009), optical module and component maker Opnext Inc of Fremont, CA, USA has reported revenue of $85.3m, up 2% on $83.6m last quarter and just 1.3% on $84.2m a year ago (despite the inclusion of $32.3m from the former StrataLight Communications Inc of Los Gatos, CA, USA, acquired on 9 January).

"Our sequential increase in revenue for the June quarter and indications from our customers suggest that demand has stabilized," says president & CEO Gilles Bouchard. Revenue from sales to Ciena Corp, Cisco Systems Inc and Nokia Siemens Networks (NSN) represented 57.6% of sales (similar to last quarter's 58.7%, as increased sales to Ciena and Cisco were partially offset by decreased sales to NSN).

In particular, sales of 10Gb/s and below products rose in all major product categories (except 300-pin fixed-wavelength modules), by 16.5% from $41.2m last quarter to $48m. Sales of 40Gb/s products fell by 11.8%, from $39.7m to $35m (with a drop for subsystems partially offset by growth for modules). Sales of industrial and commercial products fell by 14.8%, from $2.7m to $2.3m.

"We experienced a rebound in our 10G sales in both datacom and telecom applications," says Bouchard. "As expected, 40G sales returned to more normalized levels following the spike in demand in the March quarter."

Excluding non-cash charges and costs from the StrataLight acquisition as well as stock-based compensation expense, non-GAAP gross margin has risen from 13.5% last quarter to 23.2%. This is attributed to lower material and outsourcing costs, lower manufacturing spending, and favorable product mix more than offsetting the effect of lower average selling prices.

Compared with non-GAAP net income of $3.9m a year ago, non-GAAP net loss has been halved from $18.5m a year ago to $9.2m, due mainly to the improvement in gross margin and lower operating expenses (after a $2.8m benefit from cost-reductions).

During the quarter, cash and cash equivalents fell by about $3.6m to $165.3m, as $1.7m of capital expenditures and $2.8m of capital lease payments exceeded $0.9m of cash from operations.

"I am encouraged by our solid operational achievements in the June quarter. The fixed-cost actions taken and the variable-cost initiatives we have underway contributed to positive cash flow from operations," says Bouchard. "We remain committed to preserving cash while investing in key 10G, 40G and 100G technologies, which we believe will position us well as demand returns and the market emerges from this current downturn," he adds.

"For the remainder of the year, sales of our 40G subsystems products will vary depending on the timing of carrier deployments," Bouchard continues. "While we expect modest growth in our 10G and 40G module business, visibility remains limited and we, therefore, remain cautious."

Hence for fiscal second-quarter 2010 (to end-September 2009) Opnext expects revenue to remain stable at $80–90m.

www.opnext.com

IN BRIEF

## Opnext ships 1 millionth 10Gb/s transceiver

Optical component, module and subsystem maker Opnext Inc says that it has shipped more than 1 million 10Gb/s transceivers to its global customer base.

Opnext's portfolio of products in the 10Gb/s family include 300-pin, XENPAK, X2, XPAK, XFP and SFP+ modules, encompassing all port types within these form factors. These support SONET OC-192, SDH STM-64 and 10GbE protocols, enabling long-reach terrestrial transmission, metropolitan-area network, optical add-drop multiplexer (OADM), access, enterprise switching, high-speed data and storage communications.

"It took almost a decade for the 10G market to reach high volumes, where economy of scale is starting to pay off," says Dr Vladimir Kozlov, founder of market research firm LightCounting. "Opnext is one of very few vendors with a long-term vision and true commitment to transceiver technology, which are likely to benefit from increasing demand for high-data-rate modules."

This achievement demonstrates Opnext's ability to lead the industry from early technology development to high-volume commercial production, claims president & CEO Gilles Bouchard. "This milestone exemplifies the strength of the partnerships we have established with our customers to help them deploy their next-generation networking platforms."

Opnext's 10G transceiver comply with industry standards from ITU-T G.691, G.709, and IEEE 802.3, and OIF recommendations, supporting a variety of electrical interfaces, including SFI-4, XAUI and XFI, easing integration onto system host boards.

IN BRIEF

## Oplink enters profit as revenue rebounds

For its fiscal 2009 (to end June), photonic component, module and subsystem maker Oplink Communications Inc of Fremont, CA, USA has reported revenue of $143.7m, down 18% on fiscal 2008's $176.3m. However, though still down 13% on $37.3m a year ago, fourth-quarter revenue of $32.4m was up 5% on the prior quarter's $30.8m (and slightly above the forecast $28–32m).

The 10% customers were Alcatel-Lucent (13%), Tellabs (18%) and Huawei (23%, up from 18% last quarter, with China the strongest region while the Americas is still relatively weak).

Net loss doubled from $6.8m in fiscal 2008 to $13.8m in fiscal 2009. But, after a net loss of $791,000 a year ago and $114,000 last quarter, fiscal Q4 saw net income of $249,000. Cash, cash equivalents and investments rose by $11.5m to $168.7m.

"We have focused on improving our global operational efficiencies and cost structure, and we are selectively investing in next-generation platform technology upgrades," says CEO Joe Liu.

Oplink has continued to invest in R&D in China and expanding in Zhuhai (to which it has almost completed transferring manufacturing from Optical Communication Products Inc, acquired in 2007). During Q4, Oplink's headcount rose from 2150 to 2260.

"Although order visibility is still somewhat limited, we believe that, with existing lean inventory levels at our customers, modest growth in telecommunications spending and upside potential from new design wins, we are poised to gain additional market share," Liu says.

For its fiscal first-quarter 2010 (to end-September 2009), Oplink expects revenue of $30–34m.

**www.oplink.com**

# Satellite deals boost Emcore amid $27m write-down

Fiber-optic and photovoltaic component supplier Emcore is hopeful that the worst of the recession is over, after seeing revenues slip to $38.5m in its latest financial quarter.

For the three months that ended on June 30, the New Mexico firm recorded a net loss of nearly $46m, although that was compounded by a $27m write-down in the value of some of its assets relating to the fiber-optic half of the business.

However, with CEO Hong Hou confident that the slump in the fiber-optic sector has now bottomed-out, and strong order momentum for solar cells to be used in satellite applications, things now appear to be looking up.

"It is clear that demand is now starting to come back," said Hou, referring to the fiber-optic segment specifically. He also pointed out that a book-to-bill ratio of 1.3 heralded an upswing later in the year.

Revenues from Emcore's solar business jumped 8% sequentially in the June quarter, with the accompanying order backlog swelling by 83% to $36.2m.

That is largely due to a raft of new, multi-year supply deals with major satellite contractors including Boeing, NASA and the US Air Force Research Laboratory. Those deals are ultimately expected to rake in some $100m in revenues overall, while the relaxation of certain US export restrictions means that Emcore is now free to target 'friendly' nations with its satellite components.

As a result, Emcore is now talking with European aerospace companies and says that it is making significant headway towards cementing new supply deals.

On the terrestrial solar side, Emcore's concentrated photovoltaic (CPV) business still faces two huge challenges: making the technology appear cost-competitive with rival thin-film approaches; and overcoming the risk-averse nature of the energy business.

In what remains a difficult financial environment, the latter problem means that any new technology such as CPV is still viewed as a risk rather than an opportunity.

As a result, Emcore is tweaking its strategy in the CPV systems business. Rather than ship entire systems and developing large-scale solar projects, it will now seek to license key parts of the CPV systems, such as its tracker technology, to partners.

As a result, the only products that it will need to ship over long distances would be CPV modules, which ought to mean much lower total shipping costs.

Hou said that Emcore was pursuing a joint-venture agreement in China, where it hopes to cash in on the Chinese federal government's policy on renewable energy production. In particular, it sees an emerging opportunity for its third-generation CPV systems, which are nearing the end of development.

**Rather than ship entire systems and developing large-scale solar projects, it will now seek to license key parts of the CPV systems, such as its tracker technology, to partners**

Emcore also filed an S-3 registration form with the US Securities and Exchange Commission (SEC) during the quarter, under which it can seek to raise up to $50m via either debt or equity financing.

For the forthcoming quarter, Emcore expects revenue to remain flat or grow slightly, to $38–42m.

**www.emcore.com**

*By Michael Hatcher*

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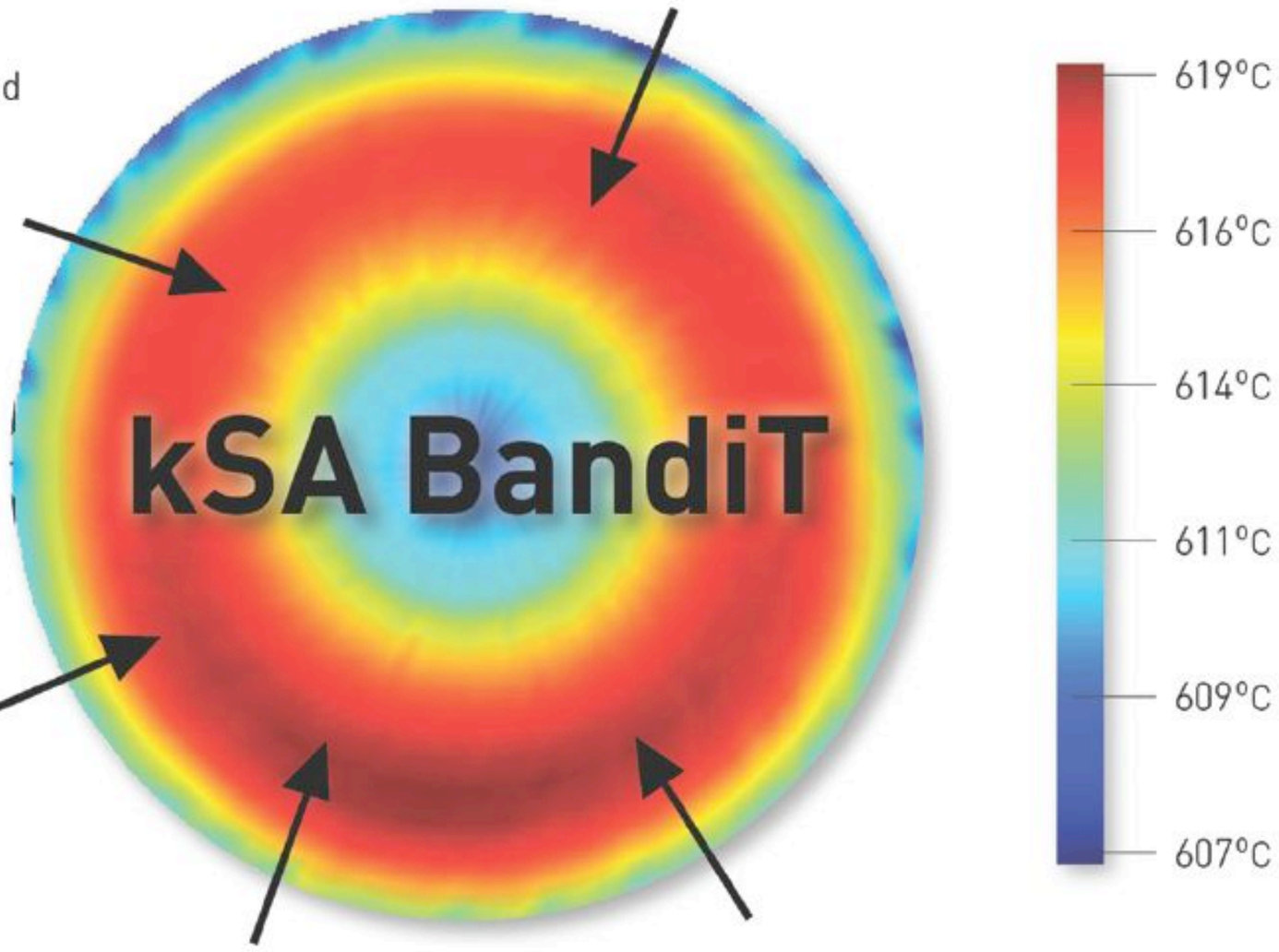


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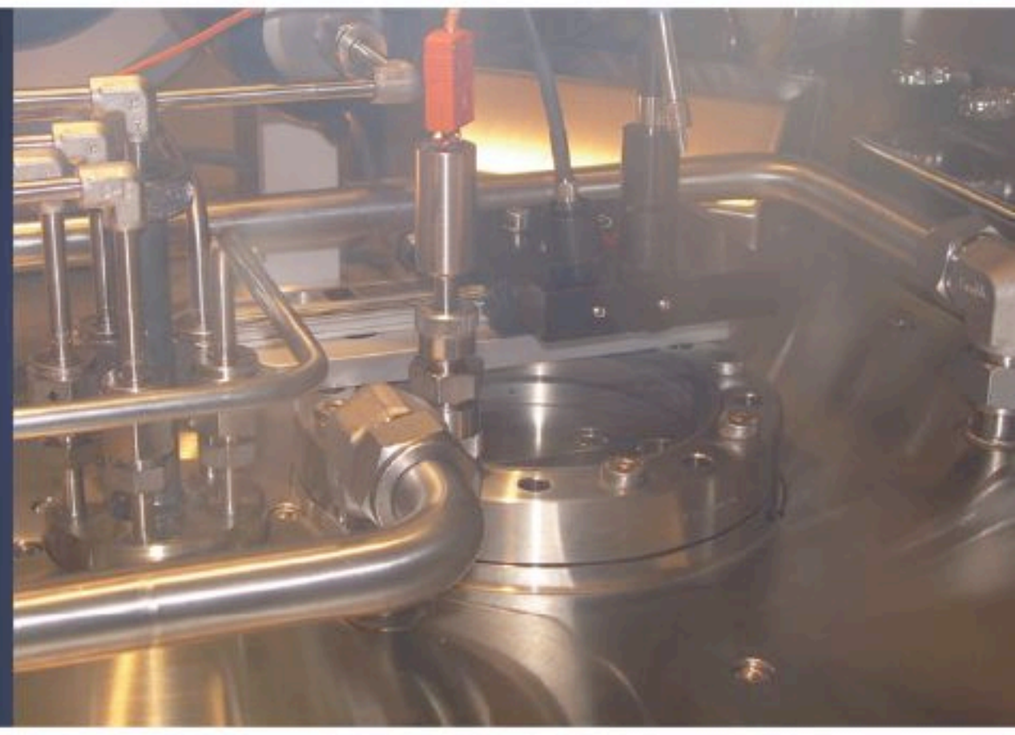

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# Rochester Institute of Technology professor appointed director of NREL's National Center for Photovoltaics

Dr Ryne P. Raffaelle has been appointed director of the National Center for Photovoltaics at the US Department of Energy's (DOE) National Renewable Energy Laboratory (NREL), effective 31 August. Prior to the appointment, Raffaelle was academic director for the Golisano Institute for Sustainability and director of the NanoPower Research Laboratory at the Rochester Institute of Technology (RIT).

Raffaelle has over 20 years experience leading laboratory research teams, and co-founded two photovoltaic and power system start-ups: Wakonda Technologies Inc in 2008 and Alpha V Inc in 2002.

**Ryne P. Raffaelle.**

While directing the two institutions at RIT, he was also a professor of physics, microsystems engineering and sustainability and was responsible for more than $20m in research grants in photovoltaics, thin-film processing, and nanomaterials research.

"With Dr Raffaelle on board, we expect to build on our leadership position in solar research and accelerate photovoltaics technology research, development, and deployment to make solar energy a significant part of our energy future," said Robert Hawsey, NREL associate director of renewable electricity and end-use systems.

Raffaelle's career includes working as a visiting scientist at the NASA-Glenn Research Center; the NASA Lewis Research Center; and at Oak Ridge National Laboratory. He has a Ph.D. in physics from University of Missouri-Rolla, and bachelor of science and master of science degrees in physics from Southern Illinois University.

Raffaelle has authored or co-authored over 100 refereed publications and books, and he is also co-editor of Progress in Photovoltaics.

www.nrel.gov

# OPEL and BETASOL complete second 110kW phase of 440kW Spanish HCPV solar farm

OPEL International Inc of Shelton, CT, USA and Toronto, Canada, which makes high-concentration photovoltaic (HCPV) panels (as well as both roof- and ground-based dual- and single-axis solar trackers for mounting them), and its Spanish partner BETASOL, which builds utility-grade solar farm installations for subsequent sale to investor groups, have completed the second, 110kW phase of a four-phase, 440kW utility-grade solar photovoltaic power plant in the Tarragona region of Spain (said to be a prime location for solar development).

One of the world's first commercial HCPV installations, the plant now generates 220kW of electricity for the power grid and provides increasing revenue for BETASOL. The balance of the installation is expected to take place during third-quarter 2009. When fully completed, the plant will supply electricity to over 350 households.

OPEL built the installation with its Mk-I HCPV panels (which concentrate light from the sun more than 500 times) mounted on dual-axis trackers which, combined, result in higher power production per unit of land (acre/hectare) than silicon or thin-film flat panels, with the potential to boost photovoltaic yields by up to 40%, the firm claims. OPEL also reckons that the conversion efficiency is up to twice that of silicon flat-plate solar panels and more than three times that of thin-film solar panels.

**OPEL's Mk-I HCPV panels.**

Previously, in early summer, OPEL unveiled the photovoltaic power plant to prospective customers, technical institutions and investors from across Europe and Africa in a four-day preview event that demonstrated one of the first operable solar grid fields in the world using OPEL's HCPV solar technology. "Being able to visit BETASOL's solar grid farm and to see OPEL's HCPV panels mounted on dual-axis trackers vividly demonstrated that advanced HCPV technology is ready now to deliver scalable electric power," said Laurent Pignol, Responsable Montage et Financement de Projets for CARI Construction Services Compris, one of France's leading construction companies. "Visitors can see the system's efficiency using HCPV panels on dual-axis trackers, thus making the rate of return provided by the Spanish feed-in tariff structure even more attractive to investors," says BETASOL's managing director Jesus Cabetas.

OPEL plans additional customer visits to the site in September, and says that it will continue to report on progress with the solar technology as it completes the final phases of the project.

www.opelinc.com

# AdvanceSis becomes Circadian Solar to reflect CPV commercialization

AdvanceSis of Coventry, UK, which is developing concentrated photovoltaic (CPV) systems incorporating gallium arsenide multi-junction photovoltaic cells, has formally changed its name to Circadian Solar. The firm says that it is retaining its focus on developing CPV units while advancing its commercial operation worldwide.

AdvanceSis was founded in 2004 by CEO Dr Robin Godfrey — previously business development manager at the UK's Defence Research Agency (now QinetiQ plc) — together with an academic group from the University of Warwick's Physics Department. The initial aim was to commercialize strained silicon structures. Funding came from Seven Spires Investments and the Mercia Technology Seed Fund. The firm's technology has been developed by scientists and engineers from the University of Warwick, the semiconductor industry and the automotive industry.

Circadian Solar says that it is now developing large-scale solar power generation on a global basis. "We have reached a certain point of maturity, of which the name change is an obvious external signal," says CEO Robin Godfrey. "Recent months have seen rapid development of our CPV technology and we will soon be in a position to deploy our solar power units on a wider scale," he adds.

**Circadian has a number of projects planned for the coming months. In August, it is sending a 1kW unit to one of its Mediterranean test sites for extensive field testing, followed by a commercial-size system later this year**

The firm employs more than 20 people in the UK, but is working with an extended team across Europe. Circadian has a number of projects planned for the coming months. In August, it is sending a 1kW unit to one of its Mediterranean test sites for extensive field testing, followed by a commercial-size system later this year.

The firm says that it is currently exploring a number of applications for its CPV systems, both on- and off-grid, such as remote telecoms power supply, decentralized power in rural areas, and refrigeration.

"The global population has reached a tipping point in the way it produces and consumes energy," says Godfrey. "CPV technology can be seen as a core component in a complete portfolio of renewable energy technologies, and is set to make a significant contribution to meeting the world's growing energy needs."

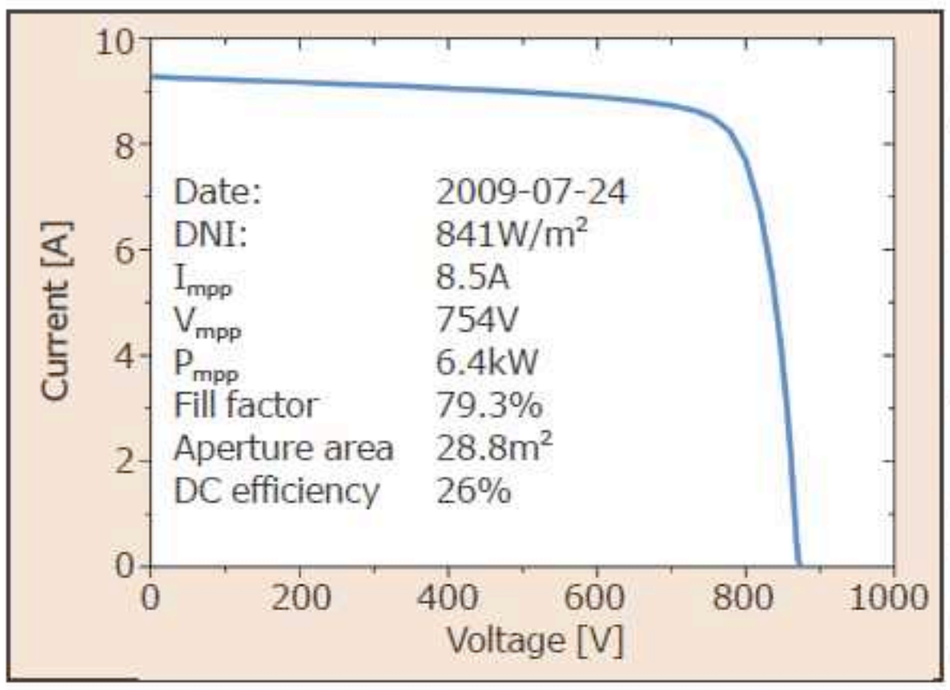
www.circadiansolar.com

# New CPV module raises system efficiency record to 25%

Concentrix Solar GmbH of Freiburg, Germany has raised its record for concentrator photovoltaic (CPV) AC (alternating-current) system efficiency from 23% (first achieved in May 2008) to 25% by using its new CX-75 generation of modules.

In mid July, Concentrix entered into a joint project in which a demonstration CPV system with a power of 5.75kW was installed and put into operation on the grounds of the University of California, San Diego (UCSD). The aim was to test the new-generation CX-75 module under California climate conditions and to create a reference in the USA, especially for American customers. Concentrix has already been represented on site in San Diego since the beginning of 2009 by its director of business development for the USA, Martin Mesmer (an electrical engineer who has been working on PVs since 1993, including several years in North America and in Asia).

"USCD is an ideal partner for a co-operation, because it already has many years of experience in the field of photovoltaics and was one of the first American universities that began to install PV systems for their own use in a big way," says project leader Inka Heile. "In addition, the site of the demonstration system situated at UCSD's East Campus Energy Park and located close to the international airport is very accessible for our customers."




**Current vs voltage, showing the output power of 6.4kW under 841W/m² irradiation.**

Two weeks after the demonstration system went into operation, and following the installation of new systems using CX-75 modules in a commercial power plant as part of the Institute of Concentration Photovoltaics Systems (ISFOC) project in Puertollano, Castilla-La Mancha, Spain, AC system efficiencies of 25% were measured under full field operating conditions. An output of over 6kW is generated under irradiation conditions of about 850W/m² and with a tracker aperture area of 28.8m² (301.4ft²). Output can increase to almost 7kW on a particularly sunny day, says the firm. Since CPV systems can only use direct irradiation, the definition of nominal output is based on a DNI (direct normal irradiation) of 850W/m² ('PV USA test conditions'). This corresponds to global radiation of about 1000W/m², the value which is used as a basis for calculating the output of silicon PV systems.

"The key factor for high system efficiency is very low module variability," says chief technical officer Dr Andreas Gombert. "All the modules must be identical. The results achieved with our fully automated production line were even more consistent than expected," he adds. The CX-75 has an average module efficiency of 27.2%. The high system efficiency achieved in San Diego also shows that CPV systems, which only incur a third of the energy loss of conventional silicon PV power plants, are suited to locations with high ambient temperatures, claims the firm.

"We are registering a large demand for our technology from the USA," says CEO Hansjörg Lerchenmüller. "Due to the large energy demand during the summer months, the high temperatures and the high irradiation, our CPV technology is ideally suited for the southwestern states in the USA. Thus, we will further expand our capacities and in the future will intensify our involvement in the US market," he adds.

www.concentrix-solar.de

# Concentrix appoints chief sales officer to build international sales

From September, Henning von Barsewisch, an expert with many years of experience in setting up new markets in the renewable energy sector, joins Concentrix as chief sales officer, leading the departments of sales, marketing and business development. Initially, he will focus on further building up the international sales activities and opening up new markets for the CPV technology.

Concentrix's five person management team is now complete. CEO

Hansjörg Lerchenmüller is responsible for management, COO Karl Friedrich Haarburger for production and logistics, CTO Dr Andreas Gombert for research, development and technology, and CFO Holger Janke for finance and power plant business.

For the past six years, von Barsewisch has built up the British subsidiary of German wind turbine maker REpower Systems AG. As managing director, the company developed from market entry to one of the leading turbine suppliers in Great Britain, with an installed power of 300MW and 60 staff. Previously, von Barsewisch, who has a degree in industrial engineering, was VP of business development for the Helm Tool Company, a US manufacturer of injection moulding tools. He also worked as a consultant for Bain & Company.

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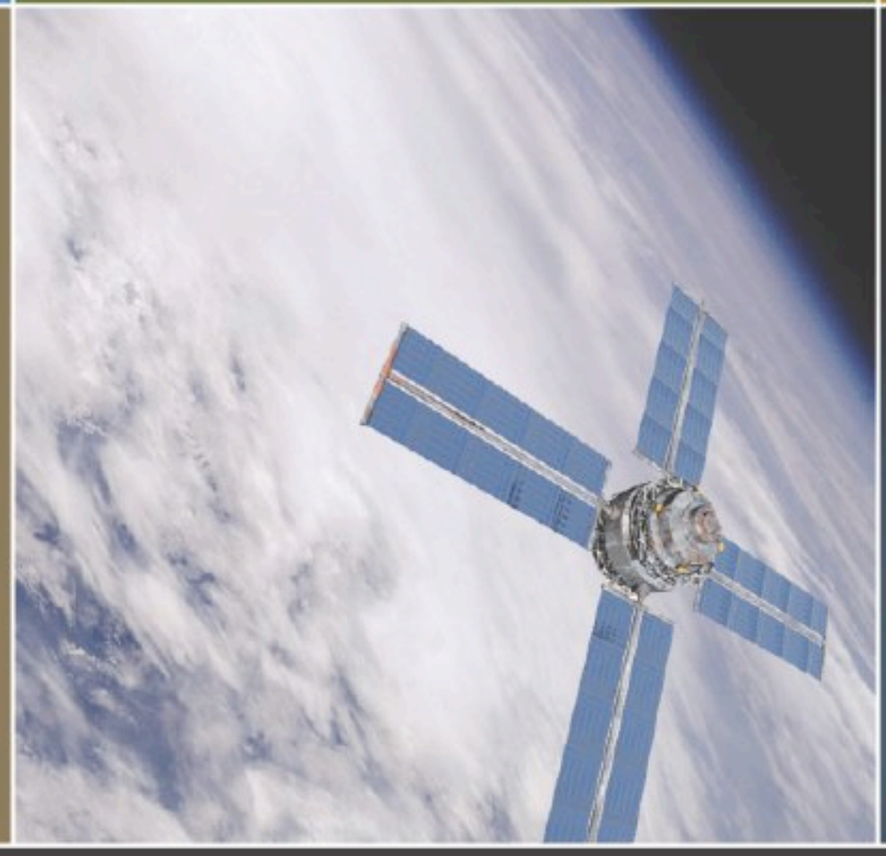

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# Veeco creates Solar Process Development Center from DayStar Technologies' assets in Halfmoon, New York

In order to accelerate its penetration of the rapidly growing copper indium gallium diselenide (CIGS) thin-film solar cell market, epitaxial deposition, process and metrology equipment maker Veeco Instruments Inc of Plainview NY, USA has acquired certain non-core assets of the Halfmoon, NY operation of CIGS PV developer DayStar Technologies Inc. Veeco has bought selected equipment, taken over leased facilities, and hired DayStar's 18-strong R&D group in Clifton Park, NY.

"As we have previously disclosed, we are in negotiations with potential strategic partners to allow us to expand our manufacturing capability and commercialize our CIGS PV modules," says DayStar's CEO Dr Robert Aldrich. "This sale of our New York assets is another step in our strategic partnership strategy and is consistent with the direction we established for DayStar approximately two years ago. In 2007 we moved our primary operations to Santa Clara, California and focused our development on single-step reactive sputtering on glass substrates and we moved away from flexible foil-based CIGS," Aldrich explains. "We have retained the intellectual property developed in New York for future use in either glass or flexible substrate PV modules, while Veeco has purchased assets that will allow them to advance their CIGS solar equipment strategy."

DayStar reckons that the asset sale will reduce annual operating expenses by over $2m. Previously, the firm cut its staffing by 30% in Q2/2009, after net loss grew to $7.7m in Q1/2009 due to increased R&D spending for CIGS-on-glass module and manufacturing process development. Cash and cash equivalents fell during the quarter from $17.1m to $6.5m. As of 31 March, DayStar had total liabilities of $16m and stockholders' equity was $37m.

The transaction also allows DayStar to continue efforts on its proprietary reactive sputter process currently in use to produce CIGS-on-glass PV modules without diminishing opportunities to re-enter flexible PV module markets when business, technology, and market conditions favor such a product. DayStar's core technology (the creation of the critical CIGS layer in a single heated process step using the same proven reactive sputter process as used in virtually all flat-panel display and architectural glass factories) remains exclusively owned by the firm.

"Veeco's efforts to advance their CIGS equipment business, leveraging their extensive portfolio of thermal deposition technology, aligned perfectly with DayStar's efforts to bring our single-step reactively sputtered CIGS to market," says DayStar's chief technology officer Robert Weiss. "Our New York team has provided expert support as the company transferred headquarters to California," he adds. "DayStar's resources are focused on our core technology as we begin our production ramp while our earlier efforts on flexible substrate two-step CIGS facilitates Veeco's mission in solar."

"The creation of a Solar Process Development Center will accelerate Veeco's position as a leading integrated equipment provider to the rapidly growing CIGS solar market," says David Bruns, senior VP, general manager, Veeco Solar Equipment. "We have brought on board a team of highly qualified CIGS technology specialists who bring to Veeco years of CIGS process know-how on a range of glass and flexible substrates. These CIGS process development specialists will now work in tandem with our design team to help our customers achieve the lowest cost of ownership through process and hardware optimization on Veeco's suite of equipment," he adds.

"This transaction is another example of Veeco's commitment to the fast-growing CIGS thin-film marketplace," says CEO John Peeler. "In the past year we have rapidly expanded our CIGS product line [based on the May 2008 acquisition of Mill Lane Engineering of Lowell, MA, which made CIGS web-coater systems and deposition sources] to include integrated thermal deposition sources, our FastFlex platform for flexible CIGS solar cells and our FastLine platform for CIGS on glass. Based upon the broad end-market applications for CIGS in solar farms, building-integrated and portable devices, combined with CIGS' forecasted competitiveness on a cost/watt basis, we see a $750m equipment market opportunity for CIGS by 2011," Peeler adds.

www.veeco.com

## DayStar in need of cash to avoid bankruptcy

DayStar has since cut net loss to $6.7m for its June quarter.

But, even adding $2m from selling its Halfmoon, NY operations, cash reserves fell to just $1.3m. At the end of June, DayStar had just $1.5m in current assets.

On 10 August, DayStar declared in a 10-Q report filed with the US Securities and Exchange Commission (SEC) that "to continue operations, we require immediate and substantial additional capital beyond our current cash on hand". DayStar has not been able to raise additional capital or complete an agreement with an investor or strategic partner. It may be forced "in the near term" to cease operations and file for bankruptcy. protection.

www.daystartech.com

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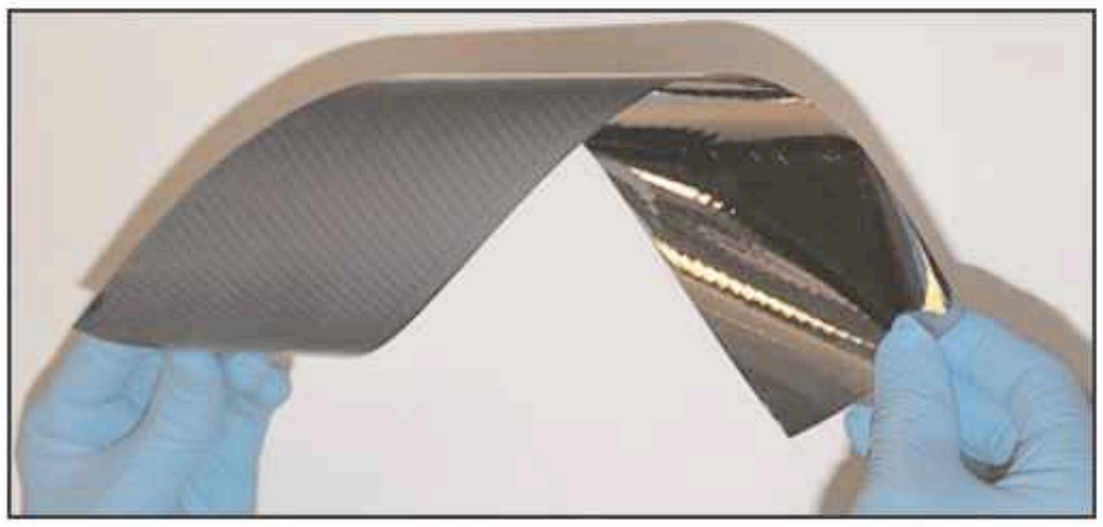
# Ascent's production CIGS modules exceed 10% efficiency

Ascent Solar Technologies Inc of Thornton, CO, USA has achieved its initial target efficiency goal of 10% for its flexible thin-film photovoltaic copper indium gallium diselenide (CIGS) monolithically integrated modules.

The US Department of Energy's National Renewable Energy Laboratory (NREL) has independently verified that the modules have a conversion efficiency as high as 10.4% (up on the 9.64% verified by NREL last December). The latest modules tested at NREL were standard 429cm$^2$ modules produced by Ascent Solar's 1.5MW production line (at its original headquarters in Littleton, CO), which entered commercial production in first-quarter 2009.



**Ascent Solar's monolithically integrated flexible CIGS photovoltaic module.**

"This is a significant breakthrough in demonstrating our ability to manufacture monolithically integrated flexible CIGS modules with greater than 10% module efficiency in commercial production," says Dr Prem Nath, senior VP of production operations.

Ascent's high-volume 30MW commercial plant in Thornton is scheduled to start initial production at the beginning of 2010. "Module efficiency of 10% is a vital element for our low-cost-per-watt manufacturing goal in high volume and will establish Ascent Solar as a leader in the production of lightweight flexible photovoltaics used for portable power and building-integrated photovoltaic (BIPV) products," Nath adds.

"Ascent Solar has made progress in advancing the state-of-the-art flexible, lightweight thin-film CIGS photovoltaic technology," comments Dr Harin S. Ullal, who is senior project manager for the National Center for Photovoltaics at NREL.

www.ascentsolar.com

# Ascent appoints ex-Applied Materials and Intel manager as CEO

After an extensive search lasting nine months, Ascent Solar Technologies Inc of Thornton, CO, USA, a developer of flexible thin-film photovoltaic modules based on copper indium gallium diselenide (CIGS), has appointed Dr Farhad Moghadam as president & CEO, effective from 3 August.

Moghadam has extensive senior executive experience in global operations, business development and commercialization of complex technologies. Most recently, he was senior VP & general manager at semiconductor equipment maker Applied Materials Inc where, among other things, he led the Thin Films Product Group (the firm's largest business unit) and was responsible for managing over 1100 staff in the US, Europe and Asia. He also served on the board of directors of Sokudo Co Ltd (which is a joint venture between Applied Materials and Japan's Dainippon Screen Mfg Co Ltd).

Before joining Applied Materials, Moghadam held management positions at Intel Corp. He received his Ph.D. in Materials Science and Engineering from Stanford University. He has authored over 250 publications and is a named inventor on about 65 patents.

Since 2007, Moghadam has been engaged with prominent private equity firms, and recently assisted firms seeking to participate in the US Department of Energy loan guarantee program with independent engineering assessments and bankability evaluations.

**Ascent Solar is among a very few PV companies which has proven technology ready for high-volume manufacturing of CIGS photovoltaic material on a plastic substrate, says Moghadam**

"Ascent Solar is moving rapidly on many business fronts, and we expect that the addition of Dr Moghadam to lead our company will help us meet the challenges associated with the rapid growth we see ahead," says founder & chairman Dr Mohan Misra.

"Moghadam possesses an impressive track record at Applied and Intel in shaping and building the businesses of those leading companies... Ascent Solar will benefit significantly from Dr Moghadam's outstanding, broad based qualifications and experience," he adds.

"Ascent Solar is among a very few PV companies which has proven technology ready for high-volume manufacturing of CIGS PV material on a plastic substrate," says Moghadam. "There are two key constraints in solar industry today — efficiency and cost. I believe that Ascent Solar, through extensive process development and characterization, has a unique product ready for scale-up."

# Luxembourg cells reach 12% efficiency

The University of Luxembourg's laboratory for photovoltaics (LPV) has produced its first compound semiconductor thin-film solar cells, reaching 12% efficiency already.

Thin-film solar cells are considered to be much cheaper than silicon-based solar cells because they need much less material and energy in their production, but their efficiency is much lower (a theoretical maximum efficiency of about 20%, compared with 44% for crystalline silicon-based solar cells). The university's cells are based on copper indium gallium diselenide (CIGS) and made using a process with what is reckoned to be the potential for the highest performance. Of all the available thin-film technologies, solar cells based on CIGS have shown the highest efficiencies in research and in production, the laboratory says.

In addition, the laboratory is developing new materials and processes for solar cells. The researchers have also produced another solar cell based on a new cheaper material that does not contain costly indium, made by a low-cost galvanic process. This cell reached an efficiency of just 3.2%. This is already close to the record for a cell based on this material (and prepared by a similar low-cost process) of 3.4%.

Currently, the laboratory produces the absorber and buffer layers of the solar cells, explains professor Susanne Siebentritt, head of the laboratory. "But, for completing the solar cells, we rely on the help of our colleagues from Helmholtz-Zentrum Berlin," she adds. The luxembourgish laboratory focuses not only on the development of solar cells but also on furthering the physical understanding of the materials and interfaces in them.

The laboratory for photovoltaics (LPV) was founded in April 2007 within the framework of the TDK Europe professorship, a public–private partnership funded by both the university and TDK. "We have just a few months ago moved into our new labs," says Siebentritt. "This allows us finally to start the solar cell preparation. These are really our first solar cells and they have already reached competitive efficiencies."

**www.uni.lu**

# SPG secures $13m to speed expansion

SPG Holdings LLC of Novato, CA, USA has raised $13m in equity financing from the Global Environment Fund and Robeco.

SPG includes SPG Solar Inc (which designs and installs solar systems) and Thompson Technologies Industries Inc (which designs and makes PV products including trackers and panel mounting equipment).

A recent installation was a 132kW system using Solyndra's CIGS PV panels in Livermore, CA.

The funds will support SPG's growth, and should allow it to secure materials and resources to support its business development. "Both SPG Solar and Thompson Technologies now have the ability to do multiple large-scale projects," says SPG Solar founder & chairman Dan Thompson. The funding will take the firm to the next level in terms of project size and company expansion.

Near-term plans include expansion throughout the USA, and the infusion of capital provides greater ability to respond to the growing opportunities.

**www.spgsolar.com**

# Shin-Etsu launches materials for PV cell processing

Tokyo-based Shin-Etsu Chemical has introduced a range of products designed specifically for the photovoltaic (PV) and solar market.

For thin-film solar cell device manufacturing, Shin-Etsu is offering customized PBN (pyrolytic boron nitride) crucibles, boats and other products for copper indium gallium diselenide (CIGS) film deposition processes.

Both PBN-coated graphite and pure PBN parts offer high purity and stability with very limited outgassing, says the firm. The ceramic parts are high heat and thermal shock resistant with excellent thermal insulation. PBN is chemically stable and non-toxic, and is resistant to oxidation, while impurities are almost undetectable.

The firm also offers PBN/PG (pyrolytic graphite) heaters and PBN-coated graphite heaters for application-specific requirements.

For weatherproofing solar panel junction boxes, Shin-Etsu has also launched new silicone-based potting materials, protecting the electronics encapsulated inside them. These materials quickly cure at room temperature and, after curing, make the junction box both corrosion and moisture proof.

For sealing either the junction box or the PV panel to the frame, new sealing materials offer what is claimed to be superior lap shear strength, fast tack-free/skin-over cure, color and clarity stability and cohesion both before and after curing.

The firm is also offering double stick thermal tape for thermal diffusion of the substrate on the solar module's back sheet, which helps to boost overall efficiency. Once applied, the tape offers superior handling, high peeling-shear strength and can be easily reworked.

The new materials have been introduced to the European and Asian markets and are available to the US market through subsidiary Shin-Etsu MicroSi of Phoenix, AZ, which provides products and materials for photolithography, packaging, PVs and flexible printed circuits. All the materials adhere to IEC (International Electrotechnical Commission) design and safety standards.

**www.shinetsu.co.jp**

# First Solar to build France's largest panel-making plant

Renewable energy firm EDF Energies Nouvelles (EDF EN) of Paris, France has announced a venture for First Solar Inc of Tempe, AZ, USA, which makes thin-film photovoltaic modules based on cadmium telluride, to build and operate France's largest solar panel manufacturing plant. It will also recycle panels, France's first such facility and Europe's only solar panel recycling plant outside Germany. The firms aim to announce the location in the next few months.

With an expected investment of over €90m, EDF EN has agreed to finance half of the capital expense and plant start-up costs in exchange for the entire output for the first 10 years. Initial annualized capacity will exceed 100MWp. At full production (in second-half 2011), the plant will employ more than 300 people.

The venture will support the French government's recently declared goal to become a leader in sustainable energy technologies, including solar electricity. The investment was announced in the presence of French Sustainable Development Minister Jean-Louis Borloo. "I salute the decision of EDF Energies Nouvelles and First Solar to invest and create jobs in France's solar sector, which has begun to take off since the Grenelle de l'Environnement [an open multi-party debate instigated by President Sarkozy in summer 2007 to tackle environmental issue]." The investment confirms that France is in a position to play a leading role globally, he asserts.

EDF EN raised €500m last year to fund its expansion in the PV sector, and has set a target of installing 500MWp in capacity for its own use by 2012. "Securing a competitive supply is essential for us to participate in the development of a large French solar market," says chairman Pâris Mouratoglou. "We have successfully built a number of projects with First Solar panels. This strategic agreement is the result of a relationship built on trust," he adds.

"The decision to invest in France reflects our firm belief in the French market and its great potential," says First Solar's chairman & CEO Mike Ahearn. "It represents a vote of confidence in the policies being developed by the French government since the Grenelle de l'Environnement to promote renewable energies and allow solar electricity to compete economically," he adds.

"Countries that create market frameworks that enable solar and other renewable energies to achieve commercial scale will reap the greatest benefits in private sector investment, technological innovation and job creation," says Ahearn. "The long-term commitments of the French Government to provide the policy and regulatory frameworks that enable robust solar markets and of EDF EN to invest in developing and expanding the French market were key factors in our decision to invest in France."

www.edf-energies-nouvelles.com

# 55MW for Los Angeles; 550MW for Southern California Edison

First Solar has won a contract with the Los Angeles Department of Water and Power (LADWP) to build a large-scale solar power project in Imperial County, CA with a generation capacity of 55MW.

The firm will design, engineer and construct the 55MW Niland project. Construction is expected to start next year and finish in 2011. The contract is conditional on approval by Los Angeles City Council and the mayor of Los Angeles. Also, the solar arrays will require building permits from Imperial County.

First Solar has also struck deals with Southern California Edison (SCE) to build two large-scale projects with a total generation capacity of 550MW (one the largest solar installations of its kind, sufficient to power about 170,000 homes):

- the 250MW Desert Sunlight project near Desert Center, Riverside County; and
- the 300MW Stateline project in northeastern San Bernardino County.

As one of the USA's largest electric utilities, SCE serves a population of nearly 14 million via 4.9 million customer accounts in a 50,000-square-mile service area within Central, Coastal and Southern California. The agreements are subject to approval by the California Public Utilities Commission.

First Solar will engineer, procure and construct the two facilities. Pending network upgrades and receipt of applicable governmental permits, construction is scheduled to begin in 2012 for Desert Sunlight and 2013 for Stateline. Both projects are expected to be completed in 2015. Several hundred construction jobs are expected to be created at each site. When completed, the solar projects should produce 1.2 billion kilowatt-hours of energy per year.

"Supplying solar power to Southern California Edison and its customers advances our mission of providing clean, affordable and sustainable solar electricity," says John Carrington, First Solar's executive VP, marketing & business development. "These projects will help California reach its renewable energy goals, and are powerful examples of large-scale photovoltaic solar generation becoming a reality in the USA."

California aims to deliver 20% of electricity from renewable sources by 2010 but is considering legislation to raise this to 33% by 2020. SCE is the USA's leading buyer of renewable energy and, in 2008, delivered 12.6bn kWhr to its customers from renewable resources — about 16% of its total energy portfolio. Also, in 2008 the utility delivered more than 65% of the solar energy produced in the USA.

www.firstsolar.com

# 5N Plus doubles sales and earnings annually

For its fiscal fourth-quarter 2009 (to end May), high-purity metals and alloy producer 5N Plus Inc of Montreal, Canada has reported revenue of CDN$18.1m (almost double $9.4m a year ago). This boosted fiscal 2009 to a record $69.4m, up 124% on fiscal 2008's $31m (and triple 2007's $21.9m).

5N Plus draws its name from the purity of its products (99.999%, or five nines, and above), which include the metals tellurium, cadmium, selenium, zinc and antimony. It also produces II-VI and III-V compounds like cadmium telluride (CdTe) and cadmium sulphide (CdS) as precursors for growing crystals for electronic applications, including infrared detectors and lenses for night-vision systems, gamma-ray detectors for nuclear imaging in medicine, thermoelectric modules for cooling, and thin-film photovoltaic cells.

"Fiscal year 2009 was the year in which we truly became an international company, with operations and employees in two different countries," says president & CEO Jacques L'Ecuyer. "We completed our international expansion and successfully commissioned our new German facility in Eisenhuttenstadt [the subsidiary 5N PV GmbH, which began shipments of solar-grade products in fiscal Q1/2009]. This $18m investment, our largest project ever, was completed on time and within budget, enabling us to better serve our European customers," he adds. "Interactions and close collaboration between our two facilities has been a determining factor in our ability to improve operational performance, sales and margins and meet the growing demands of our customers."

"Fiscal 2009 was a record-breaking year, with sales, EBITDA and earnings all more than doubling when compared to the previous fiscal year, in spite of the financial turmoil and the difficult economic environment," says L'Ecuyer. Net earnings were $5.7m (up on $2.7m a year ago), taking fiscal 2009 to a record $20.9m (almost triple fiscal 2008's $7.2m). Earnings before interest, taxes, depreciation and amortization (EBITDA) was $8.6m (up 119% on $3.9m a year ago), taking fiscal 2009 to a record $31.4m (up 178% on fiscal 2008's $11.3m).

"This has allowed us to further strengthen our balance sheet and cash position," L'Ecuyer says. Cash flow from operating activities was $5m for the quarter and $16.2m for the fiscal year, versus cash consumption of $3.5m and $2.2m the prior year. In fiscal 2009, cash and cash equivalents rose by from $59.6m to $65.1m. This gives 5N the flexibility to implement its growth plan (investments aimed at accretive acquisitions and diversification of its product range).

"Although 2009 has been more difficult than initially anticipated for the solar industry, we have continued to experience an increasing demand for our solar-grade products for most of the year," says L'Ecuyer. "The recent extension of our supply agreements with our key customer [CdTe PV maker First Solar Inc of Phoenix, AZ, USA, which has a plant in Frankfurt-an-der-Oder] and their corresponding commitments is perhaps the best example." Order backlog (expected to yield sales in the next 12 months) is $52.2m (up 73% on fiscal 2008's $30.2m).

**www.5nplus.com**

# Sunovia/EPIR's second DOE contract targets IR detectors

Sunovia Energy Technologies Inc of Sarasota, FL and its partner EPIR Technologies Inc of Bolingbrook, IL (in which Sunovia has a stake) say that the US Department of Energy has awarded a second contract to EPIR to provide improved infrared (IR) detectors to be used in a new generation of Fourier transform infrared (FTIR) tools for the non-destructive inspection and characterization of IR materials and products (especially for quality control in production environments).

Founded in 1998, EPIR develops IR products (many of which are developed and produced under contracts with the US Department of Defense). Sunovia is their exclusive distributor.

The IR detectors to be produced are based on II-VI materials (cadmium telluride on silicon, CdTe/Si), similar to those used in the ultra-high-efficiency multi-junction solar cells that are being jointly developed by Sunovia and EPIR (also under DOE sponsorship, after the first award at the end of May). The firms believe the solar cells will outperform the most efficient cells produced currently, but at a fraction of their cost.

"While II-VI materials have been the state-of-the-art in infrared detection for years, they are just now beginning to impact the solar industry with the emergence of thin-film CdTe technology," says EPIR founder & CEO Dr Siva Sivananthan. "The single-crystal II-VI materials we have developed for IR applications can be tuned more precisely and to a wider degree than those of the materials currently used in ultra-high-efficiency solar cells. This allows us to more efficiently split the solar spectrum and thus achieve higher-performance solar cells," he adds.

"Government funding is an important element in the early success of the Sunovia–EPIR partnership, not only for its financial impact but also because it demonstrates the value of the advanced technology we are jointly developing," says Sunovia's co-founder & CEO Carl Smith. "The success of EPIR's IR detection business, along with the growth of Sunovia's leading-edge LED illumination business, will generate cash that will help fund our important work in developing ultra-high-efficiency solar cells."

**www.sunoviaenergy.com**
**www.epir.com**

# New angle on approach to green lasers

**Mike Cooke reports on UCSB's use of 1°-miscut m-plane GaN substrates to develop blue–green lasers with lower threshold current densities than is achieved using on-axis c-plane GaN.**

Shuji Nakamura's group at University of California Santa Barbara (UCSB) has reported on a blue–green laser diode (LD) based on a miscut m-plane gallium nitride (GaN) substrate [You-Da Lin et al, Applied Physics Express, vol.2, p.082102, 2009]. Nakamura is responsible for much of the development and commercialization of GaN as a light-emitting material for electronics as part of Nichia Corp in Japan in the late 1980s and all through the 1990s until he became a UCSB professor in 1999. Also involved in the research is a researcher from Mitsubishi Chemical's Optoelectronics Laboratory, Kenji Fujito, who has worked on hydride vapor phase epitaxy (HVPE) of high-quality non-polar m-plane GaN substrates [Fujito et al, physica status solidi (a), vol.205, p.1056, 2007].

While producing red and blue laser light from semiconductors is relatively simple, producing green lasers has been much harder. At present, green laser light (520–570nm) in commercial LD-based systems, such as overhead projectors, is most often produced using conversion from sources emitting another frequency via second harmonic generation (SHG).

This year has seen a number of groups publish papers describing various approaches to producing green lasers in the III-nitride material system with indium gallium nitride (InGaN) active layers. In February, Rohm pushed InGaN laser wavelengths out to 499.8nm; in March, Osram crossed the 500nm boundary; in May, Nichia reported a 515nm device; and in July Sumitomo Electric Industries reported pulsed lasing at 531nm (see page 46).

**One problem for c-plane laser diodes in the blue–green region has been low slope efficiency. Devices using m-plane substrates demonstrate better slope efficiency than those grown on c-plane GaN, meaning that more of the extra power delivered beyond the threshold becomes laser light**

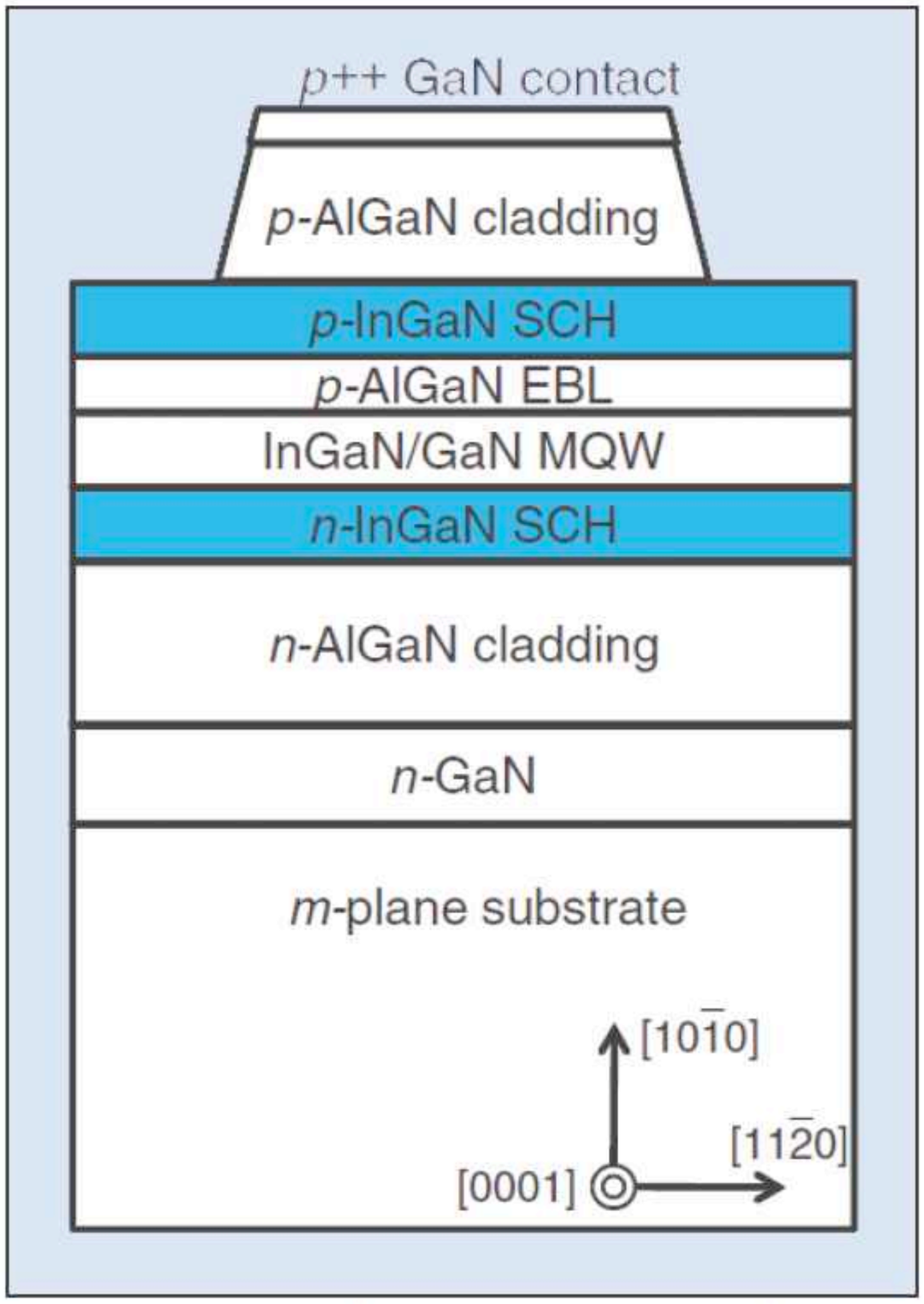



**Figure 1. Schematic of laser diode structure used by UCSB. SCH = separate confinement heterostructure; EBL = electron blocking layer.**

These developments use various techniques to improve material quality, which is particularly key for the active layer where indium concentrations have to exceed 20% to achieve suitable energy band gaps to produce green light. High-indium-content InGaN is notoriously difficult to grow with the high quality demanded from laser applications.

Although the UCSB work has only reached 481nm so far, the researchers point to improved performance by using miscut non-polar substrates in terms of lasing threshold currents and slope efficiency that suggest moving to longer wavelengths should be 'easy' and a possible route to realizing high-power green laser diodes.

Normally LDs are grown on c-plane GaN, but large polarization fields arise. Such fields separate the electron and hole wave-functions, reducing their ability to radiate light by recombination. An advantage of m-plane GaN is that it is non-polar. Violet m-plane GaN LDs were reported in 2007 and also were the basis of Rohm's work.

One problem for c-plane LDs in the blue–green region has been low slope efficiency. Devices using m-plane substrates demonstrate better slope efficiency than those grown on c-plane GaN, meaning that more of the extra power delivered beyond the threshold becomes laser light.

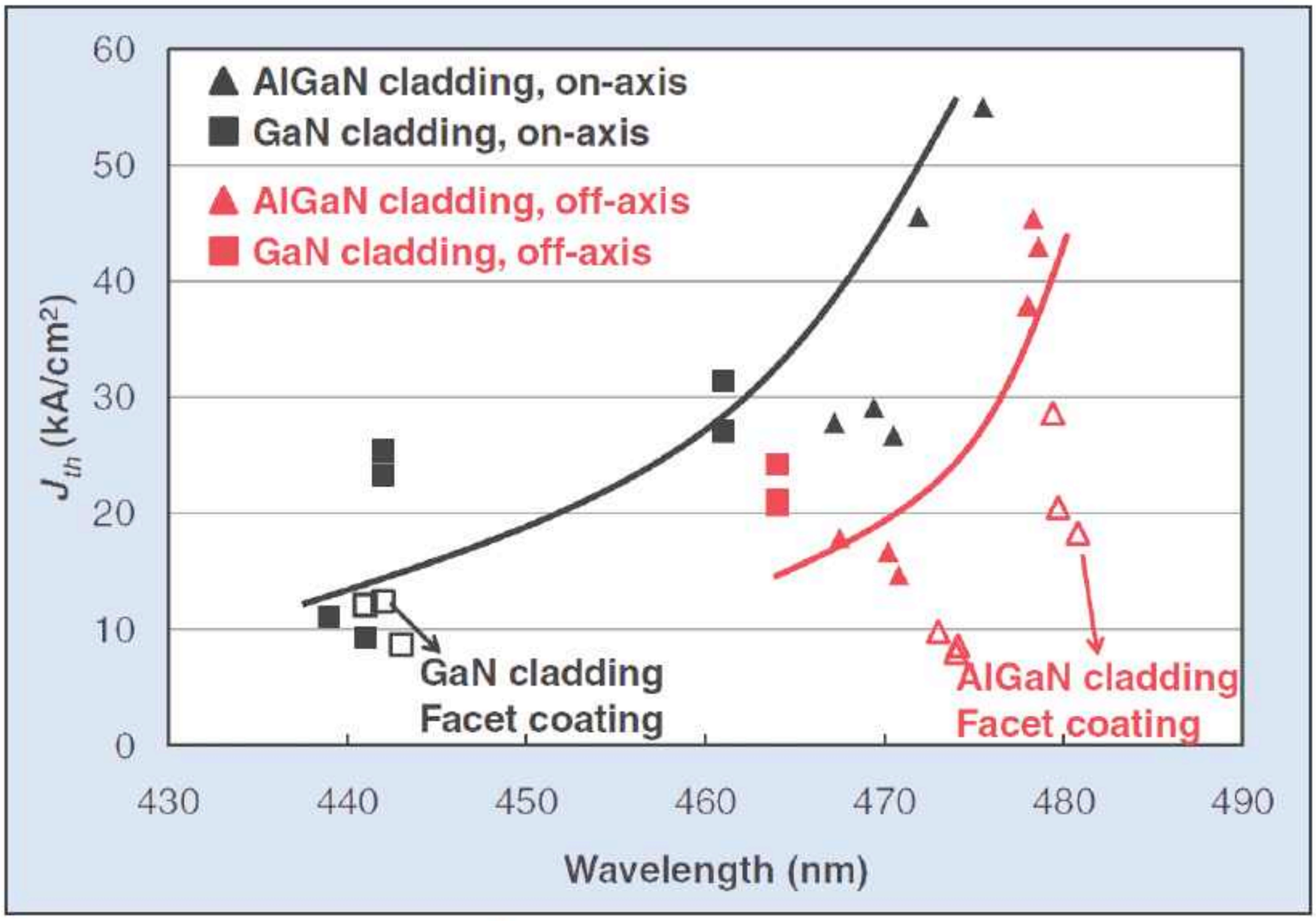



**Figure 2. Dependence of threshold current density on lasing wavelength for various laser diodes produced by UCSB using on-axis and 1° towards [000$\bar{1}$] direction misoriented substrates.**

For the UCSB laser diodes, the m-plane GaN substrate was miscut about 1° in the [000$\bar{1}$] (-c) direction. Miscutting of substrates is commonly used to improve or manipulate material quality on a wide range of substrates. [For a recent example involving improving quantum dot shapes and sizes on an indium phosphide (InP) substrate, see 'Optimizing InP substrate orientation for 1.55μm InAs QD telecom lasers' — www.semiconductor-today.com/news_items/2009/JULY/INP_140709.htm].

UCSB used metal organic chemical vapor deposition (MOCVD) to grow the LD. The active layer was a three-period multi-quantum well (10 nm undoped $In_{0.03}Ga_{0.97}N$ barriers, 3nm InGaN wells with ~26% In estimated through high-resolution x-ray diffraction). Electron blocking layers (EBLs) and separate confinement heterostructures (SCHs) were also used (Figure 1).

Ridge lasers pointing in the c-direction were formed using normal photolithography and etch processes. Nomarski and fluorescence optical microscopy of laser diode surfaces grown on nominal on-axis and miscut substrates showed significantly smoother surface without 'hillocks' for the laser diode on miscut substrate. Also, photoluminescence was much more homogeneous for the miscut substrate device.

A comparison of 2x500μm laser diodes with uncoated facets in pulsed operation (1% duty cycle) show a lower threshold current (153mA, compared with 413mA for nominal on-axis device) for the miscut substrate. Further, less blue shift was seen in moving from spontaneous to laser emission (~483nm spontaneous wavelength for both miscut and nominal, 471nm miscut lasing, 461nm on-axis lasing). These properties are attributed to larger indium fluctuations in the on-axis samples. A clarification of the mechanisms is promised in a future publication from the group.

The threshold current density tends to increase with wavelength (Figure 2), but with the miscut devices generally reporting a lower value. The longest lasing wavelength found was 481nm (10nm from spontaneous photoluminescence at 491nm) from a coated facet device in 1% duty pulsed operation.

**http://apex.ipap.jp/link?APEX/2/082102/**
**http://dx.doi.org/10.1002/pssa.200778709**

**A comparison of 2x500μm laser diodes with uncoated facets in pulsed operation (1% duty cycle) show a lower threshold current (153mA, compared with 413mA for nominal on-axis device) for the miscut substrate. Less blue shift was seen in moving from spontaneous to laser emission**

*The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.*

# Fujitsu develops GaN HEMT for use in power supplies

**Record current density of 829mA/mm has been achieved with an on-state voltage of over 2V and complete current interruption in standby.**

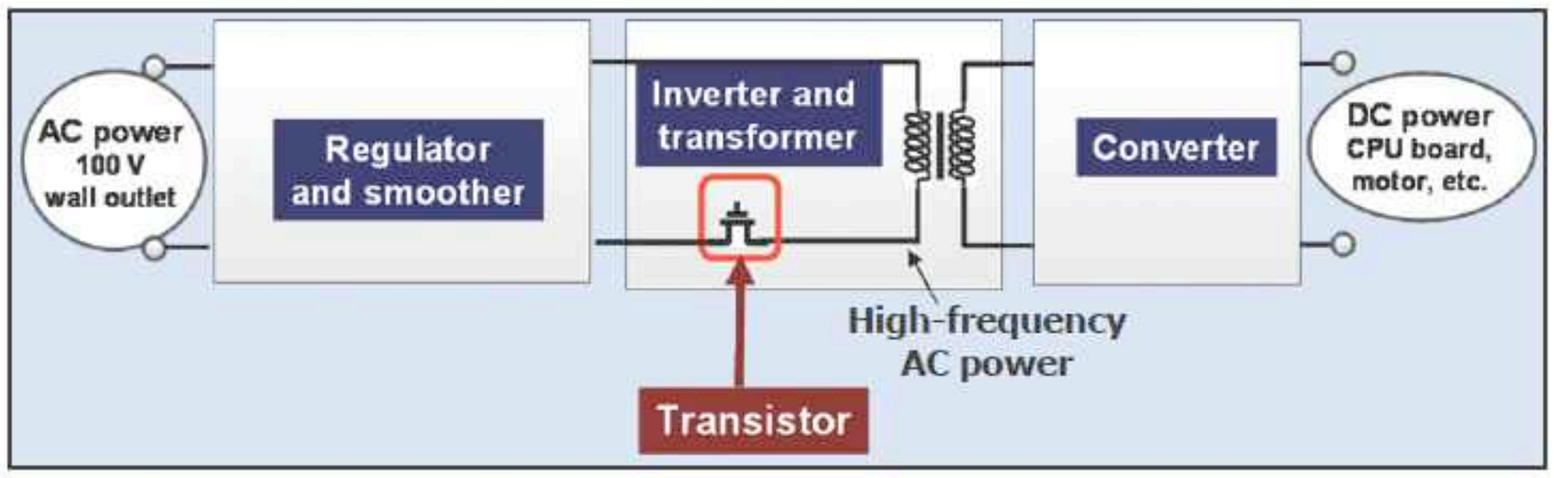



Figure 1. Schematic view of power supply.

At the Device Research Conference (DRC 2009) at Penn State University (22–24 June), Fujitsu Laboratories Ltd of Kawasaki, Japan presented the development of a new structure for gallium nitride high-electron-mobility transistors (GaN HEMTs) that is claimed to be able to minimize power loss in power supplies, enabling reduced power consumption by electronic equipment such as IT hardware and home electronics.

For power supplies used in electronic hardware (Figure 1), power lost as heat can account for 30% or more of the total power consumed by the device. Also, waste heat creates the need for additional cooling equipment, resulting in a ripple effect of increased power consumption, says Fujitsu.

A desirable characteristic for power supplies used in products such as PCs, home appliances and automobiles is therefore complete current interruption in standby mode, in which no voltage is applied to the gate electrodes. Conventional GaN HEMTs have required a negative gate voltage to be applied when in standby.

At last September's International Symposium on Compound Semiconductors (ISCS 2008) in Rust, Germany, Fujitsu reported the development of a three-layer cap structure for GaN HEMTs — by sandwiching an aluminium nitride (AlN) layer between n-type GaN layers — which can suppress the

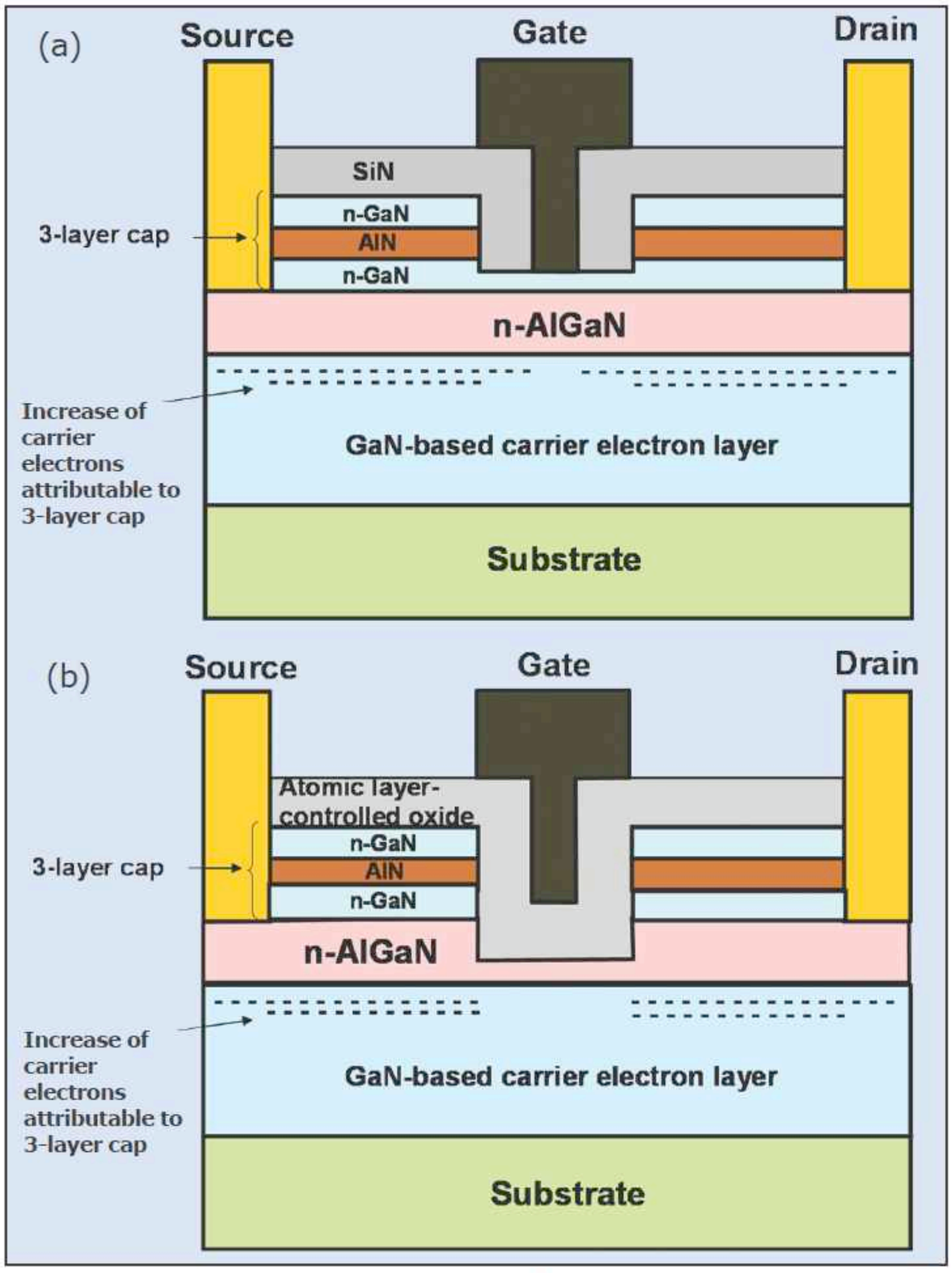



Figure 2. (a) GaN HEMT structure developed by Fujitsu in 2008 for wireless communication base-station amplifiers. (b) New structure for power supplies.

current when in standby (Figure 2a). The new GaN HEMT structure was originally developed for wireless transmission amplifiers. However, because the voltage that was applied at the gate electrode in order to switch between on and off states (the turn-on voltage) was in the range of 0.5V, it could not be used for power supplies, which need to apply +2–4V in order to apply hundreds of volts at the drain electrode. In addition, power supplies effectively need to have an on-state current density of at least 600mA/mm.

**Power supplies effectively need to have an on-state current density of at least 600mA/mm**

As well as the three-layer cap structure, Fujitsu made the two following GaN HEMT advances (Figure 2b):

- A technology was developed for precise removal of the cap layers and part of the AlGaN layer only beneath the gate electrode. By leaving a thin n-type AlGaN layer on the GaN carrier layer, while suppressing damage to the GaN layer, on-state voltage can be increased beyond +2V while preserving the total interruption in standby, enabling high-speed performance when turned on.
- A gate structure was developed that uses an insulated-gate structure with an atomic-layer-controlled oxide film that has atom-level flatness. Because this suppresses gate leakage current in which travelling electrons flow to the gate electrode when turned on, a positive voltage can be applied to the gate electrode, resulting in high on-state current density.

The on-state voltage of the new transistor reaches +3V, which can easily be applied to power supplies while achieving a current density of 829mA/mm — double that of the transistor design on which it is based — resulting in high current values (Figure 3). Among transistors that can achieve an on-state voltage of at least +2V and completely interrupt current when off, the new transistor features record on-state current density, making it the first GaN HEMT that has the characteristics required for power supplies, it is claimed (Figure 4).

**By leaving a thin n-type AlGaN layer on the GaN carrier layer, while suppressing damage to the GaN layer, on-state voltage can be increased beyond +2V**

Since the new GaN HEMT technology blocks the flow of current from power supplies in standby mode and produces high on-state current density, it has the potential to cut power consumption of electronic equipment by one-third, compared to that of power supplies based on conventional silicon transistors, Fujitsu reckons. Extrapolated to all data centers in Japan — and taking into account the knock-on benefits of energy savings enabled through reduced air-conditioning electricity required for cooling — this could cut data-center power consumption in Japan by 12%, cutting the country's total $CO_2$ emissions by 330,000 tons, it is reckoned.

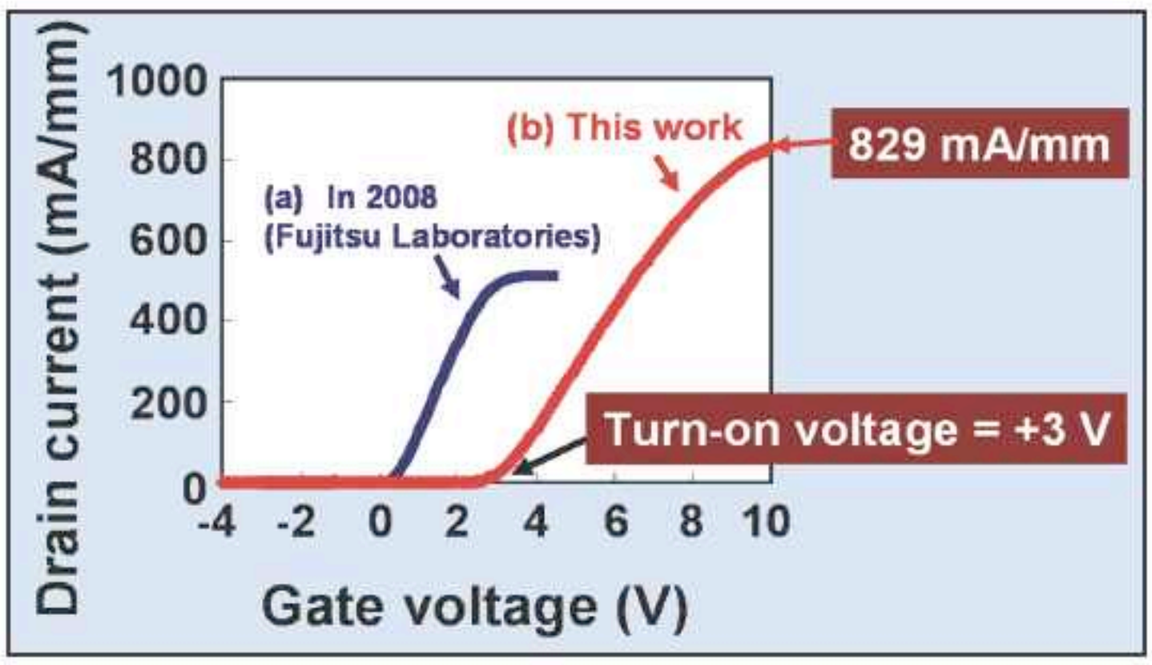



**Figure 3. Transistor characteristics of the new GaN HEMT.**

Also, the high-frequency performance of the new transistors can enable more compact power supplies. High-speed transistor operation would allow for more compact coils and transformers, which have been particularly difficult to miniaturize in conventional power supplies with low-frequency operation: the size of AC adapters for notebook PCs, for example, could be reduced to one-tenth of current sizes, says Fujitsu. Smaller power supplies would also contribute to reducing space requirements for data centers.

Fujitsu says that it is progressing with practical implementations of GaN transistors featuring high breakdown voltages, with the aim of producing power supplies based on them by about 2011. ■

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

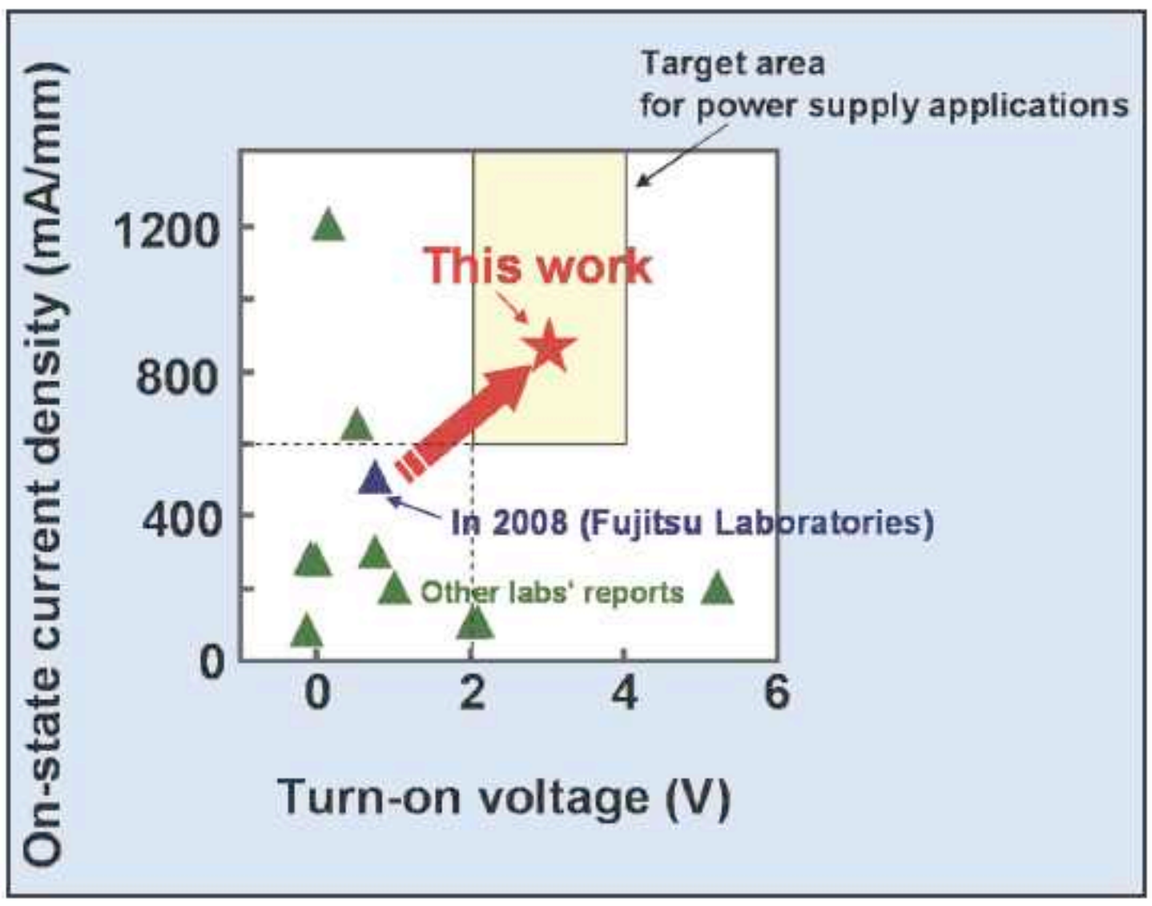



**Figure 4. Maximum current density and turn-on voltage (threshold voltage) benchmarks for the new GaN HEMT (transistors with a breakdown voltage of 100V or higher in which current can be interrupted during standby without applying a negative gate voltage).**

# suppliers' directory

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## 7 Wafer processing materials

**Air Products and Chemicals Inc**
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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
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Fax: +43 7712 5311 4600
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**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

**Surface Technology Systems plc**
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**TECDIA Inc**
(see section 16 for full contact details)

**Tegal Corp**
2201 S McDowell Boulevard,
Petaluma,
CA 94954,
USA
Tel: +1 707 763 5600
www.tegal.com

**Veeco Instruments Inc**
(see section 6 for full contact details)

## 9 Materials & metals

**Goodfellow Cambridge Ltd**
Ermine Business Park,
Huntingdon, Cambridgeshire
PE29 6WR,
UK
Tel: +44 (0) 1480 424800
Fax: +44 (0) 1480 424900
www.goodfellow.com
Goodfellow supplies small quantities of metals and materials for research, development, prototyping and specialised manufacturing operations.

**TECDIA Inc**
(see section 16 for full contact details)

## 10 Gas and liquid handling equipment

**Air Products and Chemicals Inc**
(see section 7 for full contact details)

**Cambridge Fluid Systems**
12 Trafalgar Way, Bar Hill,
Cambridge
CB3 8SQ,
UK
Tel: +44 (0)1954 786800
Fax: +44 (0)1954 786818
www.cambridge-fluid.com

**CS CLEAN SYSTEMS AG**
Fraunhoferstrasse 4,
Ismaning, 85737,
Germany
Tel: +49 89 96 24 00 0
Fax: +49 89 96 24 00 122
www.cscleansystems.com

**EMF Semiconductor Systems Ltd**
(see section 6 for full contact details)

**IEM Technologies Ltd**
Fothergill House, Colley Lane,
Bridgwater, Somerset TA6 5JJ,
UK
Tel: +44 (0)1278 420555
Fax: +44 (0)1278 420666
www.iemtec.com

**Power + Energy Inc**
106 Railroad Drive,
Ivyland, PA 18974,
USA
Tel: +1 215 942-4600
Fax: +1 215 942-9300
www.powerandenergy.com

**SAES Pure Gas Inc**
4175 Santa Fe Road,
San Luis Obispo, CA 93401,
USA
Tel: +1 805 541 9299
Fax: +1 805 541 9399
www.saesgetters.com

## 11 Process monitoring and control

**EMF Semiconductor Systems Ltd**
(see section 6 for full contact details)

**k-Space Associates Inc**
3626 W. Liberty Rd.,
Ann Arbor, MI 48103,
USA
Tel: +1 734 668 4644
Fax: +1 734 668 4663
www.k-space.com
k-Space Associates Inc specializes in in-situ, real-time thin-film process monitoring tools for MBE, MOCVD, PVD, and thermal evaporation. Applications and materials include the research and production line monitoring of compound semiconductor-based electronic, optoelectronic, and photovoltaic devices.

**LayTec GmbH**
Helmholtzstr. 13-14, Berlin, 10587
Germany
Tel: +49 30 39 800 80 0
Fax: +49 30 3180 8237
www.laytec.de

**Optical Reference Systems Ltd**
OpTIC Technium, St Asaph
Business Park, St Asaph, LL17 0JD,
UK
Tel: +44 (0)1745 535 188
Fax: +44 (0)1745 535 186
www.ors-ltd.com

**WEP (Ingenieurbüro Wolff für Elektronik- und Programmentwicklungen)**
Bregstrasse 90, D-78120
Furtwangen im Schwarzwald,
Germany
Tel: +49 7723 9197 0
Fax: +49 7723 9197 22
www.wepcontrol.com

## 12 Inspection equipment

**Bruker AXS GmbH**
Oestliche Rheinbrueckenstrasse 49,
Karlsruhe, 76187,
Germany
Tel: +49 (0)721 595 2888
Fax: +49 (0)721 595 4587
www.bruker-axs.de

**KLA-Tencor**
160 Rio Robles, Suite 103D,
San Jose, CA 94538-7306,
USA
Tel: +1 408 875 3000
Fax: +1 510 456 2498
www.kla-tencor.com

## 13 Characterization equipment

**J.A. Woollam Co. Inc.**
645 M Street Suite 102,
Lincoln, NE 68508,
USA
Tel: +1 402 477 7501
Fax: +1 402 477 8214
www.jawoollam.com

**Lake Shore Cryotronics Inc**
575 McCorkle Boulevard,
Westerville, OH 43082,
USA
Tel: +1 614 891 2244
Fax: +1 614 818 1600
www.lakeshore.com

## 14 Chip test equipment

**Keithley Instruments Inc**
28775 Aurora Road,
Cleveland, OH 44139,
USA
Tel: +1 440.248.0400
Fax: +1 440.248.6168
www.keithley.com

**SUSS MicroTec Test Systems**
228 Suss Drive,
Waterbury Center,
VT 05677,
USA
Tel: +1 800 685 7877
Fax: +1 802 244 7853
www.suss.com

## 15 Assembly/packaging materials

**ePAK International Inc**
4926 Spicewood Springs Road,
Austin, TX 78759,
USA
Tel: +1 512 231 8083
Fax: +1 512 231 8183
www.epak.com

**Gel-Pak**
31398 Huntwood Avenue,
Hayward, CA 94544,
USA
Tel: +1 510 576 2220
Fax: +1 510 576 2282
www.gelpak.com

**Williams Advanced Materials**
2978 Main Street, Buffalo, NY 14214,
USA
Tel: +1 716 837 1000
Fax: +1 716 833 2926
www.williams-adv.com

## 16 Assembly/packaging equipment

**Ismeca Europe Semiconductor SA**
Helvetie 283,
La Chaux-de-Fonds, 2301,
Switzerland
Tel: +41 329257111
Fax: +41 329257115
www.ismeca.com

**J P Sercel Associates Inc**
220 Hackett Hill Road,
Manchester, NH 03102,
USA
Tel: +1 603 518 3200
Fax: +1 603 518 3298
www.jpsalaser.com

**Kulicke & Soffa Industries**
1005 Virginia Drive,
Fort Washington, PA 19034,
USA
Tel: +1 215 784 6000
Fax: +1 215 784 6001
www.kns.com

**Palomar Technologies Inc**
2728 Loker Avenue West,
Carlsbad, CA 92010,
USA
Tel: +1 760 931 3600
Fax: +1 760 931 5191
www.PalomarTechnologies.com

**TECDIA Inc**
2700 Augustine Drive, Suite 110,
Santa Clara, CA 95054,
USA
Tel: +1 408 748 0100
Fax: +1 408 748 0111
www.tecdia.com

Tecdia is a manufacturer of single-layer chip capacitors, chip resistors, DC boards, bias-Ts, diamond scribing tools and dispensing nozzles.

## 17 Assembly/packaging foundry

**Quik-Pak**
10987 Via Frontera,
San Diego, CA 92127, USA
Tel: +1 858 674 4676
Fax: +1 8586 74 4681
www.quikicpak.com

## 18 Chip foundry

**Compound Semiconductor Technologies Ltd**
Block 7, Kelvin Campus,
West of Scotland, Glasgow,
Scotland G20 0TH,
UK
Tel: +44 141 579 3000
Fax: +44 141 579 3040
www.compoundsemi.co.uk

**United Monolithic Semiconductors**
Route departementale 128,
BP46, Orsay, 91401,
France
Tel: +33 1 69 33 04 72
Fax: +33 169 33 02 92
www.ums-gaas.com

## 19 Facility equipment

**MEI, LLC**
3474 18th Avenue SE,
Albany, OR 97322-7014, USA
Tel: +1 541 917 3626
Fax: +1 541 917 3623
www.marlerenterprises.net

## 20 Facility consumables

**W.L. Gore & Associates**
401 Airport Rd,
Elkton, MD 21921-4236,
USA
Tel: +1 410 392 4440
Fax: +1 410 506 8749
www.gore.com

## 21 Computer hardware & software

**Ansoft Corp**
4 Station Square, Suite 200,
Pittsburgh, PA 15219,
USA
Tel: +1 412 261 3200
Fax: +1 412 471 9427
www.ansoft.com

**Crosslight Software Inc**
121-3989 Henning Dr.,
Burnaby, BC, V5C 6P8,
Canada
Tel: +1 604 320 1704
Fax: +1 604 320 1734
www.crosslight.com

**Semiconductor Technology Research Inc**
10404 Patterson Ave., Suite 108,
Richmond, VA 23238,
USA
Tel: +1 804 740 8314
Fax: +1 804 740 3814
www.semitech.us

## 22 Used equipment

**Class One Equipment Inc**
5302 Snapfinger Woods Drive,
Decatur, GA 30035, USA
Tel: +1 770 808 8708
Fax: +1 770 808 8308
www.ClassOneEquipment.com

## 23 Services

**Henry Butcher International**
Brownlow House,
50–51 High Holborn,
London WC1V 6EG,
UK
Tel: +44 (0)20 7405 8411
Fax: +44 (0)20 7405 9772
www.henrybutcher.com

**M+W Zander Holding AG**
Lotterbergstrasse 30, Stuttgart,
Germany
Tel: +49 711 8804 1141
Fax: +49 711 8804 1950
www.mw-zander.com

**TECDIA Inc**
(see section 16 for full contact details)

## 24 Consulting

**WSR Optical Device Solutions**
P.O. Box 248, Flemington,
NJ 08822,
USA
Tel: +1 908 428 4986
www.wsr-ods.com

## 25 Resources

**SEMI Global Headquarters**
3081 Zanker Road,
San Jose, CA 95134,
USA
Tel: +1 408 943 6900
Fax: +1 408 428 9600
www.semi.org

**Yole Développement**
45 rue Sainte Geneviève,
69006 Lyon,
France
Tel: +33 472 83 01 86
www.yole.fr

# event calendar

**If you would like your event listed in *Semiconductor Today*'s Event Calendar, then please e-mail all details to the Editor at mark@semiconductor-today.com**

**30 August – 3 September 2009**
**CLEO/Pacific Rim 2009 (Conference on Lasers & Electro Optics & the Pacific Rim Conference on Lasers & Electro-Optics)**
Shanghai International Convention Center, China
**E-mail**: cleopr2009@siom.ac.cn
www.siom.cn/cleo

**31 August – 4 September 2009**
**NUSOD '09 (9th International Conference on Numerical Simulation of Optoelectronic Devices)**
Gwangju Institute of Science and Technology (GIST), South Korea
**E-mail**: piprek@nusod.org
www.nusod.org/2009

**6–9 September 2009**
**11th China International Optoelectronic Exposition (CIOE 2009)**
Shenzhen Convention & Exhibition Center, China
**E-mail**: nancy@cioe.cn
www.opto-china.com

**6–10 September 2009**
**Diamond 2009: 20th European Conference on Diamond, Diamond-like Materials, Carbon Nanotubes and Nitrides**
Athens, Greece
**E-mail**: ch.wilkins@elsevier.com
www.diamond-conference.elsevier.com

**14–18 September 2009**
**Solid-State Device Research — 39th European Conference (ESSDERC-2009) and Solid-State Circuits Research — 35th European Conference (ESSCIRC-2009)**
Athens, Greece
**E-mail**: info@essderc2009.org
www.esscirc2009.org

**14–18 September 2009**
**4G World 2009 (formerly WiMAX World USA)**
Chicago, IL, USA
**E-mail**: info@trendsmedia.com
http://4gworld.com

**16–17 September 2009**
**LED Japan Conference & Exhibition: Strategies in Light**
Yokohama, Japan
**E-mail**: tcarli@strategies-u.com
http://led08.events.pennnet.com

**20–24 September 2009**
**ECOC 2009 (35th European Conference and Exhibition on Optical Communication)**
Austria Center, Vienna, Austria
**E-mail**: ecoc2009@ove.at
www.ecoc2009.at

# advertisers' index

**21–25 September 2009**
## 2009 International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz)
Busan, Korea
**E-mail**: phs@caltech.edu
www.irmmw-thz.org

**21–25 September 2009**
## 24th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC)
Hamburg, Germany
**E-mail**: pv.conference@wip-munich.de
www.photovoltaic-conference.com

**28 September – 2 October 2009**
## 12th European Microwave Week (EuMW2009)
Rome , Italy
**E-mail**: vandervorst@eumwa.org
www.eumwa.org

**30 September – 1 October 2009**
## Deutscher MBE Workshop
Ruhr-Universität Bochum, Germany
**E-mail**: mbe2009@ruhr-uni-bochum.de
www.ruhr-uni-bochum.de/mbe2009

**30 September – 2 October 2009**
## SEMICON Taiwan
Taipei World Trade Center, Taiwan
**E-mail**: jacky@leadexpo.com
www.semicontaiwan.org

**1–4 October 2009**
## LED Fair
IDTM Istanbul Expo Centre, Turkey
**E-mail**: marmara@marmarafuar.com.tr
www.ledfuari.com

**4–9 October 2009**
## 216th Meeting of the Electrochemical Society (ECS 2009)
Vienna, Austria
**E-mail**: meetings@electrochem.org
www.electrochem.org/meetings/biannual/216/216.htm

**5–9 October 2009**
## ITU Telecom World 2009
Palexpo, Geneva, Switzerland
**E-mail**: jean-claude.dufour@itu.int
www.itu.int/WORLD2009

**6–8 October 2009**
## SEMICON Europa 2009
Messe Dresden (Dresden Exhibition Center), Germany
**E-mail**: ljaeth@semi.org
www.semiconeuropa.org

**7–9 October 2009**
## PV Taiwan 2009 (Taiwan International Photovoltaic Forum & Exhibition)
Taipei World Trade Center Exhibition Hall, Taiwan
**E-mail**: pv@taitra.org.tw
www.pvtaiwan.com

**11–14 October 2009**
## 2009 IEEE Compound Semiconductor IC Symposium (CSIC 2009), including the 23rd annual Reliability of Compound Semiconductors (ROCS) Workshop
Greensboro, NC, USA
**E-mail**: customer.service@ieee.org
www.csics.org

**11–16 October 2009**
## International Conference on Silicon Carbide and Related Materials (ICSCRM) 2009
Nuremberg, Germany
**E-mail**: info@icscrm2009.org
www.icscrm2009.org

**14–15 October 2009**
## Photonex 2009
Stoneleigh Exhibition Halls, Coventry, UK
**E-mail**: info@photonex.org
www.photonex.org

**18–23 October 2009**
## 8th International Conference on Nitride Semiconductors (ICNS-8)
International Convention Center, Jeju Island (ICC Jeju), Korea
Abstract deadline: 15 June 2009
**E-mail**: secretary@icns8.org
http://icns8.org

**20–21 October 2009**
## LEDs 2009 Conference
San Diego Convention Center, CA, USA
**E-mail**: olga.adamovich@pira-international.com
www.ledsconference.com

**21–23 October 2009**
## ILOPE (14th International Lasers, Optics and Photonics Exhibition)
Beijing, China
**E-mail**: lishu@ciec.com.cn
www.ilope-expo.com/en

**27–29 October 2009**
## Solar Power International 2009
Anaheim Convention Center, CA, USA
**E-mail**: sep081@experient-inc.com
www.solarpowerinternational.com



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