

# semiconductor **TODAY**

COMPOUNDS & ADVANCED SILICON

Vol. 3 • Issue 3 • April 2008

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## Raising the high-power laser bar Sharp boosts Blu-ray lasers Photonic integration


RFMD centers test in Beijing • Emcore adds Intel's datacoms  
Saint-Gobain buys Lumilog • Oxford Instruments acquires TDI

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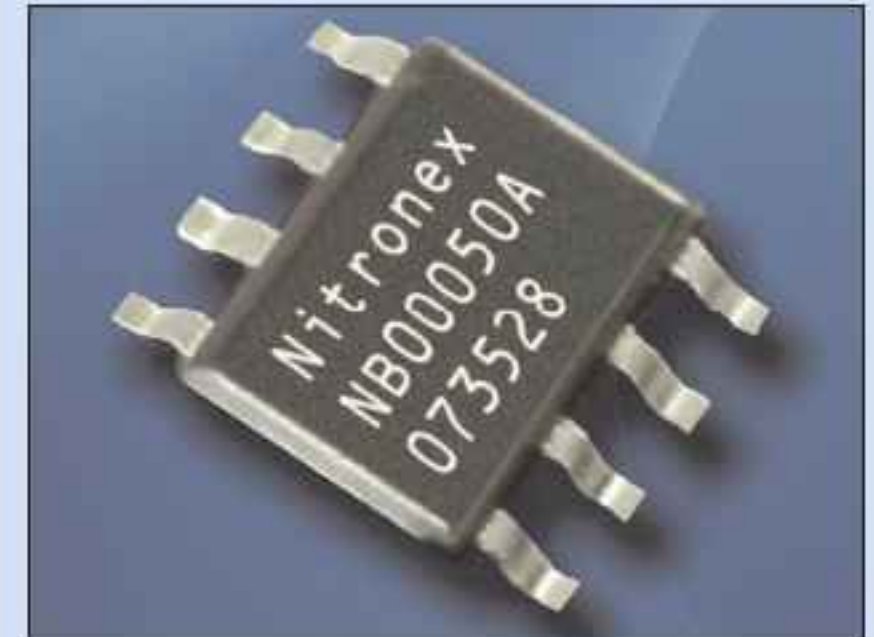


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<b>Editorial</b>	<b>2</b>
<b>News</b>	
<b>Markets</b>	<b>4</b>
LEDs to replace CCFLs in notebook-PC backlights • GaAs demand from digital cable to top \$100m by 2012 • Solar VC investment reaches record in Q1	
<b>Micro</b>	<b>6</b>
RFMD consolidating production test in Beijing; first Polaris 3 Silver orders • AWR and TriQuint JumpStart GaAs MMIC design • Skyworks extends Kopin HBT supply deal	
<b>Wide-bandgap electronics</b>	<b>16</b>
Nitronex collaborating with Merrimac and Nujira • Raytheon demos GaN in radar components • E-mode SiC JFETs boost solar inverters efficiency	
<b>Materials and processing equipment</b>	<b>20</b>
Bede bought by x-ray metrology equipment maker Jordan Valley • Palomar triples capacity for assembly & test services • Aviza cuts DRAM dependence	
<b>Nitride substrates</b>	<b>26</b>
Saint-Gobain buys GaN supplier Lumilog • Energomera acquires sapphire substrate maker Atlas PCF • Oxford Instruments acquires TDI	
<b>LEDs</b>	<b>28</b>
TSMC backs \$40m Bridgelux funding • LED University launched • Osram opens Regensburg expansion and Asian HQ • Seoul and Everlight settle with Rothschild	
<b>Optoelectronics</b>	<b>36</b>
BRILASI raises bar for high-power lasers • DILAS opens China plant • Sharp targets 400mW Blu-ray laser for 8–12x recording by 2010	
<b>Optical communications</b>	<b>39</b>
Syntune takes over chip supplier Svedice • BeamExpress raises first-round funds • Innolume launches O-band WDM comb laser • Emcore adds Intel's optical datacoms group	
<b>Photovoltaics</b>	<b>45</b>
Emcore wins \$4.6m follow-on order for CPV assemblies • Spectrolab wins 350MW CPV assembly order from Australia	
<b>Technology focus: Photonic integration</b>	<b>48</b>
<b>Infinera targeting PICs of 4Tb/s within 10 years</b>	
Infinera outlines its roadmap to integrating more components and wavelengths into InP-based photonic integrated circuits.	
<b>Suppliers' Directory</b>	<b>50</b>
<b>Event Calendar</b>	<b>56</b>
<b>Advertisers' Index</b>	<b>56</b>

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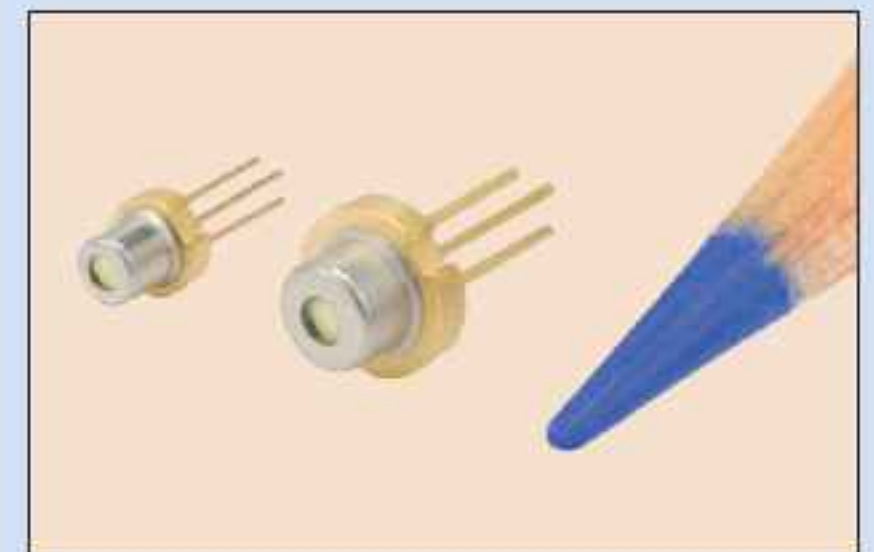
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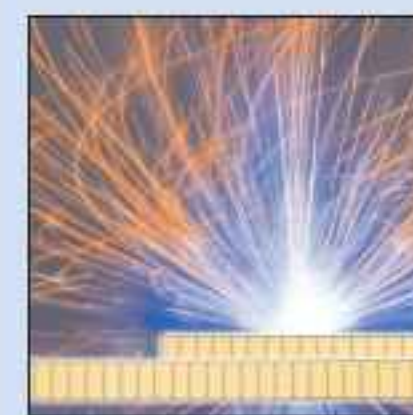
**p16** Nitronex's 45W GaN-on-Si HEMT for high-PAR use at 2.5 and 3.5GHz.



**p32** CEO Rüdiger Müller at dragon 'eye painting' ceremony during official opening of Osram Opto's Asia regional headquarters in Hong Kong.



**p37** Sharp's new 3.3mm (left) and 5.6mm (right) 250mW blue-violet laser for 6x Blu-ray disc recording in laptop and desktop PCs, respectively.



**Cover:** As part of Germany's BRILASI research project, Osram Opto Semiconductors has produced 910–980nm-wavelength laser bars with an output of 120W and an efficiency of 70% under real industrial conditions, as well as 808–880nm-wavelength bars with an efficiency of 62%. **p36**

# Consolidation and streamlining

This issue, as well as catching up on Infinera's roadmap for photonic integration reported at March's OFC/NFOEC event in San Jose (page 48), we report Emcore's acquisition of the enterprise, storage and optical cable assets of Intel's Optical Platform Division (page 44). This follows Emcore's acquisition of the telecom-related portion of the same division (announced in mid-December and completed in late February). The latest divestment by Intel marks its exit from the optical communications industry, as it focuses on its core microprocessor market. For Emcore, it bolsters its telecoms-focused optical communications business by adding datacom products (especially in 10 Gigabit Ethernet datacoms and storage-area network transceivers) in the run up to the firm's separation into two corporations (Fiber Optics and Photovoltaics).

Meanwhile, terrestrial concentrator photovoltaic (CPV) orders continue to roll in, most recently follow-on orders for the solar cell receiver assemblies of both Emcore (for Concentration Solar la Mancha in Spain — see page 45) and Spectrolab (for Solar Systems Pty Ltd in Australia). The boom in interest in GaAs-based CPVs for terrestrial solar energy generation is also driving other currently non-PV-focused GaAs manufacturers to investigate utilizing their existing infrastructure to diversify from RFIC production, for example, into wafer processing for solar cells. These include HBT epiwafer foundry Kopin and the world's biggest GaAs RFIC maker, RF Micro Devices (see next issue for more details, along with a full report from April's CS MANTECH 2008 conference in Chicago).

In the interim, in RFIC manufacturing, RFMD is continuing to cut costs by reducing outsourcing and developing capacity offshore. After shifting a planned wafer fab expansion from its base in Greensboro, NC, USA to the former Filtronic foundry in Newton Aycliffe, UK (see last issue, page 6), RFMD has now announced the consolidation of production test into its Beijing assembly plant (see page 7). This will involve about 80 job losses in Greensboro, but RFMD claims it is the last US RFIC maker to take test offshore. Unlike Polaris 2 and 3 (for which assembly & test is outsourced), this will allow in-house assembly & test of RFMD's Polaris 3 Silver module (which has just received its first production order). The relocation also cuts out shipping between separate assembly and test locations, and brings final despatch closer to the main customer base in Asia.

Consolidation is also occurring among nitride substrate manufacturers, with sapphire substrate maker Monocrystal acquiring Atlas PCF in Russia, Saint-Gobain acquiring HVPE-based GaN substrate maker Lumilog, and etch & deposition system maker Oxford Instruments acquiring nitride substrate maker TDI (particularly for the latter's HVPE process technology, with the aim of developing equipment sales). Again, further developments regarding these stories will be covered in future issue.

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**Semiconductor Today (ISSN 1752-2935) is published free of subscription charge** in a digital format 10 times per year by Juno Publishing and Media Solutions Ltd, Suite no. 133, 20 Winchcombe Street, Cheltenham GL52 2LY, UK. See: [www.semiconductor-today.com/subscribe.htm](http://www.semiconductor-today.com/subscribe.htm)

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## RF power semiconductor market to be suppressed by decline in cellular/3G

The RF power semiconductor device market below 4GHz will exhibit a five-year compound annual growth rate (CAGR) of just 2.9%, illustrating a decline in revenue for cellular/3G, according to a report by ABI Research. However, the other major segments show a healthy CAGR over the 2007–2012 forecast period of 9.5%, with the military and ISM segments leading the pack.

The report defines six main sectors: wireless infrastructure, military, ISM (industrial/scientific/medical), broadcast, commercial avionics, and non-cellular communications, with each segment branching out into smaller niches to permit highly specific forecasts for the market.

"Wireless infrastructure represents the largest segment for RF power semiconductors, and it contains the largest sub-segment: cellular/3G," says ABI's research director Lance Wilson. "But cellular/3G is in a sense a long-term market anomaly that is now in a decline which will continue steadily over the next five years."

More efficient air interfaces, coupled with average selling price (ASP) erosion and the build-out of the infrastructure base, are driving the sub-segment down in terms of revenue. On the device side, wide-scale adoption of plastic packages also diminishes revenue. Over the 2007–2012 period, revenues for the cellular/3G sub-segment will decline at a CAGR of nearly 8%.

"WiMAX, another sub-segment within wireless infrastructure, remains controversial," says Wilson. "Although fixed WiMAX is deploying, mobile WiMAX (IEEE 802.16e) is in a state of flux from a high-power standpoint. There is a potential large upside to mobile WiMAX, but there are no guarantees that this will actually occur in a wide sense," Wilson adds.

In spite of this possibility, the total wireless infrastructure segment will decline at a CAGR of 2% over the period 2007–2012, the report concludes.

[www.abiresearch.com](http://www.abiresearch.com)

### IN BRIEF

## Rich-media specialists increase share of \$19bn handset profits

Led by Nokia, the five biggest mobile handset original equipment manufacturers (OEMs) took 84% of the \$19bn global handset industry profits in 2007, according to a report by market research firm Strategy Analytics.

However, their profit share is actually declining as a new breed of suppliers led by Research in Motion, HTC, and Apple begin to carve out media-centric strategies that enhance their ability to drive both revenue and profit share through 2010.

Largely cut out of the mix, Japanese suppliers are exiting the market as their share of industry profits and revenues continue to decline, the firm adds.

In contrast, Chinese mobile handset manufacturers have yet to prove that offering carrier-branded, low-cost entry can be a viable first step in a long-term handset strategy, the report concludes.

[www.strategyanalytics.net](http://www.strategyanalytics.net)

## Solar VC investment reaches record \$280m in Q1/2008

Venture capital investment in renewable energy reached an unprecedented level of more than \$1bn in Q1/2008, according to Greentech Media's Venture Power Report. Investment in solar power led, with more than \$280m invested in 15 VC financing rounds. New entrepreneurial efforts in LEDs and other lighting technologies also attracted investment.

"VC investment in renewable energy in Q1 is on pace to better last year's record numbers," says senior analyst Eric Wesoff. "Investors are optimistic and bullish on energy in the face of global cli-

mate and economic issues. They are investing across the energy spectrum in power generation, alternative fuels, energy efficiency, and smart grid/demand response technologies," he adds. "Investors are looking for 2008–2010 to be the years of renewable energy exits."

Notable VC funding rounds in Q1 included Luminus Devices' \$72m Round E (as it expands applications for its PhlatLight LED technology from TV and display markets to solid-state lighting) and Suniva's \$50m Round B (for high-efficiency thin-film silicon photovoltaic cells).

"We see these investment num-

bers staying steady through 2009 as investors continue to nurture their current portfolios and look for new opportunities," says Wesoff.

Energy efficiency has finally come into its' own as an investment sector with dedicated energy investors and generalist VCs focused on consumer and industrial energy efficiency, the report concludes. Although thin-film solar is not receiving the same magnitude of investment as it did in 2006 and 2007, solar investment is still hot, it adds.

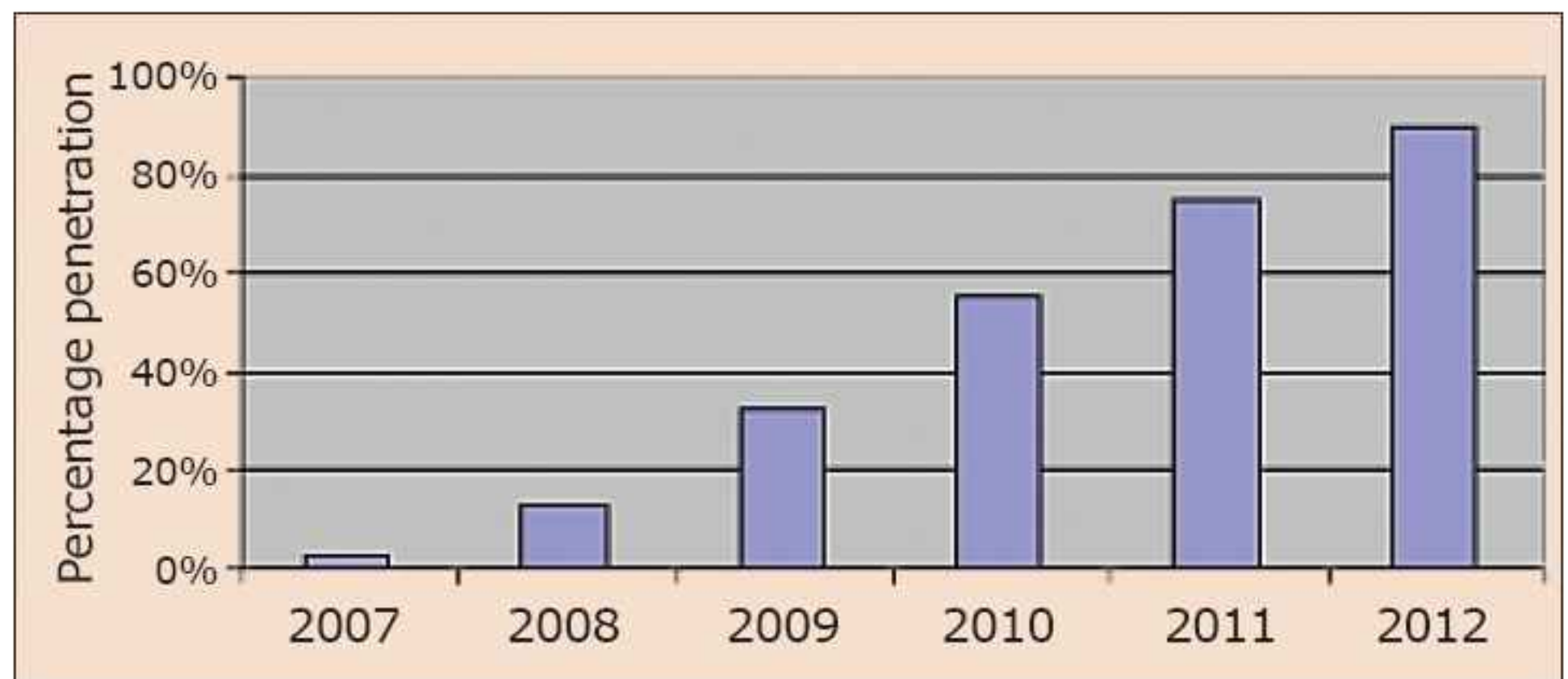
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## LEDs to replace CCFLs in notebook-PC backlights

The proportion of large-sized (10-inch diagonal and larger) LCD panels in notebook PCs employing LEDs to backlight their displays will rise from just 4.7% in fourth-quarter of 2007 to 90% in 2012, forecasts market research firm iSuppli in a new report. By the end of 2008, LED-backlit large LCD notebook PC panel shipments will surge to 17.4m units, up more than six-fold from 2.8m units in 2007, adds the firm.

Currently, large-scale LCD displays in notebook PCs predominantly use cold-cathode fluorescent lamps (CCFLs) for backlighting, says Sweta Dash, director of LCD and projection research at iSuppli. While this is a proven technology and is lower cost than LED-based backlights, LEDs are expected to be used increasingly in backlights due to their low power consumption, thin form factor, light weight, and environmental friendliness (absence of mercury). A typical 13.3-inch white LED-based notebook panel can use 20% less power and be 40% thinner and 20% lighter than an equivalent conventional CCFL-based product, says Dash.

However, although white LED-based backlights (more suited to the smaller displays) are slightly less than \$25 more costly than CCFL-backlights, RGB LED-based backlights (appropriate for



**Worldwide forecast of penetration of LED backlights in large-sized LCD notebook PC panels (source: iSuppli).**

notebook PCs) bear a \$50-80 price premium compared to CCFL-backlit notebook panels. To mitigate costs, panel suppliers are therefore starting to develop in-house LED backlighting capability, the report notes.

Another important factor for reducing costs is yield improvement, says Dash. Yield rates for LED-equipped panels are still quite low, which sometimes contributes to higher costs, so panel makers are striving to improve yields.

As chip costs decline and backlight manufacturing yields improve, the price gap for notebook panels between white-LED backlights and CCFL backlights will therefore narrow to within \$10 in the next few years, forecasts iSuppli.

"In the future, as the cost differential between LED and CCFL backlights narrows, LED-based

notebook PC panels will gain market," says Dash.

In addition, the launch by panel suppliers of new products that are thinner and brighter and have higher contrast ratios than previous models will also help to boost the adoption rate. Panel suppliers are also continuing to introduce RGB LED-based notebook panels in 15.4-inch and 17-inch sizes, mostly for higher-end products.

Nevertheless, despite the higher adoption rate for LED backlights in notebook PCs, the downside impact on CCFL demand will be very limited, concludes Dash: notebooks constitute only a small percentage of total large-sized LCD CCFL demand compared to desktop PC and TVs (since the latter do not rely on low consumption of portable battery power).

[www.isuppli.com](http://www.isuppli.com)

## GaAs demand from digital cable to top \$100m by 2012

Demand for gallium arsenide-based devices from digital cable markets will grow at a compound annual average growth rate (CAAGR) of 11% from 2007 to 2012 (from \$72m to \$109m), forecasts market research firm Strategy Analytics.

Due to the continued rollout and upgrade of networks, infrastructure will account for an increasing proportion of these markets, accounting for 57% of GaAs device demand from digital cable in 2007

and growing to 67% by 2012.

"Cable infrastructure applications, namely line amplifiers and hybrid amplifiers will continue to constitute the main demand for GaAs MMICs [monolithic microwave integrated circuits] for the next five years," notes Asif Anwar, Strategy Analytics' GaAs service director. "These products are used in the cable infrastructure networks as system amplifiers, line extenders and fiber nodes."

In the set-top box (STB) segment of the digital cable market, demand for GaAs will also grow, driven by the use of multiple tuners, adds Stephen Entwistle, VP of Strategy Analytics' Strategic Technologies Practice. However, silicon technologies will continue to dominate, limiting the CAAGR for GaAs devices in such customer premises equipment (CPE) to no more than 5% over the next five years, he adds.

[www.strategyanalytics.net](http://www.strategyanalytics.net)

## IN BRIEF

**Co-founders retire from RFMD**

Chief technical officer William (Bill) J. Pratt and corporate VP of strategic operations Powell T. Seymour have retired from RFMD after distinguished careers in the communications technology industry, including co-founding RFMD 17 years ago and playing active roles in the firm's subsequent growth.

"As co-founders, both were driving forces behind our development and growth," said president & CEO Bob Bruggeworth.

Bill Pratt, Powell Seymour and Jerry D. Neal founded RFMD in 1991. Pratt served as chairman from 1991 until August 2002 and continues to serve on the board.

**RFMD wins award from TianYu**

RFMD has been awarded one of four Strategic Partner Awards for 2007 presented by Chinese mobile device maker TianYu (with the three others going to suppliers of cellular basebands, camera sensors and LCD panels).

"In 2008, we will launch multiple products, including our RF4180 PowerStar dual-band GSM/GPRS transmit module, that lower costs, ease implementation, reduce size and accelerate time-to-market for leading customers such as TianYu," says Paul Augustine, general manager of RFMD's Components Solutions business unit.

[www.rfmd.com](http://www.rfmd.com)

**Integrated configurable components**

RFMD is sampling the first in a new line of integrated configurable components delivering what it claims are unmatched levels of flexibility and functional integration to designers of radio systems.

The RF205x family of components integrate common RF functions while retaining the flexibility required to develop radio systems that operate over a wide dynamic range and across a broad range of frequencies and channel bandwidths. RFMD says that the new line is broadly applicable to multiple radio markets, including wireless repeaters, software-defined radios (SDR), professional mobile radios and instrumentation and test equipment.

Housed in compact 5mm x5mm QFN packages, the first products in the RF205x family include the RF2051, RF2052 and RF2053:

- The RF2051 combines a wideband monolithic voltage controlled oscillator (VCO), local oscillator (LO) drivers, a fractional-N phase locked loop (PLL) synthesizer and two RF mixers. It can be configured as a monolithic upconverter and down-converter, suiting uplink and down-link chains in applications such as wireless repeaters and as self-contained frequency band-shifters.

- The RF2052 leverages the configurable core of the RF2051 (integrated VCO, PLL and LO drivers) and combines a wideband monolithic VCO, LO drivers, a fractional-N PLL synthesizer and one RF mixer. It can be configured as either an upconverter or a downconverter for applications requiring separate up- and down-conversion stages.

- The RF2053 leverages the configurable core of the RF2051 (PLL and LO drivers) and combines LO drivers, a fractional-N PLL synthesizer and one RF mixer, and uses an external VCO source.

Each product in the RF205x line can generate a broad LO signal range (300MHz to 2.4GHz) and operate over a broad RF/IF range (100MHz to 2.5GHz). The LO (which consists of the VCO and PLL) has an adjustable loop bandwidth that is set by a passive or active loop filter, allowing designers to optimize performance in wideband and narrowband applications. Finally, each product offers an operational amplifier on-chip to eliminate the need for an external amplifier in active loop configurations.

The mixer linearity is programmable up to +18dBm, at which the mixer, PLL and VCO consume just 72mA from a 3V supply. For applications with lower linearity requirements, current consumption can be reduced, allowing trade-off of performance and current (particularly important in applications requiring lower current consumption, including portable battery-powered devices).

"The unique system partitioning and functional integration of the RF205x line of integrated configurable components helps radio designers across multiple industries improve competitiveness by shrinking circuit board area, reducing risk and shortening product development time, thereby lowering the cost of implementation," says Alastair Upton, general manager of RFMD's Broadband and Consumer business unit.

**RFMD launches InGaP HBT PAs for base-stations**

In March, RFMD introduced the 1W SPA-1426Z and 2W SPA-1526Z Class A InGaP-based power amplifiers (PAs) for base-station applications across all cellular standards and frequencies.

RFMD claims that the PAs exhibit industry-leading backed-off linearity

performance, which is particularly critical to WCDMA high power amplifier (HPA) applications.

Housed in RFMD's proprietary SOF-26 package, the two new PAs lead their product class with lower thermal resistance and power dissipation while providing RoHS and

WEEE compliance, claims RFMD. Both feature on-chip active bias circuitry and bias control pins, plus an input power detector and rugged class 1C ESD rating (greater than 1kV HBM).

The SPA-1426Z and SPA-1526Z are priced at \$5.78 and \$7.38.



# RFMD consolidating production test operations in Beijing facility

RF Micro Devices Inc of Greensboro, NC, USA says that it is consolidating its production test facilities for high-volume cellular products to reduce manufacturing cycle time, improve customer service, and improve overall profitability.

The consolidation represents the final phase of a transfer to its main production test facility in Beijing, China, which will handle high-volume cellular products currently tested in the firm's production test facility in Greensboro, NC, where about 80 staff in will be affected, the firm anticipates. RFMD currently employs over 2000 staff in North Carolina.

"RFMD's international revenue is over 90% of total revenue, and it is imperative that our supply chain aligns with our customers' manufacturing facilities, which are located primarily in Asia," says RFMD's president and CEO Bob Bruggeworth. "While this is a



Artist's impression of RFMD's Beijing assembly & test plant, showing the extension (far right) completed last year.

difficult decision because of the negative impact on employees, these actions are necessary to better serve our customers, ensure competitiveness and help position RFMD for long-term sustainable profitability," he adds.

The consolidation is part of an ongoing process to improve efficiencies, eliminate duplicative operations and better align

resources for improved profitability. RFMD anticipates that it will record a cash restructuring charge of about \$1m, most of which should be recognized in the June quarter. The consolidation is expected to be completed in the September quarter and should improve cash flow and profitability by \$3-3.5m on an annualized basis.

[www.rfmd.com](http://www.rfmd.com)

## First production orders received for Polaris 3 Silver

RFMD has received its first production orders for its Polaris 3 Silver RF solution from a 'valued tier-one handset OEM'. Polaris 3 Silver was added to the firm's Polaris family of GSM/GPRS/EDGE RF solutions just this February. RFMD expects production volumes of Polaris 3 RF solutions to increase sequentially throughout 2008.

Polaris 3 Silver leverages the performance advantages of Polaris 3 but adds RFMD's patent-pending MicroShield integrated RF shielding. The highly integrated, ultra-compact Polaris 3 integrates all the necessary functions of the RF section of quad-band EDGE cellular handsets, including the power amplifier, switch, SAW filters, crystal oscillator and transceiver. With the

addition of MicroShield integrated RF shielding, Polaris 3 Silver delivers Polaris 3 performance without sensitivity to board placement and at a significant reduction in both product volume and profile. This ease-of-use allows manufacturers to release mobile devices to market faster and with less RF design effort, the firm claims.

"Polaris 3 Silver extends the value proposition for our Polaris RF solutions by adding the benefits of MicroShield integrated RF shielding to the proven performance of Polaris 3," says Eric Creviston, who is president of RFMD's Cellular Handset Product Group (CPG). "Handset manufacturers using MicroShield technology will enjoy the benefits of improved RF

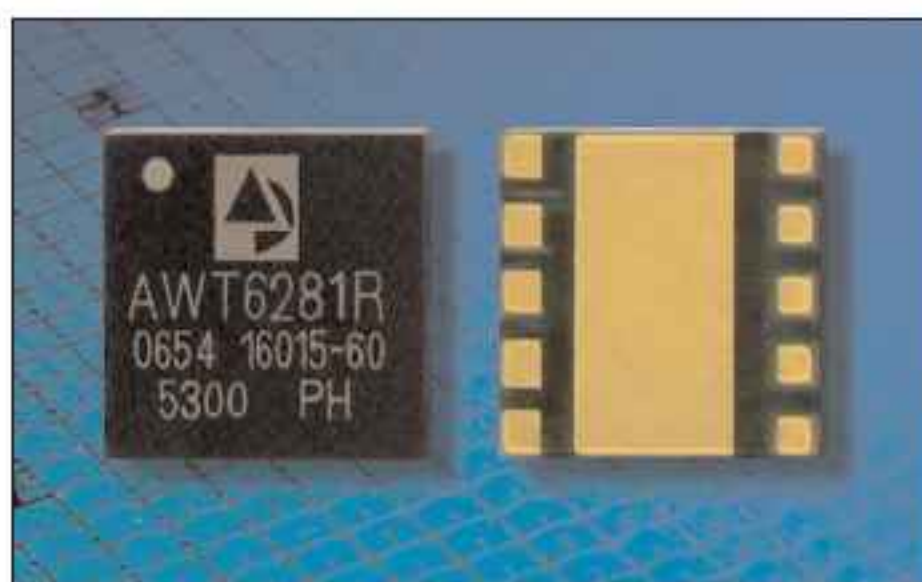
performance, lower total cost, reduced board space requirements and overall ease of RF implementation," he adds. "Based on current customer forecasts for our Polaris 3 RF solutions, we expect Polaris production volumes to extend multiple years and support meaningful profitability for RFMD."

Assembly of Polaris 3 Silver, including tape and reel, production test and application of MicroShield integrated RF shielding, is performed at RFMD's recently expanded, primary assembly facility in Beijing, China. The internal assembly, test and shielding of Polaris 3 Silver represents a cost advantage over Polaris 2 and Polaris 3, for which these functions are currently outsourced.

# Anadigics launches WCDMA linear PA for EGSM handsets

Anadigics Inc of Warren, NJ, USA has launched the AWT6281 HELP3 WCDMA linear power amplifier (PA), engineered for use in advanced 3G handsets for extended GSM (EGSM, Band 8) UMTS wireless networks. The new PA extends the operating time of 3G handsets and data cards, which is critical for operation using high-speed packet access (HSPA) networks. Anadigics says that the AWT6281 has been specified by leading chipset manufacturers for selected reference designs.

The latest member of Anadigics' family of 3G HELP3 WCDMA linear power amplifier, the AWT6281 provides full compliance with HSDPA and HSUPA requirements and reduces average current consumption by 75% compared to competing devices, it is claimed. The PA provides low quiescent currents of 7mA without a DC-DC converter and eliminates the need for an external voltage regulator. The self-contained 4mm x 4mm x 1.1mm surface-mount package incorporates matching networks



Anadigics' new AWT6281 HELP3 WCDMA linear power amplifier.

optimized for output power, efficiency and linearity. The AWT6281's performance and integration capabilities are achieved using Anadigics' patented InGaP-Plus technology, which combines bipolar and FET devices on the same GaAs die.

Engineered for UMTS900 operation, the AWT6281 enables manufacturers to design and develop the advanced 3G handsets and data cards required for conversion to UMTS900 worldwide, Anadigics says.

A market study conducted in February 2007 for the GSM Association by Ovum Consulting found that

"...UMTS900 provides between 44% (in urban areas) and 119% (rural areas) increased coverage per Node-B compared with UMTS2100. This is primarily due to the propagation characteristics of the lower-frequency band and leads directly to lower capex and increased mobility benefits, providing a new option, with greater service capability, for operators."

The study added that handset availability is crucial to the successful rollout of UMTS900, as the market will need to be populated with handsets which will work in the UMTS900 band and in other GSM and UMTS bands also."

[www.anadigics.com](http://www.anadigics.com)

**The AWT6281 enables manufacturers to design and develop the advanced 3G handsets and data cards required for conversion to UMTS900 worldwide**

## Linear power amplifier introduced for AWS and KPCS CDMA/EVDO mobile handsets and data devices

Anadigics Inc of Warren, NJ, USA has launched the AWT6309 linear power amplifier (PA), for use specifically in CDMA wireless handsets and data devices that operate in 1.7GHz bands. The new PA is designed to be compatible with Qualcomm CDMA2000 and EVDO chipsets.

The newest member of Anadigics' family of HELP2 CDMA power amplifiers, the AWT6309 reduces average current consumption by as much as 50% compared to conventional two-stage amplifiers

thanks to Anadigics' proprietary designs and InGaP-Plus HBT technology (which integrates switches and amplifier components onto the same die).

Measuring 3mm x 3mm by 1mm high in a low-profile surface-mount package, the AWT6309 enables the design of ultra-slim and compact products, Anadigics says. In addition, the new power amplifier also integrates an internal voltage regulator that eliminates the need for external voltage regulators.

Specific features include: high efficiency of 41% at +28dBm output and 22% at +17dBm; a low quiescent current of 14mA; and a low leakage current in shutdown mode of less than 1µA.

"With the introduction of the AWT6309 power amplifier, Anadigics is prepared for the expansion of CDMA services in the AWS band here in the US and in the KPCS band in Korea," says Ali Khatibzadeh, senior VP and general manager of Wireless Products.

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## AWR and TriQuint to JumpStart for GaAs MMIC design

AWR of El Segundo, CA, USA and RF front-end component maker TriQuint Semiconductor Inc of Hillsboro, OR, USA have launched Project JumpStart to offer (for a limited time) first-time customers and start-ups a low-cost introduction to the design and fabrication of GaAs microwave monolithic integrated circuits (MMICs).

The project provides designers with an affordable, low-risk means of bringing wireless design prototypes to market using AWR's electronic design automation (EDA) tools and TriQuint's pseudomorphic high-electron-mobility transistor (pHEMT) foundry process.

Project JumpStart includes free process design kits (PDKs), a free 90-day lease for AWR's flagship high-frequency design software, Microwave Office design suite, and a reduced-rate prototype develop-

ment quickturn (PDQ) shared-wafer foundry run using TriQuint's TQPED 0.5 $\mu$ m pHEMT process.

AWR says that its Microwave Office software encompasses all the tools essential for high-frequency design: linear and non-linear circuit simulators, electromagnetic (EM) analysis tools, integrated schematic and layout, statistical design capabilities, and parametric cell libraries with built-in design-rule check (DRC).

TriQuint's TQPED is a 0.5 $\mu$ m optical gate enhancement and depletion pHEMT process that features three thick global metal interconnect layers and is suited to building switches, low-noise amplifiers, power amplifiers, and integrated transceivers. The three metal layers are encapsulated in a high-performance interlayer dielectric and offer advantages for designers in its

ability to provide a high level of wiring flexibility and simplicity of plastic packaging, the firm claims.

"Many well-established wireless products were at one time nothing more than ideas waiting to be turned into working solutions," says Mike Peters, director of marketing for TriQuint's Commercial Foundry. "This joint AWR/TriQuint program offers companies with limitless ideas but limited resources an opportunity to bring an idea to life," he adds.

"Project JumpStart is a terrific incentive for MMIC designers to experience the unique combination of AWR's powerful tools and TriQuint's exceptional foundry services, with no risk and at virtually no cost," says AWR's VP of marketing Sherry Hess.

[www.triquint.com](http://www.triquint.com)

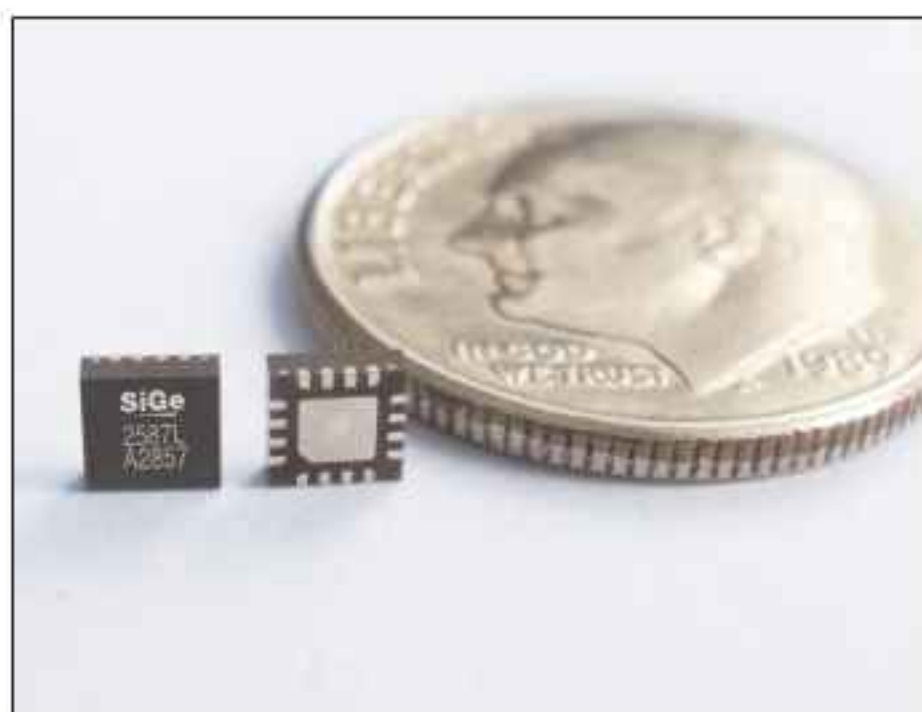
[www.awrcorp.com](http://www.awrcorp.com)

## SiGe PA boosts Wi-Fi; cuts bill of materials by 20%

SiGe Semiconductor Inc of Ottawa, Ontario, Canada and Andover, MA, USA, which supplies RF front-end solutions enabling wireless multimedia for consumer electronics, has launched the SE2587L power amplifier, designed to optimize the performance of Wi-Fi systems, including access points, personal computers, and PC cards.

The SE2587L is based on the firm's proven silicon germanium PA architecture, which is optimized for high linearity at transmit power levels of +19dBm in 802.11g mode and +24dBm in 802.11b mode. This optimizes transmission of greater data rates over longer distances, the firm claims, allowing systems to support emerging wireless multimedia applications such as video distribution, video streaming and high-speed data.

The PA is characterized for both 3.3V and 5V operation for nominal and high-power applications, respectively. SiGe integrates the reference voltage generator on-



SiGe's SE2587L power amplifier.

chip, allowing the PA to be enabled with a standard 1.8V CMOS digital signal, and eliminating large, current-hungry external reference voltage generators. The PA also integrates a power detector, which maintains accuracy, even under high antenna mismatch.

Packaged in a 3x3 QFN package, the SE2587L is the smallest of SiGe Semiconductor's discrete PAs. The device pin-out sequence is compatible with its SE2527L, SE2528L and SE2581L, minimizing layout changes and allowing manufactur-

ers to easily migrate to the new device for next-generation designs.

Also, to reduce system cost further, SiGe Semiconductor is offering application notes and support to replace discrete inductors used for output matching to patterned-on traces, taking advantage of the board space freed by the SE2587L's smaller footprint. This could result in a saving of about 20% off the external bill of materials, the firm reckons.

"With the SE2587L, we have worked closely with our customers to deliver the high performance they expect from SiGe in a form factor that is ideal for optimization of board layout and system cost," says Jose Harrison, director of product marketing, computing and consumer. "The combination of our power amplifier and applications support is unique in the industry," he claims.

The SE2587L is priced at \$0.40 in volumes of 100,000.

[www.sige.com](http://www.sige.com)

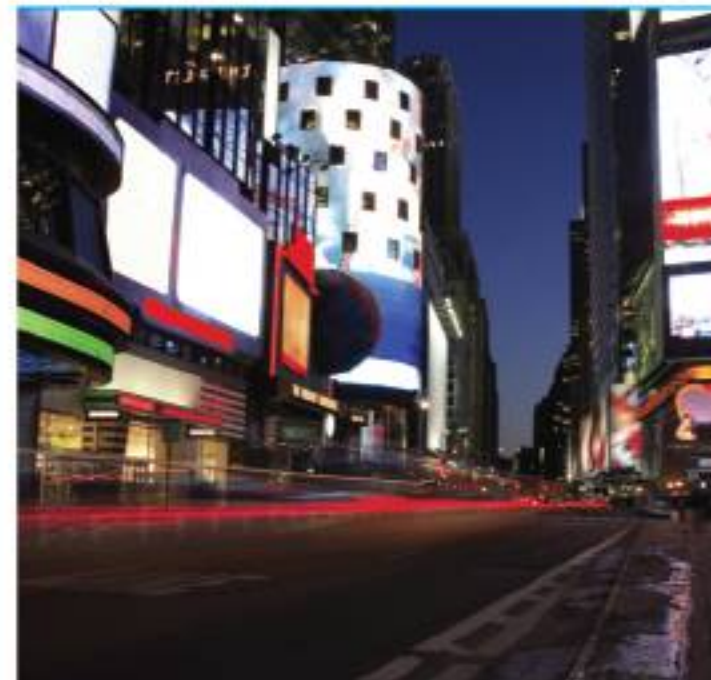


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# Skyworks extends Kopin HBT purchase and supply agreement

Kopin Corp of Taunton, MA, USA has extended its GaAs heterojunction bipolar transistor (HBT) purchase and supply agreement with Skyworks Solutions Inc of Woburn, MA, which manufactures linear products, power amplifiers, front-end modules and radio solutions.

Under the agreement, Kopin will fulfill all the 4-inch-diameter and the vast majority of the 6-inch-diameter HBT wafer requirements of Skyworks through July 2010. The agreement applies to a wide range of III-V technologies, including multiple GaAs HBT products, Skyworks' BiFET design and Kopin's

GAIN-HBT platform. It also facilitates the companies' continued collaboration to improve yields to drive down costs and to expand into new products.

"The rapid growth of advanced multi-mode phones requiring multiple power amplifiers, combined with an increasing cell-phone user base, bodes well for healthy growth in HBT power amplifier markets," says Kopin's president and CEO, Dr John C.C. Fan.

"In the past few years, we have been collaborating to improve efficiency, quality and cost, all while implementing promising new tech-

nologies," says Skyworks VP of worldwide operations, Bruce Freyman. "Our efforts have been very successful, and we presented Kopin with our Best Supplier Award last year."

In 2006, to meet growing demand, Kopin installed three MOCVD systems at one of its two production facilities in Massachusetts, and these tools are now fully qualified and supplying production wafers. Kopin has also qualified its Taiwan-based affiliate, KTC, to supply additional wafers to Skyworks.

[www.kopin.com](http://www.kopin.com)

## Kopin targets HEMTs and PVs to rebound from flat 2007 in III-Vs

For 2007, Kopin of Taunton, MA, USA, which makes III-V heterojunction bipolar transistor (HBT) epiwafers and CyberDisplay LCDs, has reported record revenues of \$98.1m, up 38% on \$71.1m in 2006, and exceeding its guidance of \$90-95m. However, the increase was due to CyberDisplay revenue doubling (from \$27.2m to \$54.6m), whereas revenue from III-V products fell slightly from \$43.9m to \$43.6m.

Net loss has risen from \$2.1m in 2006 to \$6.6m in 2007 (after accounting for \$3.7m and \$1.8m, respectively, in expenses associated with the now-completed independent review of Kopin's historical stock option granting practices). 2006 also included a \$1.2m gain from the sale of 200,000 shares of Micrel common stock.

For Q4/2007, total revenue was also a record \$28.9m: up 62% on \$17.8m in Q4/2006. However, again most of the growth was due to CyberDisplay sales (up 87.6% from \$8.9m to \$16.7m). Nevertheless, III-V product revenue

grew 35.6% year-on-year, from \$9m to \$12.2m.

Total net income for Q4/2007 was \$0.3m, an improvement on a net loss of \$2.9m for Q4/2006.

In 2006, Kopin embarked on a three-year investment program to expand manufacturing capacity and capability, enhance product performance and develop new structures. "With our recent installation of three of the world's most advanced MOCVD reactors for our III-V product line, the expansion of our III-V manufacturing capacity is now essentially complete," said president and CEO John C.C. Fan. "By consistently producing 6" III-V wafers with superior uniformity, these new systems strengthen our capability to develop products for not only the wireless handset market but also for emerging applications such as public mobile radio, advanced cell phones and photovoltaic solar cells for energy applications."

"Among the products we are developing are advanced [MOCVD-grown] III-V high-electron-mobility transistor (HEMT) structures,"

Fan continued. "We believe our new systems are ideal to produce the yield and uniformity required for HEMT structures and the performance and efficiency necessary for [GaAs-based] solar cells. In fact, solar cells were the first products we introduced commercially in the late 1980s, and consequently we have substantial intellectual property and manufacturing know-how around this technology," he points out. "New products take time to develop, and these HEMT and solar cell initiatives represent longer-term opportunities for Kopin. We believe they are technologies that Kopin is uniquely qualified to address."

For the remainder of 2008 Kopin plans to complete its three-year plan with continued product and process development to help boost efficiency, enhance performance, expand product offerings, and strengthen product mix, Fan concludes.

For 2008, Kopin expects revenue to rise 7-17% to \$105-115m.



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## AWR and WIN announce latest PDKs for MMIC design

AWR of El Segundo, CA, USA, which provides high-frequency electronic design automation (EDA) software tools, and 6-inch GaAs foundry WIN Semiconductors Corp of Tao Yuan Shien, Taiwan have announced the latest release of the WIN PP15-10 process design kit (PDK), the first in a series of next-generation commercial foundry PDKs available for MMIC design.

The combination of the WIN PP15-10 pseudomorphic high-electron-mobility transistor (pHEMT) MMIC PDK with AWR's Microwave Office 2007 software enables designers of radio, satellite, radar, and automotive products to leverage WIN's process to its fullest extent, providing optimal product performance and time-to-market advantages, the firms say.

PP15-10 is a high-frequency and high-power 0.15 micron GaAs pHEMT MMIC process that has been in production since 2003. Until now,

however, existing PDKs and design tools have lacked the technology needed to take full advantage of the advanced features in the WIN process. This new class of AWR WIN PDKs can leverage the foundry process using new technologies in the latest version of Microwave Office software.

The PDK supports AWR's Intelligent Net (iNet) routing technology and the ACE automated microwave circuit extractor, both of which serve to cut interconnect design time by 100-fold or more. Built-in design rule support through the native AWR design rule check (DRC) engine alerts engineers to manufacturing issues during early design stages, where design faults can be more quickly and easily corrected, saving design time and capturing performance margin.

PP15-10 can also be loaded into Microwave Office software simultaneously with packaging and other

IC PDKs for module co-design.

"We intend to facilitate our customers' design flow with accurate models and pCells in not only the most advanced compound semiconductor processes, but also the most advanced EDA tools and flows," says Gary St. Onge, WIN's VP of technical marketing. "AWR's iNets, ACE, and multi-PDK capabilities are unique innovations that our customers want to use," he adds. "These PDKs bridge the gap from design concept to working product. The benefits of our process capability can now be fully exploited."

"WIN's latest processes integrated in these new PDKs open up new possibilities for MMIC design," says AWR's VP of marketing Sherry Hess.

PP15-10 PDK is distributed by WIN and is available free of charge for use within AWR's Microwave Office 2007 design suite.

[www.winfoundry.com](http://www.winfoundry.com)

[www.awrcorp.com](http://www.awrcorp.com)

## FETs for multiple wireless applications

Avago has launched what it claims are the smallest packaged FETs. Just 1.0mm x 0.5mm x 0.25mm, the low-profile discrete low-noise devices occupy <5% of the volume of a standard SOT-343 package.

The VMMK-1218 and -1225 use chip-scale packaging, enabling miniaturization of transistors with high-frequency operation and good thermal dissipation. No negative voltage is needed.

The VMMK-1225 (for 0.5–26.5GHz) has a noise figure of <0.95dB, and 12dB of available gain under 50Ω conditions at 12GHz. It also offers 23dBm output third-order intercept and 8dBm output power. The VMMK-1218 (for 0.5–18GHz) has a noise figure of <0.85dB, and 9dB of available gain under 50Ω conditions at 10GHz. It also offers 22dBm output third-order intercept and 12dBm output power.

[www.avagotech.com/rf](http://www.avagotech.com/rf)

## WIN installs Rudolph inspection tools

Process characterization equipment maker Rudolph Technologies Inc of Flanders, NJ, USA says that seven of its NSX Series inspection tools were recently installed at 6" GaAs foundry WIN Semiconductors Corp of Tao Yuan Shien, Taiwan, which focuses on RFICs for cell phones and other communications applications. WIN has also acquired multiple licenses for Rudolph's Discover defect analysis/yield management software.

As the world's largest pure-play GaAs foundry, WIN's purchase was driven by the NSX 105 system's proven capability to deliver high-volume throughput while maintaining the sensitivity to identify defects as small as 1μm.

Rudolph recommended a combined defect analysis/wafer-level signature recognition software package for 24/7 process monitoring. This data management system should help WIN to quickly trace patterns

back to yield-killing process issues.

"As the leading GaAs manufacturer, they have helped us understand and respond to the specific needs of this rapidly-growing market segment," says Rudolph's VP of sales Mayson Brooks. "We look forward to continuing to serve those needs as they execute their plans for further expansion in the coming year."

"The information provided by the NSX has been critical in our efforts to meet our customers' requirements for fast delivery and high quality," comments Chin-chi Chang, WIN's associate VP, Monolithic Microwave Integrated Circuit business unit.

"At the same time, it helps us meet our own internal needs to quickly achieve profitable process yields. Its unique combination of throughput and sensitivity to small defects has been especially valuable as we strive to keep pace with rapid growth in our segment," he adds.

[www.rudolphtech.com](http://www.rudolphtech.com)





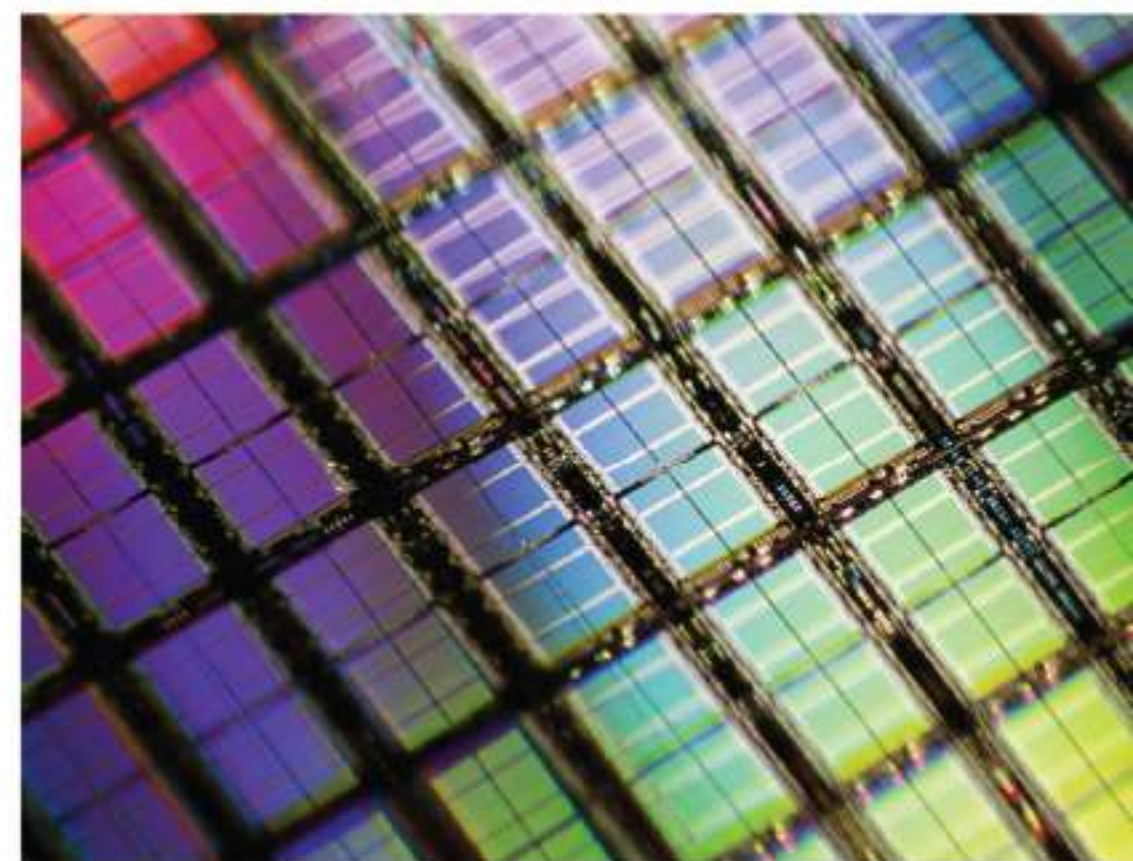
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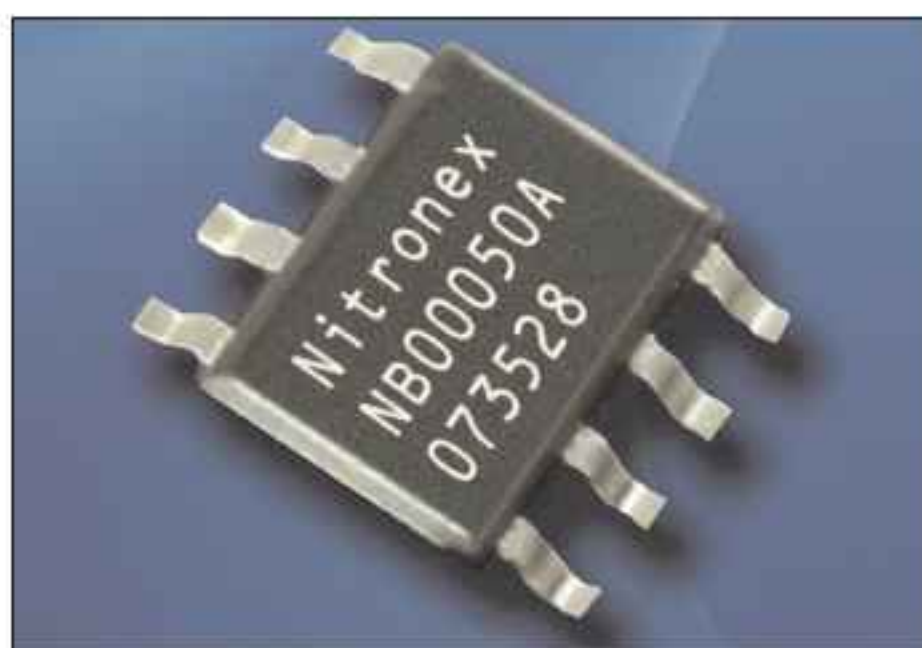
SURFACE TECHNOLOGY SYSTEMS

## Nitronex develops 45W GaN-on-Si HEMT for high-PAR power amplifiers at 2.5 and 3.5GHz

Nitronex Corp of Durham, NC, USA has developed a GaN-on-silicon high-electron-mobility transistor (HEMT) that delivers 45W at 28V for high PAR (peak-to-average ratio) and pulsed applications.

The announcement was made at April's GOMACTech 2008 (Government Microcircuit Applications & Critical Technology) conference in Las Vegas, NV, which brings together microcircuit industry leaders engaged in development work for the US military and other government agencies.

Designed using Nitronex's patented SIGANTIC NRF1 process, the NPT1004 combines a broadband DC to 4GHz high-power-density GaN-on-Si HEMT with a cost-effective thermally enhanced



**Nitronex's 45W NPT1004 GaN-on-Si HEMT for high-PAR and pulsed use.**

plastic package to offer an optimized solution for light thermal load power applications.

"Feedback from early customers confirms that the NPT1004 is an excellent fit for high peak-to-average power amplifiers for WiMAX and pulsed waveforms found in

radar, telemetry and medical applications," says Chris Rauh, VP of marketing & sales. "We believe these markets need the unique power, bandwidth and efficiency combination GaN devices can offer."

The NPT1004 delivers 5W average power for 2.5GHz WiMAX applications (single-carrier OFDMA, 64-QAM 3/4, 10.3dB peak to average, 10MHz channel bandwidth) and 4.5W for 3.3-3.5GHz WiMAX applications (single-carrier OFDMA, 64-QAM 3/4, 10.3dB peak to average, 3.5MHz channel bandwidth).

The NP1004 is packaged in a thermally enhanced PSOP package. Samples and application boards are available. Pricing is \$29 each in quantities of 1000.

[www.nitronex.com](http://www.nitronex.com)

## Merrimac and Nitronex to co-develop highly integrated power amplifiers for wireless infrastructure

A memorandum of understanding (MOU) has been agreed for the development of highly integrated power amplifiers using the proprietary Multi-Mix multilayer circuit technology of Merrimac Industries Inc of West Caldwell, NJ, USA and the high-power GaN transistor technology of Nitronex Corp of Durham, NC, USA.

Nitronex manufactures GaN-on-silicon RF power transistors for the commercial wireless infrastructure, broadband and military markets, while Merrimac designs and manufactures RF microwave signal processing components, subsystem assemblies, and Multi-Mix micro-multifunction modules (MMFM) for the defense, satellite communications (satcom), commercial wireless and homeland security markets.

Merrimac says that, due to its thermal dissipation, its Multi-Mix technology supports the design and manufacture of reliable high-power

amplifiers using RF power transistor die rather than larger, more costly packaged devices. The use of transistor die allows extensive use of automation in the amplifier manufacturing process, resulting in extremely compact, cost-effective, and highly integrated amplifiers suited to a wide range of commercial wireless infrastructure applications, including cellular and WiMAX basestations.

The firm says that its Multilayer Multi-Mix Microtechnology provides high levels of integration for both active and passive designs. Because Multi-Mix amplifier designs provide short, efficient thermal paths for active devices (even high-power-density devices such as the Nitronex GaN transistor die), they can be made very compact without the hot spots that can compromise reliability and amplifier operating lifetime. The technology is suitable for any high-power RF transistor technology in

use in commercial and military applications, including GaAs, silicon LDMOS, SiC, and GaN.

Merrimac and Nitronex have agreed to consider the joint development of a roadmap for next-generation amplifier designs based on Merrimac's Multi-Mix amplifier platform and Nitronex's GaN transistor technology. The roadmap will include the development of prototype units to demonstrate the capabilities of the Multi-Mix GaN amplifiers for different frequency bands and applications.

"By combining the high power density of their GaN transistors with the excellent thermal properties of multilayer Multi-Mix Microtechnology, we are confident that we will develop new benchmarks in terms of the RF amplifier power/size ratio, reliability, and value for our customers," says Merrimac's chairman and CEO Mason N Carter.

[www.merrimacind.com](http://www.merrimacind.com)

# Raytheon demonstrates GaN in radar components

Raytheon Company of Waltham, MA, USA says it is developing GaN-based transmit-receive modules for use in future radar upgrades. "This transmit-receive module demonstration and parallel reliability testing show that GaN will soon be ready to take over where increased power and advanced capabilities are needed," says Mark Russell, VP of engineering at Raytheon Integrated Defense Systems (IDS) in Tewksbury, MA.

The development is part of an on-going 42-month, \$11.5m 'Next-Generation Transmit Receive Integrated Microwave Module' (NGT) contract funded by the US Missile Defense Agency's Advanced Technology Directorate.

Raytheon says it is demonstrating that transmit-receive modules using GaN-powered monolithic microwave integrated circuit amplifiers (MMICs) have a significant performance advantage in that they provide significantly higher RF power with greater efficiency than current modules.

The NGT program leverages GaN technology being developed under the Wide Bandgap Semiconductor program of the Defense Advanced Research Projects Agency (DARPA) as well as company funded efforts.

Russell says that GaN technology can increase radar ranges, sensitivity and search capabilities in the battlefield. Alternatively, the

technology can enable a reduction in the size of the antenna, improving transportability and reducing acquisition and lifecycle costs without sacrificing performance.

"The NGT program is important because it is the first significant government-funded contract to address the use of the more capable GaN semiconductors in a relevant environment," says Steve Bernstein, IDS' program manager on NGT.

"This recent demonstration shows that GaN technology performs better in transmit-receive modules representative of those used in modern radars."

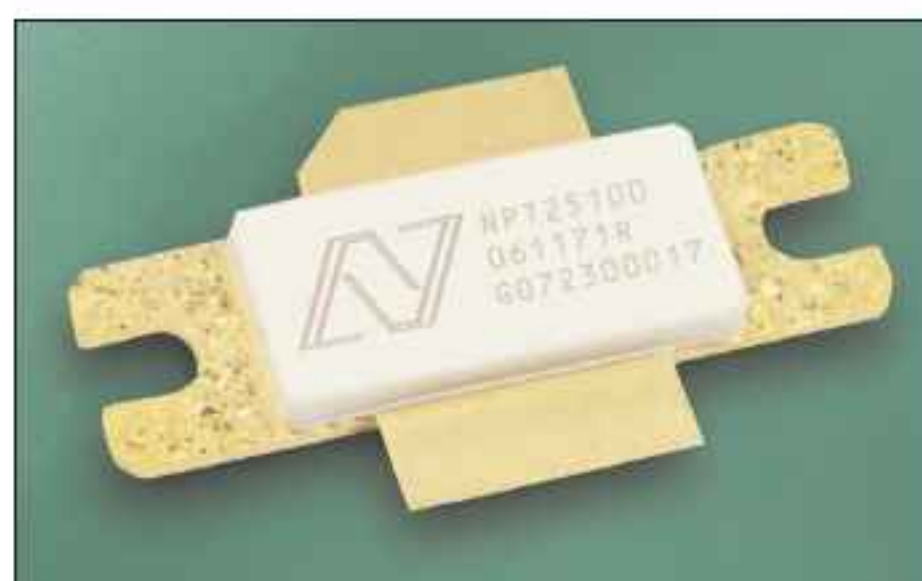
[www.raytheon.com](http://www.raytheon.com)

## Nujira collaborates with Nitronex on WiMAX PAs

At April's Next Generation Networks & Basestations conference in Bath, UK, GaN-on-silicon RF power transistor manufacturer Nitronex Corp of Durham, NC, USA said that it is creating a power amplifier reference design for WiMAX base-stations delivering over 45% efficiency by collaborating with RF power efficiency specialist Nujira of Cambridge, UK. This is being done by using Nujira's high-accuracy tracking (HAT) modulator technology to dynamically control the power supply to the GaN device in line with the transmission performance required.

Nujira's aim is to improve the energy efficiency of 3G and 4G cellular network base-stations and DVB digital broadcast transmitters by reducing the amount of waste energy dissipated as heat in the RF power amplifier circuit.

Using a four-channel WCDMA waveform, the firms have been able to realize over 44dBm of linear power with 45% efficiency at a linearity of -55dBC using conventional



**Nitronex's NPT25100.**

DPD (digital pre-distortion) techniques. The results were achieved using production-ready devices from both companies, which greatly increases customers' confidence in adopting the approach, says Nitronex's VP of marketing & sales Chris Rauh. This same solution demonstrated its flexibility by achieving 43.2dBm of linear power with 43% efficiency under a demanding WiMAX waveform with 20MHz video bandwidth and 8.2dB peak/average ratio (PAR).

"Nitronex believes that GaN devices will most clearly establish their value when combined with advanced

power amplifier techniques such as Nujira's HAT technology," says Rauh.

"Nujira HAT envelope tracking technology can greatly enhance the efficiency of power amplifiers, allowing the creation of modules that deliver both high energy efficiency over a broad frequency spectrum and flexibility," says Nujira's VP strategy & marketing Julian Hildersley. "The same Power Modulator module can equally well be applied to WiMAX, WCDMA or even DVB and other transmission," he adds. "Our reference design work with Nitronex very effectively demonstrates how well our technology works in a real circuit."

Samples of Nitronex's NPT25100, simulation models and standard evaluation boards are available now. Samples of the amplifier pallet optimized for high-accuracy tracking integrated with Nujira's power modulator enabling development of amplifiers using customers' own DPD systems will be available in Q3/2008.

[www.nujira.com](http://www.nujira.com)

## IN BRIEF

## SemiSouth awarded patent for implant-free SiC JFET manufacturing

SemiSouth Laboratories, which designs and manufactures SiC-based discrete electronic power devices and epiwafer materials, has been awarded another US patent. The firm now either owns or has exclusive licenses to 12 patents in silicon carbide power electronics.

Patent 7,314,799 ('Self-Aligned Trench Field Effect Transistors With Regrown Gates And Bipolar Junction Transistors With Regrown Base Contact Regions And Methods Of Making') enables SemiSouth to eliminate the need for implantation in the fabrication process for SiC power JFETs.

"This not only saves on costs [by 10-15% per wafer], but reduces cycle time and improves yield," says chief operating officer Kenney Roberts. "This new technique greatly simplifies our manufacturing process and is a significant milestone in our ongoing cost reduction roadmap," adds Dr Jeff Casady, chief technical officer.

The principal markets that SemiSouth serves includes solar power, computing, motor drive, automotive and military-aerospace applications. The firm's SiC JFET is a replacement for silicon MOSFETs, IGBTs (insulated-gate bipolar transistors) or BJTs (bipolar junction transistors) and can eliminate more than 50% of the energy losses in power converters used in these industries, it is claimed. In the price-sensitive automotive industry, SiC JFETs are expected to revolutionize the design of hybrid electric vehicles, making them more fuel efficient and affordable.

[www.semisouth.com](http://www.semisouth.com)

# E-mode SiC JFETs boost solar inverters

SemiSouth Laboratories Inc of Austin, TX, USA says that its enhancement-mode silicon carbide (SiC) junction field-effect transistor (JFET) has significantly improved the efficiency of an off-the-shelf inverter commonly used in residential and commercial solar power energy systems. Guidance and precision test equipment required to measure and validate the efficiency improvement was provided by the Center for Advanced Vehicle Systems (CAVS) at Mississippi State University (MSU). SemiSouth was spun off from MSU in 2000, and since August 2006 has based its manufacturing in a 20,000ft<sup>2</sup> MSU-owned facility in Starkville, MS.

CAVS validated that, by replacing the existing silicon transistors with SemiSouth's enhancement-mode SiC JFETs, the inverter reduced losses in power semiconductors by as much as 50%. Most significantly, CAVS used the JFETs as 'drop-in' replacements for the silicon devices, without

**The inverter reduced losses in power semiconductors by as much as 50%**

any design changes to the inverter. The grid-connected, low-frequency isolated inverter, purchased from commercial inventory of a leading solar inverter provider, was designed with conventional silicon insulated-gate bipolar transistors (IGBTs). "CAVS is putting a major emphasis on positioning itself for a lead in automotive power electronics R&D," says Rand German, CAVS' director and Mechanical Engineering professor at MSU. "This result validates our belief that developing and testing applications for silicon carbide power electronics through our partnership with SemiSouth is leading to breakthroughs in energy efficiency."

Beyond the dramatic reduction in both conduction and switching losses, the use of a SiC JFET as a 'drop-in' replacement to achieve the efficiency gains is unprecedented, claims SemiSouth. "All that was necessary to drop-in the enhancement-mode JFETs was the addition of a few passive components in the control circuit to take into consideration the change in threshold voltage between the original IGBTs and these JFETs. We started the inverter and it ran without any problems," says SemiSouth applications engineer Robin Kelley. "With this simple change, immediate improvement with respect to performance and efficiency were realized." This opens the door to additional modifications to fully take advantage of the device, yielding additional improvements not only in performance and efficiency but also in overall system reliability, he adds.

The enhancement-mode SiC JFET are "cheaper to produce, smaller than any comparable silicon or SiC transistor, and free of reliability concerns with gate-oxides that have plagued more conventional approaches to developing an enhancement-mode field-effect transistor using SiC," claims chief technical officer Dr Jeff Casady.

The new enhancement-mode JFET can be used as a direct replacement for silicon MOSFETs and IGBTs in virtually any off-the-shelf converter or inverter design, SemiSouth claims. According to president and CEO Vess Johnson, this means that the barrier to entry has been greatly reduced and that designers working with the enhancement-mode SiC JFETs can see immediate performance and efficiency improvements and will be able to drive new and better products to market much faster.

[www.semisouth.com](http://www.semisouth.com)

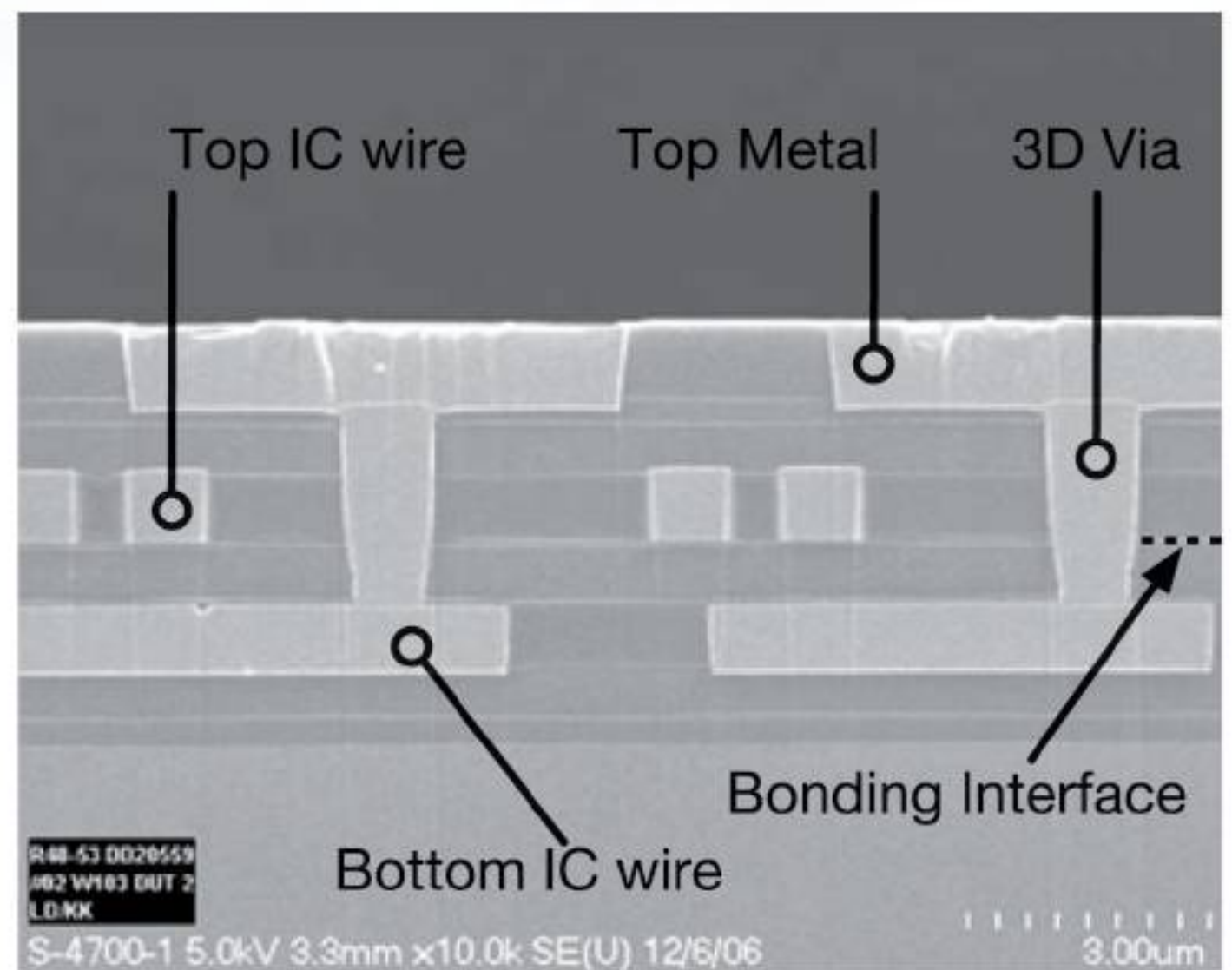
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[www.EVGroup.com](http://www.EVGroup.com)

## IN BRIEF

## Real-time, in-situ multi-wafer temperature mapping for MBE

k-Space Associates of Ann Arbor, MI, USA has developed what it claims is the first real-time, in-situ multi-wafer temperature mapping system for MBE. By using its kSA BandiT temperature monitoring system, along with rotational synchronization techniques, the new option allows full platen temperature mapping of all wafers in real-time during MBE growth.

The new temperature monitoring software, combined with automated servo motor-controlled detector scanning, yields a technique for obtaining full wafer and platen temperature mapping in real-time. Multiple units have been installed and are in full production at a 'leading RFIC manufacturing facility'.

According to k-Space, the system offers the only monitoring technique that can provide real-time, two-dimensional temperature information for all wafers during growth. Thermal uniformity profiles can be monitored and adjusted via typical multiple filament heating zones used on production MBE systems. The mapping system is also available for single-wafer MBE and MOCVD systems, where full wafer temperature uniformity measurements are required.

By using the fundamental band gap versus temperature material property of semiconductors, the kSA BandiT is unaffected by changing viewport coating, stray IR light sources, reactor maintenance or system emissivity changes, says the company.

Configurations of the BandiT are now available for most commercial single- and multi-wafer systems.

[www.k-space.com](http://www.k-space.com)

## Bede bought by x-ray metrology equipment maker Jordan Valley

After going into administration (equivalent to Chapter 11) on 31 March, high-resolution x-ray diffraction (HR-XRD) metrology equipment maker Bede of Durham, UK has been acquired by Jordan Valley Semiconductors Ltd of Migdal Ha'Emek, Israel. Jordan Valley's main shareholders are Clal Industries and Investments Ltd, Intel Capital and Elron Electronic Industries Ltd.

Bede X-Ray Metrology was founded in 1978 as a spin-off from the UK's University of Durham, and has been listed on the London stock exchange since 2000. Revenues in 2007 were \$11.6m.

"The acquired technology will fit into our product line almost seamlessly and will strengthen Jordan

Valley's position as the market leader in x-ray metrology," claims Jordan Valley's CEO Isaac Mazor. "With the consolidated x-ray metrology product line and expanded customer base, Jordan Valley becomes a comprehensive solution provider for current and future semiconductor process control and metrology challenges," he reckons.

Jordan Valley provides metrology solutions for thin films based on rapid, non-contacting, and non-destructive x-ray technologies, and offers a family of solutions based on advanced x-ray reflectivity (XRR), x-ray fluorescence (XRF), and small-angle x-ray scattering (SAXS).

[www.bede.co.uk](http://www.bede.co.uk)

[www.jvsemi.com](http://www.jvsemi.com)

## Palomar triples cleanroom capacity for assembly & test services

Palomar Technologies of Carlsbad, CA, USA has tripled cleanroom space for its Palomar Microelectronics assembly & test division and increased its prototyping, applications engineering, process development, volume assembly, and test services capabilities.

The company says that its new 2500ft<sup>2</sup> (232.26m<sup>2</sup>) class 100,000 and 500ft<sup>2</sup> (46.45m<sup>2</sup>) class 10,000 cleanrooms enable rapid prototyping and fast turn-around so OEMs can get their products into development or to market faster.

Processes include wire bonding, gold ball bumping, and precision component placement for semiconductor packages, high-power LEDs, MEMS devices, microwave and RF components, optoelectronic packages, multichip modules, and hybrids.



Palomar Microelectronics' cleanroom facilities for assembly & test.

"The new cleanroom space allows us to provide microelectronic services for many of the emerging technologies in areas such as MEMS, high-brightness LEDs, and other advanced packaging applications and to speed delivery of these services," says Palomar Microelectronics' operations manager Donald Beck.

[www.palomartechnologies.com](http://www.palomartechnologies.com)

## Nanometrics appoints VP of worldwide sales

Metrology tool maker Nanometrics of Milpitas, CA, USA has appointed Michael Fischer as VP of worldwide sales. With 23 years experience of the semiconductor and process control industry, Fischer joins after nearly 20 years at KLA-Tencor. Most recently, he was general manager of the Global Qimonda Business Unit, before which he was senior director of worldwide sales of the Reticle Inspection Division.

"Mike brings a wealth of selling and commercial experience in international markets," says president and CEO Dr Timothy J. Stultz.

Nanometrics' compound semiconductor and materials characterization product lines include the RPM2000, Vektor, Vertex, ECV Pro, NanoSpec 3000 and NanoSpec 6100 systems. These systems primarily serve the high-brightness LED (HB-LED), wafer substrate and solar photovoltaic (PV) metrology sectors.

[www.nanometrics.com](http://www.nanometrics.com)

## Sales & service director for semi and solar

Edwards of Crawley, UK has appointed Michael Allison to the new position of sales & service director, semiconductor and solar, which is aimed at focusing resources on the semiconductor vacuum and abatement market as well as the rapidly expanding solar industry.



Allison was previously worldwide VP of business operations at KLA-Tencor, and has extensive senior level experience in the semiconductor capital equipment industry, covering the USA, Europe and Asia. "His knowledge and experience of managing change and developing successful sales and service businesses will make a significant contribution to our growth strategy," reckons CEO Nigel Hunton.

[www.edwardsvacuum.com](http://www.edwardsvacuum.com)

## Plasma clean

Plasma Etch Inc of Carson City, NV, USA has launched the PE-100 low-cost plasma etching system for universities, small R&D labs and pilot production facilities.

A modestly sized chamber caters for up to 240" of process area capacity per run cycle. An RF power supply with matching network, vacuum pumping, and PLC-based process/vacuum controller with touch-screen programming is all included as a complete turn-key package. Processes can be scaled up to Plasma Etch's larger systems, as required by substrate size and throughput demands.

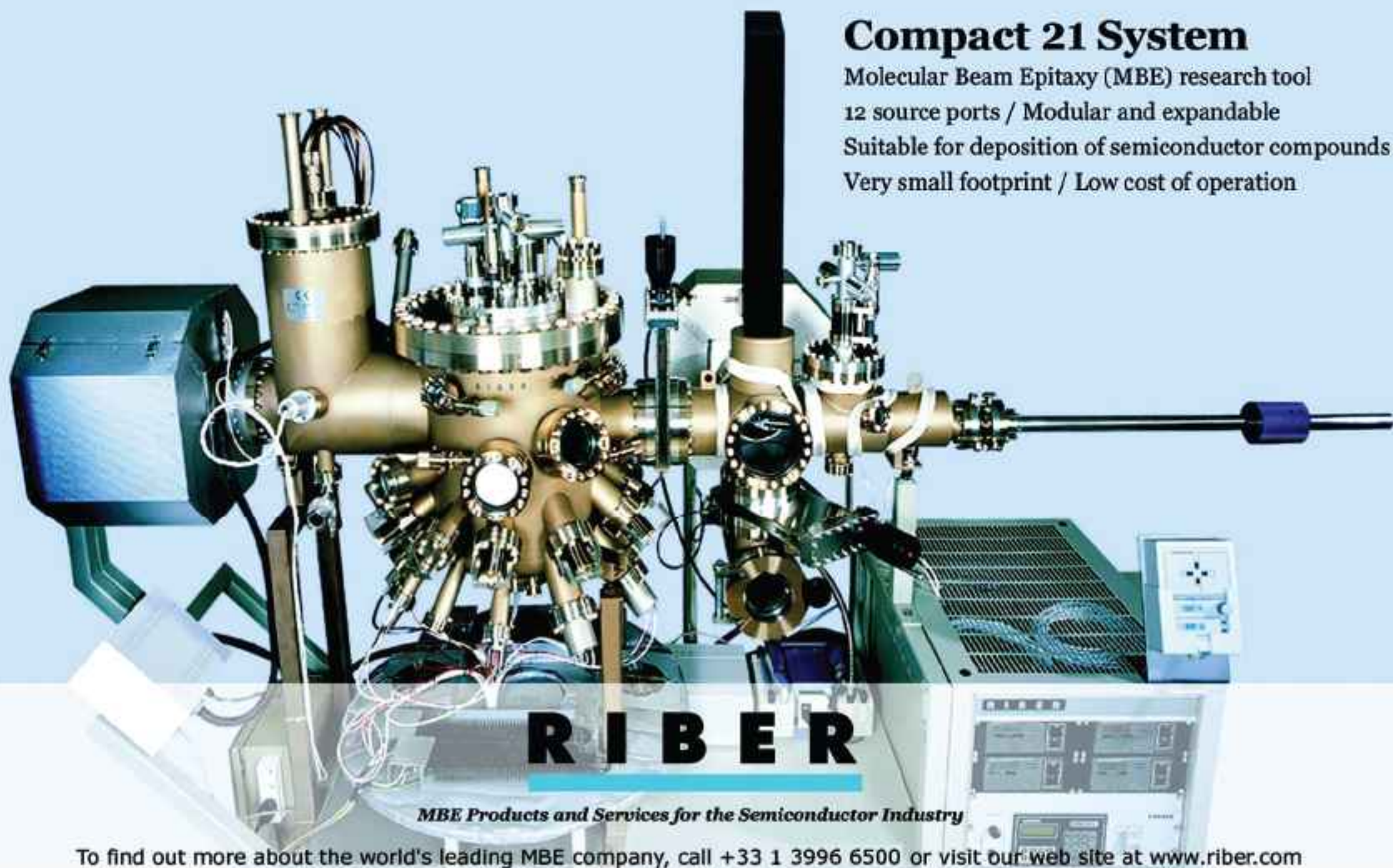
Plasma Etch's systems operate using a dry RF-induced ionized plasma process, enabling uniform removal of contaminants such as organics, coatings and metal oxides as well as providing a hydrophilic surface for adhesion of subsequent part processing.

[www.plasmaetch.com](http://www.plasmaetch.com)

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# Aviza cuts DRAM dependence

On 31 January, deposition and etch equipment maker Aviza Technology Inc of Scotts Valley, CA, USA said that, for its fiscal second-quarter 2008 (ended 28 March), it expected net sales of \$30–35m (down on \$60.6m a year ago) and an operating loss of \$7–8m (compared to net income of \$1.4m). However, the firm says that it now expects results to be towards the low end of this guidance (excluding any restructuring charges).

For its fiscal third-quarter 2008 (ending 27 June), Aviza expects net sales of more than \$36m (rebounding slightly compared to fiscal Q1/2008's \$34m). An update will be provided when announcing fiscal Q2/2008 results (tentatively expected in early May).

Also, on 28 March, Aviza received a letter from Nasdaq notifying it that the bid price of its common stock had closed below the minimum \$1 per share requirement for continued listing. Aviza has been given 180 days (until 24 September) to regain compliance (through the bid price closing at \$1 per share or above for a minimum of 10 consecutive business days).

Following an analysis of its product strategy, served markets and internal operations, Aviza plans a significant restructuring of its workforce, products and business operations, with the aim of reducing its

cost structure and improving its operational execution and financial performance.

Aviza is refocusing on its core strengths in atomic layer deposition (ALD) technology for the sub-45nm nodes, and etch and PVD technologies for the fast-growing 3D-IC market segments, in which the firm believes it has competitive advantages (as demonstrated by recent wins for ALD in Japan, etch for MEMS devices and PVD for power ICs).

Aviza says it will downsize programs, products and spending related to trench capacitor technology for DRAMs, and decrease its overall dependence on the DRAM market. In addition to shedding assets that are not core to its future business plan, the firm will cease development of large batch thermal systems for the trench capacitor market. However, Aviza says it will continue to service and support its large global installed base of these products and retain the capability to manufacture the systems when customers require additional units.

"This restructuring effort is designed to allow Aviza to focus on our core market strengths, shed some underperforming products, and ultimately position the company for growth," says president and CEO Jerry Cutini. "We have taken multiple actions to properly

scale our company, including a recent reduction in workforce, divesting of certain operations such as our machine shop in the UK [selling ET Equipment Ltd of Cwmfelin-fach to ETEQ Ltd of Vale of Glamorgan, Wales], and focusing our spending on markets and products that have a clear path for sustainable growth. In doing so, we expect that Aviza will be better positioned to become profitable on an ongoing basis," he adds. "We feel confident that the measures we are taking will enable Aviza to lower its financial break-even point and improve our financial performance."

The cost of the restructuring program and other one-time charges is estimated to be \$20–24m, due mainly to the write-down of assets relating to non-core products which include inventory revaluation, cancellation of purchase commitments, and fixed assets. It also includes costs relating to a reduction in the number of staff and contractors by about 15%. Aviza expects further savings to occur when it relocates its headquarters from Scotts Valley to a more appropriately sized facility in Santa Clara County, CA. Volume manufacturing will no longer be performed at Aviza's current location. The restructuring should result in annualized savings of \$16–20m.

[www.aviza.com](http://www.aviza.com)

## Follow-on shipment of etch systems to Anadigics

Aviza says that, in its fiscal first and second quarters of 2008 (ended 28 March), it made a follow-on shipment of multiple Omega etch systems to GaAs RFIC maker Anadigics Inc of Warren, NJ, USA, which is an established customer of Aviza's etch and physical vapor deposition (PVD) system. The latest etch systems can be used to etch silicon nitride, GaAs backside vias and BCB/silicon oxide.

"We selected Aviza because they proved that their Omega fxP and Omega i2L systems could clearly meet our process requirements and we know Aviza can deliver excellent customer support and service," says Anadigics' supply chain director Iain Black.

"As an incumbent process equipment supplier to Anadigics, we are sensitive to their manufacturing requirements," said Kevin Crofton, VP and general manager of Aviza's

PVD/CVD/Etch business unit. "Our existing Omega i2L and Sigma fxP systems previously installed at Anadigics' facility proved the manufacturing worthiness of our products," he adds. "We are grateful that Anadigics has turned to Aviza to both help meet their rapidly expanding etch capacity needs, and at the same time, address the challenging process performance and productivity requirements for their next-generation products."



## Rohm and Haas divests stake in UP

Rohm and Haas Company of Philadelphia, PA, USA has sold its 40% equity interest in UP Chemical Company (a South Korean firm that specializes in DRAM and high-k gate dielectric precursor technology) to South Korea's Woori Consortium for about \$112m (reflecting a pre-tax gain of about \$84m on its September 2004 acquisition).

"We identified UP Chemical as a good strategic partner during the very early stages of using ALD (atomic layer deposition) in semiconductor manufacturing," says Dr Yi Hyon Paik, VP and business group director for Rohm and Haas Electronic Materials of Marlborough,

MA. "In 1998, Rohm and Haas invested \$3.5m in UP Chemical."

Rohm and Haas continues to participate in the ALD market. In March 2007, Rohm and Haas Electronic Materials signed an exclusive licensing agreement with Harvard University to manufacture and market rare-earth metal amidinate compounds, such as lanthanum, dysprosium and gadolinium (the next generation of ALD materials for advanced high-k dielectric, metal gate and barrier/adhesion thin-film layers in CMOS silicon-based memory and logic devices with feature sizes of 45nm and less).

[www.rohmhaas.com](http://www.rohmhaas.com)

## M-Com orders As/P reactor for multi-junction solar cells

Millennium Communication Co Ltd (M-Com) of Hsinchu, Taiwan has ordered a TurboDisc E450 As/P MOCVD system from Veeco for the production of high-efficiency III-V-based multi-junction solar cells.

Founded in January 2001, M-Com manufactures GaAs and silicon solar cells, as well as optoelectronic components such as vertical-cavity surface-emitting lasers (VCSELs), edge-emitting lasers, and resonant-cavity LEDs (RC-LEDs). The firm also packages MMIC/LNFET (low-noise field-effect transistors).

"We expect that adding this tool into production will help us to reduce our cost-per-chip ten-fold, which is critical as we continue to gain market share in the photovoltaic cell market," says M-Com's general manager Lih-Wen Lai.

"M-Com's selection of our TurboDisc E450 As/P MOCVD system is further evidence of its ability to produce consistently high yields of premium multi-junction solar cell devices," says Sam DiRenzo, VP, general manager of Veeco's MOCVD operations.

[www.m-comm.com.tw](http://www.m-comm.com.tw)

## Veeco delivers GaN MOCVD reactors to Genesis Photonics

Veeco has delivered multiple TurboDisc K-Series GaN MOCVD systems to Genesis Photonics Inc (GPI) of Southern Taiwan Science-Base Industrial Park, boosting its production capacity for GaN-based blue high-brightness LEDs (HB-LEDs) for lighting, display, backlighting, and automotive applications.

"The excellent throughput of the TurboDisc technology, plus the proven productivity of this platform in the LED industry in Taiwan, will meet our needs today and into the future," says GPI's chairman and CEO David Chung.

"The TurboDisc K-Series multi-generational platform and larger reactor capability will give GPI a long-term cost of ownership advantage, plus the technology to achieve their LED brightness roadmap objectives," says Veeco's Sam DiRenzo.

Veeco claims its TurboDisc K-Series MOCVD GaN platform (which includes the K300 and K465 models) delivers the highest throughput available for volume production of blue and green LEDs and blue lasers.

[www.veeco.com](http://www.veeco.com)

## IN BRIEF

### SuperNova orders Aixtron CCS CRIUS MOCVD system

Aixtron AG of Aachen, Germany has received an order for a Close Coupled Showerhead CRIUS epitaxy reactor (in the 31x2-inch wafer configuration) from SuperNova of Taoyuan, Taiwan for the development and manufacturing of GaN-based high-brightness LEDs.

"SuperNova was one of the first users of the Close Coupled Showerhead technology in Taiwan, and this additional tool will feature prominently in our expansion program," says SuperNova's chairman Chun-Tsao Huang. "Aixtron has given us unrivalled technical and process support so we look forward to a smooth and quick production ramp up," he adds.

Aixtron says that Taiwan is one of its most important markets, with over two dozen clients (most with multiple tools).

[www.aixtron.com](http://www.aixtron.com)

### In-situ Monitoring Award at ICMOVPE

At June's 14th International Conference of Metalorganic Vapor Phase Epitaxy (ICMOVPE 2008) in Metz, France, LayTec GmbH of Berlin, Germany will present the inaugural In-situ Monitoring Award for the best in-situ related contribution.

The firm will award a prize of EUR1000 in recognition of outstanding contributions to MOVPE by applying optical in-situ sensors. Both basic growth studies and device-related monitoring applications — either from academia or industry — are eligible.

Entries will be evaluated by the ICMOVPE program committee and assisting international experts in in-situ studies.

[www.movpe.umi2958.eu](http://www.movpe.umi2958.eu)

# Tegal agrees beta-site NLD shipment to HB-LED maker

Plasma etch and deposition system maker Tegal Corp of Petaluma, CA, USA has signed a beta-site agreement to ship a Compact 360 NLD system this summer to the central process development laboratory of 'one of the world's foremost LED makers'. The tool will be used for developing and qualifying conformal nano-layer deposition (NLD) passivation processes for high-brightness LED (HB-LED) manufacturing.

The beta-site agreement enables Tegal to continue cooperating with the customer in developing and refining deposition processes for NLD thin films, further optimizing the electrical and physical properties of NLD thin films, and confirming the applicability of NLD thin-film deposition to HB-LED manufac-

turing. The firms will also collect tool performance and reliability data from the system as it is exercised in production mode by the customer.

"We are proud to have been selected for this important development effort with the leading company in HB-LEDs," says Tegal's president and CEO Thomas Mika. "We believe that our NLD technology has wide application in the fast-growing area of HB-LED manufacturing and are pleased to have this opportunity to demonstrate our capabilities in our first beta site for both NLD and the new Compact platform."

The Compact 360 NLD cluster tool is a 200mm/300mm-capable bridge tool supporting Tegal's patented nano-layer deposition processes. NLD is a unique, cyclic MOCVD

process for highly conformal coatings that incorporates plasma film treatment with each deposition cycle, says the firm. It offers the benefits of atomic layer deposition (ALD) but with the potential for much higher deposition rate and system throughput. NLD also offers the benefit of using common MOCVD precursor materials that are readily available for a wide variety of metal, metal oxide and metal nitride films. Also, Tegal's Compact platform can accommodate all wafer sizes from 100 to 300mm in one, two or three process module configurations, with a variety of front-end/loadlock options that include FOUP (front-opening unified pod) and EFEM (equipment front-end module).

[www.tegal.com](http://www.tegal.com)

## IN BRIEF

### SMI appoints US rep

Structured Materials Industries Inc of Piscataway, NJ, USA has named ARS Associates of Allentown, PA as its principle representative in the USA for selling its CVD and MOCVD tools, components and services.

SMI's CVD kits and subassemblies are used to build, retrofit, modify or enhance its own CVD tools. SMI supplies custom and research tools, as well as converting compound semiconductor tools to oxide tools and vice versa.

SMI has sold tools for GaN electronics, ZnO, nanowires, oxide dielectrics/ferroelectrics, and SiGe etc. Research technologies include GeSbTe and GeS for MOCVD of PCRAM and CBRAM, respectively, and transparent conductive metal oxides (TCOs) for LEDs, OLEDs, displays, and photovoltaics.

[www.structuredmaterials.com](http://www.structuredmaterials.com)

## First Nano and Brooklyn College to develop ZnO nano-materials and devices

First Nano of Ronkonkoma, NY, USA, a division of CVD Equipment Corp, and The City University of New York (CUNY) at Brooklyn College, have signed a sponsored research agreement to jointly develop zinc oxide (ZnO) nano-materials and related semiconductor devices. The research is supported by a matching NYSTAR-CAT Grant.

The terms of the agreement give CVD a non-exclusive license and the option of an exclusive license to CUNY intellectual property related to the project, whether developed solely by Brooklyn researchers or jointly with First Nano/CVD. The technology is being developed in research labs at Brooklyn College under professors Kai Shum and Mim Nakarmi, and at First Nano's lab on its EasyTube 3000 systems.

"CVD shares our vision and confidence in developing this innovative technology to fabricate ultraviolet

light-emitting chips with variable sizes and shapes," says Shum. "These chips are based on ZnO nanowire grown by CVD. Since these new photonic devices rely on one-dimensional electronic density of states of nanowire structures and the large exciton binding energy of ZnO, they will offer superb performance in power, efficiency, and integration," he adds. "Major applications of these novel UV light-emitting chips include medical and data-storage devices, forensic and biological analysis tools, UV-based secure communications, space sensors, mineral identification and miniature displays."

The technology is well suited to scaling up to commercial production, Shum concludes, since it uses nanowires as templates, eliminating the delicate and time-consuming task of placing each nanowire separately on a device.

[www.firstnano.com](http://www.firstnano.com)

## Gold Canyon ups claims on Cordero gallium property

Mineral exploration firm Gold Canyon Resources Inc of Vancouver, Canada has retained SRK Consultants (US) Inc to undertake an environmental planning study and geo-hydrological study as part of its ongoing strategy for advancing its Cordero Gallium Project in Humboldt County, NV, USA (owned through US subsidiary Gold Canyon Resources USA Inc).

SRK will provide a scoping level assessment of environmental permitting requirements, including: an inventory of applicable state permit requirements; a review of comparable permitting efforts for similar-size projects in Nevada; a scoping level schedule for environmental permitting.

SRK will also provide a technical memorandum summarizing findings of the geo-hydrological assessment.

Also, in mid-April, Gold Canyon staked additional claims, contiguous to Cordero. The property is estimated to hold the largest known primary gallium resource in North America.

In February, the firm announced the completion of an updated National Instrument (NI) 43-101 technical report and resource estimation for Cordero prepared by Tim Carew of reserva International LLC, an independent mining consultant.

reserva's previous estimate of April 2006 reported indicated resources containing 337,360kg of gallium. This has now been more than doubled to 713,930kg.

The expansion of the gallium resource is based on an additional 18,850ft (5745m) of reverse circulation (RC) drilling in 81 RC drill holes completed in 2006 and 2007. This brings the total to 39,985ft (12,190m) in 163 RC drill holes.

Gold Canyon is hence moving forward with collection of a bulk sample for metallurgical testing in partial preparation for commencing a pre-feasibility study.

Earlier, in February, Gold Canyon said that large-diameter core drilling (announced in late Novem-

ber) had started at Cordero to complement the collection of bulk samples. At least US\$1m is budgeted to meet these objectives and take Cordero to the next stage. This follows Gold Canyon raising \$3m in mid-December in a private placement of common shares.

The Cordero drilling program and metallurgical work is being conducted for Gold Canyon under the supervision of mine consultant Douglas Christopherson (a qualified person, as defined by NI 43-101), who is responsible for the preparation of technical information. A copy of the updated technical report from 28 January is available at [www.goldcanyon.ca](http://www.goldcanyon.ca).

● At its annual general meeting of shareholders on 24 April, directors Akiko Levinson, Ron Schmitz, Ivan Obolensky, Duncan Riesmeyer and Vincent Della Volpe were re-elected for the coming year, and new nominees Garry Smith and Douglas Christopherson were also elected.

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## IN BRIEF

**Group IV appoints VP of engineering & product development**

Group IV Semiconductor of Ottawa, Canada has recruited Robert Burdalski as its VP of engineering & product development. The appointment should help the firm to strategically execute its vision of creating low-cost, widely available and energy-efficient light bulbs, using its silicon-based solid-state lighting technology. Last August, to further develop its technology, Group IV raised 'substantial' funds in a round led by Garage Technology Ventures Canada and Applied Ventures LLC (a subsidiary of process tool maker Applied Materials Inc).

"The significant expertise and experience that Robert brings to Group IV adds a distinct strength to our management team," says CEO Stephen Naor. "Our vision is that silicon-based technology will deliver the affordable solution to sustainable, energy-efficient lighting. The addition of such a seasoned executive will help propel the company's growth as we scale up our product development."

Burdalski has over 25 years of experience turning technology into commercial products and working with emerging technologies in solid-state lighting, power electronics and RF technology. He was previously chief operating officer for Lamina Lighting Inc of Westampton, NJ, USA.

"The company's nanofilm technology promises to provide all the widely known benefits that solid-state lighting can deliver, but at a cost comparable to fluorescent," says Burdalski. "My objective is to drive the development of the Group IV technology into integrated, energy-efficient products, dramatically reducing the cost of solid-state lighting and enabling its widespread global adoption."

[www.groupivsemi.com](http://www.groupivsemi.com)

**Saint-Gobain buys GaN supplier Lumilog**

At the beginning of April, French materials maker Saint-Gobain acquired Lumilog of Vallauris, France (in the Sophia-Antipolis Technological Park), which is now operating as a subsidiary of Saint-Gobain. Financial terms of the transaction were not disclosed.

Spun off in 2001 from the Center of Hetero-Epitaxie Research and Applications (CHREA) of France's National Scientific Research Center (CNRS) by Jean-Pierre Faurie (president), Bernard Beaumont (director/production manager) and Pierre Gibart (VP of the supervisory board), Lumilog develops and manufactures HVPE-grown free-standing bulk gallium nitride substrates as well as MOCVD-grown 2-inch gallium nitride template epiwafers on sapphire substrates, for both optoelectronic and microelectronic applications.

In 2001 Lumilog received Sophia

Euro Lab seed funding of e1m, as well as support from the European Union, CNRS, the Paca-Est incubator, the regional research & technology body DRRT and Anvar. In 2005, the firm raised €2.15m in second-round funding, bringing total capital to €5.15m. Investors included Banexi Ventures Partners, Emertec Gestion, Sophia Euro Lab SAS and TechFund Capital. In 2007, Lumilog had a turnover of €2m.

Previously, in October 2006, Saint-Gobain's main corporate research center, Saint-Gobain Recherche, signed an 18 month agreement to jointly develop commercial, engineered substrates for Australian GaN-on-glass developer BluGlass Ltd, leading in March 2007 to BluGlass demonstrating blue-light emission from a GaN LED structure.

[www.lumilog.com](http://www.lumilog.com)

[www.saint-gobain.com](http://www.saint-gobain.com)

**Energomera acquires sapphire substrate maker Atlas PCF**

Concern Energomera of Stavropol, Russia, which owns sapphire substrate maker Monocrystal, has bought Atlas PCF of Belgorodskaya obl, Russia. Like Monocrystal, Atlas also manufactures sapphire substrates for HB-LED and RFIC applications. Atlas becomes part of Energomera's Electronic Material business (EEM), which is led by Monocrystal.

The acquisition makes Energomera the largest synthetic sapphire crystal-growing and processing company in the world in terms of production capacity, expanding its global customer base and product portfolio, claims Energomera's president and chairman Vladimir Polyakov.

"This is a part of our strategy to develop a stronger presence in compound semiconductor market."

"For the last five years Atlas has been one of the most rapidly growing companies in the sapphire business," claims Atlas' general manager Martik Ovsepyan. The financial resources of Energomera enable it to ramp up production capacities more rapidly and to meet the growing demand from LED, RFIC and optical industries, he adds.

"The sales channels of Monocrystal and Atlas do not overlap and we will be able to offer a broader product range to the existing clientele as well as support new customers with strengthened production capacity and service" concludes Oleg Kachalov, Monocrystal's VP of sales and marketing.

[www.energomera.ru](http://www.energomera.ru)

[www.atlas-pcf.ru](http://www.atlas-pcf.ru)

# Oxford Instruments acquires TDI

As part of the strategy of CEO Jonathan Flint to acquire complementary technologies and double the size of the group over five years, UK-based Oxford Instruments plc has acquired Technologies and Devices International Inc (TDI) of Silver Spring, MD, USA for up to \$6m: \$1m in cash initially, plus a cash earn-out payable in 2012 based on the sales of tools the preceding financial year. Oxford Instruments also assumes TDI's debts of \$2.2m.

TDI was owned by private individuals, mainly staff and family members of Vladimir Dmitriev. After developing hydride vapour phase epitaxy (HVPE) technology for UV and visible LEDs and power electronic devices at Russia's Ioffe Institute in St Petersburg, Dmitriev founded the firm in 1997 and was president and CEO until his untimely death in January from a heart attack at the age of 52.

TDI develops and manufactures nitride materials (including GaN, AlN, AlGaIn, InN and InGaIn) using its patented HVPE technology and processes, mainly for applications in solid-state lighting, short-wavelength optoelectronics and RF power electronics.

"This acquisition is part of our on-going strategy to deliver added value to our current and future high-brightness LED (HB-LED) customers and gives us the opportunity to supply new markets," says Andy Matthews, managing director of Oxford Instruments Plasma Technology (OIPT) of Yatton, UK.

Oxford Instruments currently sells process tools to complete three of the nine steps needed to manufacture HB-LEDs, including supplying its Plasmalab range of etch and deposition tools to leading HB-LED makers. The acquisition allows the firm to supply tools for a fourth step (which has historically been the most time consuming and costly) with a unique offering that should greatly enhance production efficiencies.

Adding HVPE opens up the opportunity to deliver products to the epitaxy market sector, says OIPT. TDI's HVPE technology offers HB-LED makers lower manufacturing costs and improved output compared to conventional MOCVD techniques, it is claimed. Using HVPE, Oxford Instruments aims to produce tools that enable HB-LED makers to cut manufacturing time by 25%, allowing a reduction in production costs.

For the year to end-June 2007, TDI made a pre-tax loss of \$0.8m. The business is expected to continue to be loss-making for the first year of Oxford Instruments' ownership while process tools are developed, but to be profitable in the second year.

To assure continuity of supply to existing customers of HVPE-grown III-nitride materials, TDI will remain at its present facility, with president Tatiana Dmitriev and head of R&D Dr Alexander Usikov continuing to lead the team. Matthews adds that OIPT intends to work with the TDI team to develop the HVPE process further.

"We are very happy to be part of the Oxford Instruments group of companies to further develop III-nitrides HVPE and carry on with the innovative work that my father, Vladimir, and his team have been conducting over the past 10 years," says Tatiana Dmitriev. Vladimir Dmitriev leaves a company that, last November, was awarded the latest in a series of patents covering HVPE production equipment for manufacturing low-defect nitride materials (particularly bulk GaN and AlGaIn) substrates.

[www.oxford-instruments.com](http://www.oxford-instruments.com)

## TDI puts 20-130µm-thick 3-inch GaN epi into production

In early April, nitride material manufacturer Technologies and Devices International Inc (TDI) of Silver Spring, MD, USA said that its 3-inch diameter, thick gallium nitride wafers had entered production.

Manufactured using TDI's proprietary patented HVPE process and multi-wafer equipment, the GaN wafers consist of a 20-130µm-thick GaN layer deposited on 3-inch (0001) c-plane sapphire substrates. The new product broadens TDI's family of GaN, AlN, AlGaIn, InN, and InGaIn templates manufactured on 2-inch sapphire and AlN templates on 2-, 3-, 4-inch SiC. These thick GaN templates are targeted for

applications such as quasi-bulk low-defect GaN substrates for MOCVD and MBE homoepitaxial growth of blue, green and white GaN-based LEDs as well as laser diodes. Use of the wafer lowers the cost of epitaxy, simplifies the growth process, and improves final device performance, claims TDI.

"There is a clear trend in the industry to develop and commercialize GaN-based devices on larger substrates. TDI's customers are rapidly moving from the industry-standard 2-inch epitaxial wafer used for fabrication of light emitters to 3-inch wafers," says the firm's technical director Alexander Usikov.

"Increasing the quasi-bulk GaN wafer size to 3 inches is a substantial step toward dramatically reducing nitride epiwafer pricing for blue-green-white LEDs," he adds. "TDI has been perfecting the development of our advanced HVPE process for several years and we are now able to fabricate 3-inch diameter, thick GaN wafers in commercial quantities. This production breakthrough of large-area low-cost GaN wafers will benefit our customers in terms of higher device throughput, improved material yields and reduced production costs," Usikov reckons.

[www.tdii.com](http://www.tdii.com)

# Bridgelux closes \$40m series D funding round backed by TSMC

Bridgelux Inc of Sunnyvale, CA, USA, which supplies InGaN-based LED chips for solid-state lighting (using volume production capacity in Asia), has closed a \$40m funding round. This includes \$10m of bank lines of credit and \$30m of venture capital, led by new investor VentureTech Alliance (majority owned by Taiwan's TSMC, the world's biggest silicon foundry) and joined by existing investors DCM, El Dorado Ventures, VantagePoint, Chrysalix Energy Venture Capital, and Harris & Harris.

VentureTech Alliance's Jim Diller joins Bridgelux's board. "Bridgelux's team features an impressive roster of seasoned individuals with combined experience in the LED, IC, compound semiconductor materials, lighting and consumer electronics sectors, all of whom will be key to driving its future success," he says.

The firm was founded in December 2002 as eLite Optoelectronics Inc by Dr Heng Liu (formerly of North Carolina State University, Emcore, Hewlett Packard, and AXT, and now chief technology officer). Following initial funding in late 2003, it raised \$8.5m in series B funding in May 2005 plus (after changing its name to Bridgelux) \$23m in series C funding last August.

Bridgelux says that the latest funding will allow it to pursue its strategy for product development and market expansion, while continuing to drive its technology R&D activities. "Our capabilities in GaN epitaxy growth processes, device structures and chip designs, coupled with our market knowledge, has enabled us to quickly become a leader in the high-power LED industry," claims Bridgelux's CEO Mark Swoboda.

The latest round of funding will enable the firm to rapidly expand beyond its LED chip product offerings and move aggressively into value-added, application-specific LED lighting products, expanding its market reach, he adds.

Market research firm Strategies Unlimited forecasts a compound annual growth rate (CAGR) of 20% over the next five years for the LED market. High-brightness LEDs alone are projected to grow by 12% in just 2008, while new market opportunities are also emerging around display backlighting, camera flash, architectural lighting, task lighting, commercial and other general lighting applications. The overall market is therefore expected to reach \$11.4bn by 2012.

[www.bridgelux.com](http://www.bridgelux.com)

## Marketing and sales executives added in US and Europe

Bridgelux has appointed Keith Scott as VP of business development and David Barnby (based in Paris, France) as VP of sales and general manager for Europe, the Middle East and Africa (EMEA).

Both will play a key role in taking Bridgelux to the next stage of its growth, says CEO Mark Swoboda. "Keith is a seasoned lighting industry veteran with deep market experience and a unique understanding of the new product opportunities afforded within our dynamic industry." Scott will help to drive alignment of the firm's technology roadmap with its new product strategy, he adds.

Scott has over 20 years of global experience in the commercial and consumer lighting industry, holding positions in product and market development. He joins after 6 years at Philips Lumileds of San Jose, CA, USA, growing a multi-million-



Scott (left) and Barnby (right).

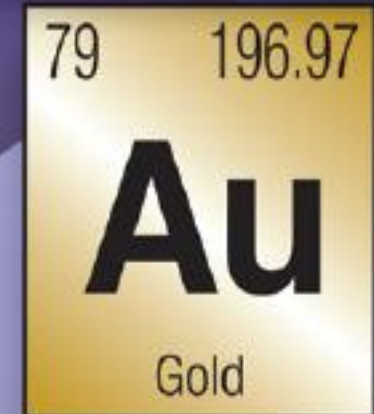
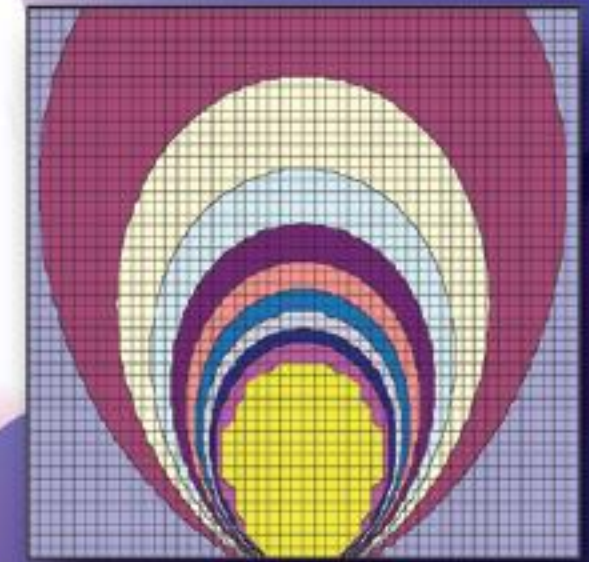
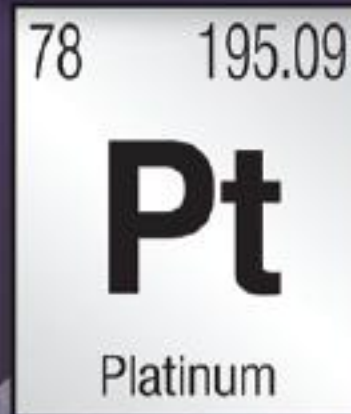
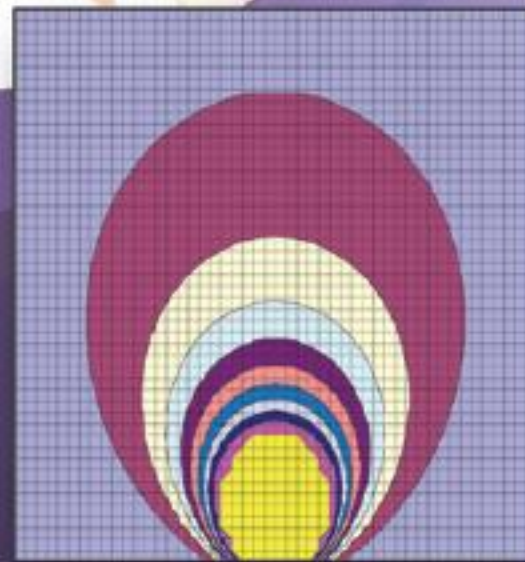
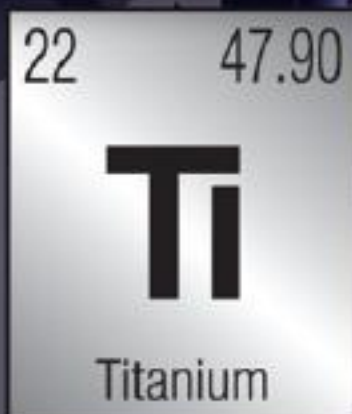
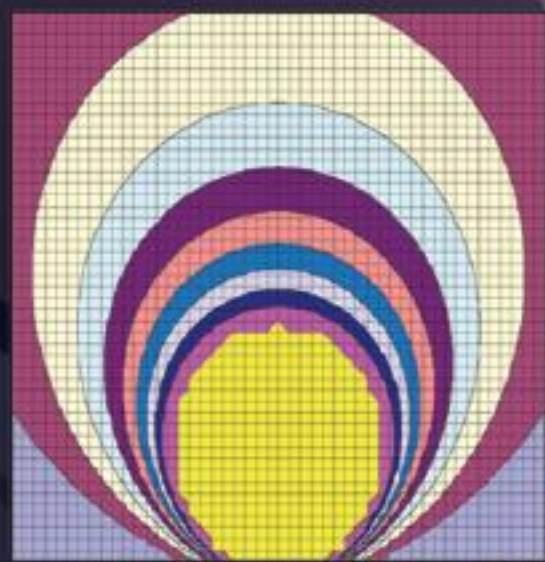
dollar, solid-state lighting business while in marketing and product development roles. Previously, he held marketing roles at Osram Sylvania Inc for 14 years, where he launched high-growth lighting and lamp compound products.

Regarding Barnby, Swoboda says Bridgelux sees great potential to expand its presence in Europe. "His extensive experience in building and leading sales and distribution networks in this region will prove instrumental in forging

closer ties throughout EMEA. Not only does his appointment demonstrate our deep commitment to our EMEA customer base, but it also shows our unwavering commitment to improve our support infrastructure in this critical region."

Barnby brings more than 20 years experience managing and growing business opportunities in Europe for high-tech Silicon Valley firms. Most recently, he was the EMEA VP of sales & marketing for Pinnacle Systems (the consumer division of Avid Technology). Previously, he was VP, global sales & marketing in the OEM Solutions business group of Thales. From 1985 until 2003, he held general management, sales and marketing positions at HP, including EMEA and worldwide responsibility for Optoelectronic and RF Semiconductor products (the Components Group).

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# LED University launched

LED maker Cree Inc of Durham, NC, USA has launched the LED University program, an international community of universities working to accelerate the adoption of energy-efficient LEDs. As well as evaluating, promoting and deploying LED lighting, the aims are to work toward increasing energy savings, protecting the environment, reducing maintenance costs and providing better light quality for improved visibility and safety.

Inaugural participant North Carolina State University along with Marquette University, University of California at Santa Barbara, University of Arkansas and Tianjin Polytechnic University in China have committed to evaluating and deploying LED lighting in areas such as offices, dormitories, parking garages, walkway lighting and streets across their campus infrastructures.

Each participating university is conducting LED lighting pilots to determine the cost and environmental benefits of switching to LED lighting in campus applications. Initial installations include the following:

- North Carolina State University has installed LED recessed can lighting from Cree in the chancellor's office and a dormitory, and is installing LED parking garage lighting from BetaLED.
- Marquette University has installed LED T8 replacements from LED Dynamics in the office of the vice president for administration

and is installing LED recessed and task lighting.

- University of California at Santa Barbara has installed 23 LED streetlights from BetaLED on a campus street and has reported that, compared to its traditional streetlights, it is achieving a 44% reduction in energy use as well as better light distribution and color rendition.

- University of Arkansas has installed the first set of what it plans will be 1700 recessed LED lights from Cree in university buildings, starting with lighting the chancellor's residence.

- Tianjin Polytechnic University installed 1,500 LED streetlights designed by its graduate students on the campus' main roadway.

"Our commitment to become the first university in Cree's LED University initiative marks an important milestone for NC State University," says NCSU's chancellor James Oblinger. "Part of our mission is to develop and implement real-world solutions that have global impact," he adds.

**Each participating university is conducting LED lighting pilots to determine the cost and environmental benefits of switching to LED lighting in campus applications.**

"NC State has a strong heritage in energy research and conservation — including LED research..."

Cree was founded by NC State graduates based on research work conducted in our engineering labs. It's the basis for our commitment to this partnership," he continues. "By joining the LED University initiative, we are making a long-term investment in an energy-efficient future for NC State."

"As a Catholic, Jesuit university, stewardship of the earth's natural resources is an important part of our mission," comments Marquette's VP for administration Art Scheuber. According to the US Department of Energy, 22% of electricity used in the US powers lighting. "By participating in the LED University initiative, we're able to develop and share research on new lighting technology," he adds.

"Outfitting our new buildings with LED is one of many steps that we are taking to make our campus sustainable and energy efficient," says Nick Brown, executive assistant for Sustainability at University of Arkansas. "We look forward to adopting this technology widely across our campus, in both indoor and exterior applications."

"Tianjin Polytechnic University is proud to be among the first to join this important lighting and energy conservation initiative," adds professor Pingjuan Niu.

[www.leduniversity.org](http://www.leduniversity.org)

## Cree expands network of solution providers

LED maker Cree says that seven new firms have joined the global Cree Solution Provider network: Cooler Master Ltd; LEDIKO; LEDynamics Inc; Light Engine Ltd; MetroSpec Technologies LLC; Naotek; and XLight Ltd.

Created in November, the program now includes 21 solution providers offering a wide range of LED lighting services including design con-

sulting; customized design; LED engines; turnkey solutions; sub-assembly; and complete assembly.

"The world is seeking high-quality LED lighting now," says Cree's senior VP of sales, Bob Pollock. "Creating lighting-class LED systems requires new resources and areas of expertise."

The network offers XLamp LED customers a full range of LED

lighting-system design assistance and solutions to help accelerate time-to-market and reduce product development costs. Network members work closely with Cree to help ensure alignment of technologies. Cree says that members are chosen on the basis of their history of collaborating successfully with customers.

[www.cree.com/csp](http://www.cree.com/csp)



# Cree sustains growth through focus on LED lighting

For its fiscal Q3/2008 (to end March), Cree Inc of Durham, NC, USA has reported revenue of \$125m (including \$0.7m from the acquisition of LED Lighting Fixtures Inc announced in February). This is up 5% on the prior quarter and up 38% on \$90.3m a year ago.

LED revenue was \$105m (up 7% on last quarter and up 57% on a year ago, following the acquisition of Hong Kong-based COTCO Luminant Device Ltd last April). High-power (GaN and SiC) product revenue was \$6.2m (up 30% on last quarter and 26% on a year ago). Revenue for SiC substrates was \$6.3m (down 11% on last quarter and 37% on a year ago).

"Cree's strategy to drive revenue growth by focusing on LED lighting continued to pay dividends in Q3, as we delivered financial performance that was in line with our previously announced guidance," says CEO Chuck Swoboda. "Revenue growth

was led by higher sales of LED components, which exceeded sales of LED chips for the first time."

Gross margin was 35% of revenue. Including net expenses of \$6.4m, net income has fallen from \$21.1m a year ago to \$5.7m. However, excluding one-time items (such as a tax benefit in the year-ago quarter), net income has almost tripled from \$4.7m to \$12m. Cash and investments grew \$36.4m to \$398.3m during the quarter.

The \$103m acquisition of LED Lighting Fixtures Inc (the first company to develop a viable, energy-efficient, 'no-compromise' retrofit LED down-light for general illumination, it is claimed) expands Cree's market opportunity by providing direct access to the lighting market, and enables it to drive retrofit solutions to convert existing lighting infrastructure to energy-efficient lighting and to accelerate the adoption of LED lighting, Swoboda

believes. "For Q4, we target growth from XLamp LEDs, high-brightness LED components and our new LED lighting solutions, all of which are benefitting from the rising demand for energy-efficient LED lighting."

Cree also announced that Austin, TX, USA and the Tianjin Economic Development Area (TEDA) in China are joining its LED City initiative. Austin plans to evaluate and deploy LED lighting technology across its municipal infrastructure and is offering rebates covering about 30% of the upfront cost of LEDs to help businesses explore the benefits of the technology. TEDA is the first city area in China to join the program and has partnered with Tianjin Polytechnic University to develop the expertise needed to speed the adoption of LED lighting in China.

For its fiscal Q4/2008 (to 29 June), Cree expects revenue to rise 3–6% to \$129–133m.

[www.cree.com](http://www.cree.com)

## LR6 downlight made available globally for 220–240V

Following the rapid adoption of its LED downlight in the USA, Cree is introducing its flagship LED lighting solution globally. A new version of the LR6, designed for 220–240V electrical systems, has been released to address Europe, Asia, and other major markets.

Cree LED Lighting Solutions (Cree LLS) launched the 165mm LR6-230V at April's Light+Building show in Frankfurt, Germany. The LR6-230V is based on Cree's lighting-class XLamp LEDs and patented color-mixing technology. Cree says that this combination allows it to excel in three critical elements: color quality (CRI Ra 94), efficiency and longevity.

"The high quality of light and the energy efficiency of LEDs enable our

fixtures to deliver unprecedented value," says Cree LLS' president Neal Hunter. "As part of Cree, we now have an ideal technology platform to advance LED lighting and are expanding the application of our LED products globally."

The LR6 was the grand prize winner in a 2007 competition sponsored by the American Lighting Association, with performance verified by tests in independent labs under the direction of the US Department of Energy. The LR6 gained "high marks for light output and color quality with luminaire efficacy exceeding even the most efficient fluorescent downlights currently available."



The LR6-230V uses 12W of electricity and produces light comparable to a 75W incandescent. It uses about 85% less energy and lasts up to 50 times longer; over 20 years in homes and 10 years in businesses under normal use conditions, says Cree. Compared to compact fluorescent lamps (CFLs), the LED lights use 50% less energy and last up to five times longer.

Cree LLS is shipping production quantities of the LR6-230V this quarter and is in the process of selecting distribution partners for Europe and the Middle East.

At the Light+Building show, Cree LLS also previewed its expanding product portfolio with its new 115mm downlight and 600mm x 600mm recessed architectural lights.

# Last section of Osram Opto's Regensburg expansion opened

The last section of the Regensburg site at LED maker Osram Opto Semiconductors GmbH in Germany has been officially opened by CEO Dr Rüdiger Müller and Martin Goetzler, CEO of parent company Osram, together with Regensburg mayor Hans Schaidinger.

"Since the start of construction seven years ago we have invested hundreds of millions of euros," said Müller. During that time, staffing has risen by about 500 to 1500, he added. The expansion has boosted capacity by almost 50%. The plant in Regensburg now covers a total area of more than 55,000m<sup>2</sup> (600,000ft<sup>2</sup>).

Products based on Osram Opto Semiconductors' technology already account for 12% of the parent company's overall sales. "LEDs are the light sources of the future so we have every intention



From left: Regensburg mayor Hans Schaidinger, Osram Opto Semiconductors' CEO Dr Rüdiger Müller, and Osram's CEO Martin Goetzler.

of expanding in this field, which is why we have invested heavily in expanding the sites in Regensburg and Penang (Malaysia)," said Goetzler.

This also applies to research and development, for which investment last year alone amounted to 13% of Osram Opto Semiconductors' sales.

[www.osram-os.com](http://www.osram-os.com)

## Asia regional headquarters opened in Hong Kong

The new Asia regional headquarters of its LED-making subsidiary Osram Opto Semiconductors GmbH of Regensburg, Germany has been formally opened by CEO Dr Rüdiger Müller together with Dr Alfred Felder, CEO of Osram Opto Semiconductors Asia Ltd.

Osram Opto Semiconductors chose Hong Kong in order to be nearer to customers and partners in Asia, especially Greater China, Korea and Japan. Also, regional activities for other business units of Osram Opto Semiconductors' parent company Osram have been located in Hong Kong since 2006. The new office will initially house staff to coordinate sales and marketing activities in Asia.



Osram Opto's CEO Dr Rüdiger Müller at dragon 'eye painting' ceremony during official opening.

"Choosing Hong Kong as our new regional headquarters reflects our long-term commitment to Greater China and the Asia market, which is open to innovative solutions in LED lighting," says Müller. "The opening of this office represents a

successful step forward in the strategic development of Osram Opto Semiconductors in Asia and paves the way for us to strengthen our sales and marketing efforts here."

The opening follows the groundbreaking last July of a second opto chip factory in Penang, Malaysia, which, when it opens in spring 2009, will be the world's most advanced chip factory to serve the booming LED market, the firm claims. The production capacity expansion enabled by

the new factory in Penang, together with the opening of the Hong Kong headquarters, should mean that Osram Opto is better placed to meet growing demand for LEDs in Asia Pacific, the firm reckons.

# EU mandate to drive use of LEDs in daytime running lamps

Philips Lumileds of San Jose, CA, USA reckons its Luxeon power LEDs are poised to increase their presence in front-of-vehicle applications due to expected European Union regulations mandating daytime running lamps (DRLs) on new cars from 2011, driven by the big reduction in power consumption (about 80%) compared to incandescent or halogen bulbs.

Audi and VW offer Luxeon-based DRLs, and several other car makers will follow in the next 12–18 months as part of a movement to improve road safety by increasing vehicle visibility during daylight hours.

LEDs are used as a DRL light source for their styling possibilities. But the EU regulations will make cutting power consumption the driver for

adoption. The energy saving is critical, since DRLs with conventional bulbs consume more power than any other exterior lighting application due to their always-on daylight use.

A typical DRL with incandescent or halogen bulbs uses 40–80W of power. Luxeon-based DRLs consume 10W or less due to their low power demands and energy efficiency.

So, any new regulation requiring DRLs is expected to drive broader LED adoption for DRLs as well as other forward automotive lighting applications. Luxeons are already used in the world's first all-LED headlight on the Audi R8 supercar.

"Today LED DRLs are used on fewer than 1% of vehicles, in part because DRLs are not required in most coun-

tries," says Scott Kern, VP automotive sales. "If the new regulation by the United Nations Economic Commission for Europe moves ahead as expected, it will increase that number dramatically because of the low power usage, longevity and design flexibility of LEDs compared to conventional light sources."

Lumileds claims to have pioneered many automotive exterior lighting applications with its Luxeon, Super-Flux and SnapLED products. As well as driving the first all-LED DRL and all-LED headlamp, they enabled the world's first all-LED rear combination lamp, first single-LED stop-tail lamp, and first LED front-, rear- and side-mirror turn signals.

[www.philipslumileds.com](http://www.philipslumileds.com)

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# Rothschild's ITC action yields Seoul and Everlight settlements

LED makers Seoul Semiconductor Co Ltd of Korea and Everlight Electronics Co Ltd of Taipei, Taiwan have signed settlement agreements in the patent case brought before the US International Trade Commission (ITC) on 19 February by Gertrude Neumark Rothschild, professor emerita of Materials Science and Engineering at Columbia University, New York, USA, say her intellectual property attorneys Albert Jacobs Jr and Daniel Ladow of Dreier LLP.

The complaint ('In the matter of Short-Wave Light Emitting Diodes') alleged infringement by 34 firms of her 1993 US patent 5,252,499 'Wide band-gap semiconductors having low bipolar resistivity and method of formation' (covering a method of producing gallium nitride-based semiconductors for LEDs and laser diodes emitting in the blue, green, violet and ultraviolet end of the spectrum).

The complaint also seeks to bar importation into the USA of a wide range of consumer electronics products incorporating infringing devices. These include DVD players using Sony's Blu-ray format, Motorola Razr phones and Hitachi camcorders, as well as instrument panels, billboards, traffic lights and data storage devices. Other firms cited include Blu-ray DVD player makers Matsushita Electric Industrial Co (Panasonic), LG Electronics Inc and Samsung Group and HD DVD player manufacturer Toshiba Corp, as well as Nokia Corp, Sony Ericsson Mobile, Pioneer, Sanyo Electric Co, and Sharp Electronics.

The ITC agreed to institute an investigation on 20 March, saying that the case would be referred to ITC administrative law judge Paul Luckern to make an initial determination whether it should be subject to ITC review.

Rothschild began her research career in private industry, working with Sylvania Research Laboratories in Bayside, NY in the 1950s and later at Philips Laboratories in Briarcliff Manor, NY before joining Columbia as a professor of materials science in 1985. She conducted research in the 1980s and '90s into the electrical and optical properties of wide-bandgap semiconductors that is claimed to have been pivotal in the development of short-wavelength emitting (blue, green, violet and ultraviolet) diodes now used in consumer electronics.

Recognized by the American Physical Society as a Notable Woman Physicist in 1998, Rothschild was elected as a Fellow of the American Physical Society in 1982. In 2008, she was selected as a recipient of Barnard College's Distinguished Alumna Award. She has published about 90 research articles and given 28 invited talks since 1980.

"The licensing agreements with Seoul Semiconductor and Everlight are an

important step forward in this case, since more companies are recognizing professor Rothschild's seminal breakthroughs in the production of the blue, green, violet and ultraviolet

LEDs and LDs that are essential to a host of consumer products," says Dreier LLP's Jacobs.

"With the license agreement, Seoul Semiconductor is able to provide unrestrictive sales of LED

products in the US market, providing further assurance to our vendors and customers," said the Korean LED maker.

"Seoul Semiconductor is a strong proponent of protecting its intellectual property rights and respects the intellectual property right of other companies," the firm adds. "This is evidenced by our recent successes in protecting our IP rights in a number of lawsuits in Korea and by us signing a patent license agreement with Itswell Co Ltd just last month [see facing page]."

After previous patent complaints filed elsewhere starting in 2002, LED makers including Germany's Osram Opto Semiconductors and Japan's Nichia and Toyoda Gosei have already settled with Rothschild over alleged patent infringement. (On 7 April, Toyoda Gosei confirmed that it had agreed a patent license with Rothschild in August 2006 after settling a lawsuit filed in July 2005. So, regardless of February's ITC complaint, its LED chips are not infringing the patent and customers are not be subject to Rothschild's exercise of her patent rights.)

Most recently, on 10 March, a separate action that had been brought before the US District Court for the Southern District of New York by Rothschild was settled by LED maker Philips Lumileds of San Jose, CA, giving it a non-exclusive license. Also, earlier this year, Philips endowed a 'Philips Electronics Chair' in the Department of Applied Physics at Columbia University's Fu Foundation School of Engineering and Applied Science in Rothschild's honor.

A further case against LED maker Cree Inc of Durham, NC, USA is still pending.

[www.dreierllp.com](http://www.dreierllp.com)

[www.everlight.com](http://www.everlight.com)

[www.seoulsemicon.com](http://www.seoulsemicon.com)

**More companies are recognizing professor Rothschild's seminal breakthroughs in the production of the blue, green, violet and ultraviolet LEDs and LDs**

## Seoul wins AOT white LED lawsuit

LED maker Seoul Semiconductor has won a lawsuit filed in the Korean Supreme Court on 14 March by Advanced Optoelectronic Technology Inc (AOT) of Hsinchu, Taiwan seeking to have Seoul Semiconductor's white LED patent ruled invalid.

Last October, the Patent Court of Korea turned down appeals by both AOT and LED maker Itswell of Cheongwon Chungbuk, Korea to overturn the Korean Intellectual Property Tribunal's rejection of invalidation actions regarding Seoul Semiconductor's patent.

Subsequently, in late October, the Seoul High Court ruled in favor of a Seoul Semiconductor latent infringement lawsuit that Itswell should pay \$1.2m in damages for past infringement of its utility patent for producing white LED, as well as an injunction against any further infringing activities.

Seoul Semiconductor has now also signed a patent license agreement with Itswell after the firms reached an amicable settlement of the various lawsuits and claims relating to white LED patents.

The firm says that the license agreement will allow it to collect royalty payments from Itswell for the use of its patent on white LED manufacturing technology in the past and for future use of the patent.

"With the Itswell license agreement, we will help create an atmosphere where companies respect each others' patents, and at the same time build a cooperative relationship with other LED corporations," says Seoul Semiconductor. "However, we will take strong action against those who do not respect intellectual property rights."

[www.seoulsemicon.com](http://www.seoulsemicon.com)

### IN BRIEF

#### Court clears Osram of libeling Dominant

The US Court of Appeals for the Federal Circuit has upheld a ruling by the District Court for the Northern District of California that Osram GmbH did not engage in unfair competition, intentional interference with contractual relations, interference with prospective economic advantage, and trade libel when it told customers that it believed Malaysia's Dominant Semiconductors Sdn Bhd had infringed its LED patents.

Since later court rulings found Dominant responsible for infringing the patents, Osram's claims were based on fact and did not constitute libel, the appeals court found.

[www.ca9.uscourts.gov/opinions](http://www.ca9.uscourts.gov/opinions)

Photograph by Michael Betts



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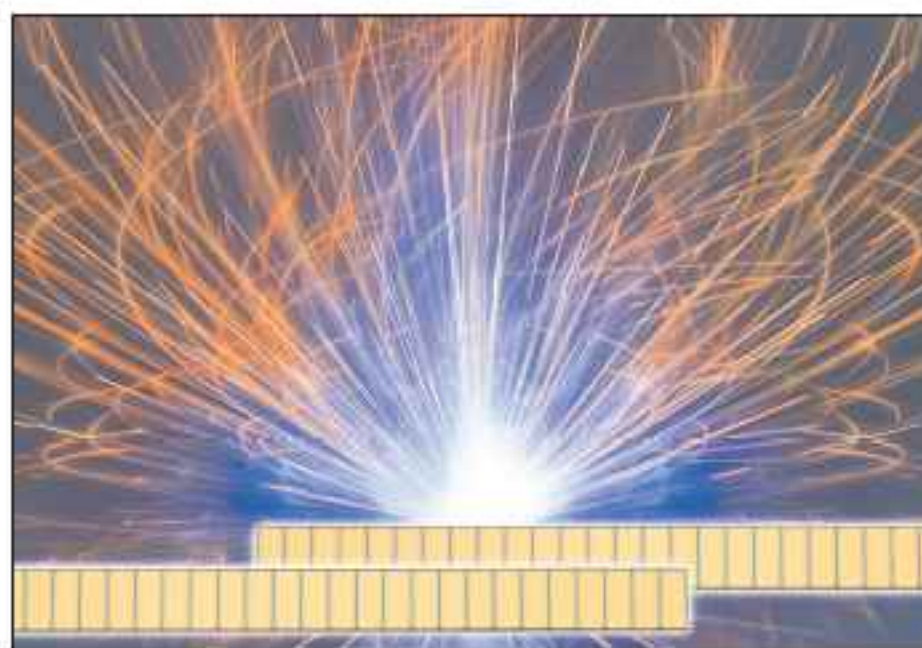


## BRILASI raises the bar for high-power lasers

Osram Opto Semiconductors GmbH of Regensburg, Germany says that, as part of the BRILASI research project, it has improved the efficiency, output power, life-time and beam quality of laser bars (chips).

The results include laser bars with a wavelength of 910–980nm that achieve an optical output of 120W under real industrial conditions and a typical efficiency of 70%, as well as bars with wavelengths of 808–880nm and an efficiency of 62% at 120W (almost twice the output and 10% higher efficiency compared to previous components). The firm will launch the improved generation of laser bars with products that have a 50% fill factor. Structures with a fill factor of 20% complete the range.

“With this latest generation of laser bars we will be able to offer much more powerful components”, says Dr Jörg Heerlein, head of product marketing lasers. The new, more powerful laser bars allow system output to be increased but with the same lifetime, says Osram Opto. Systems can



Laser bars from Osram Opto.

also be made smaller and more reliable while offering the same output.

Applications include pumping solid-state lasers and direct material processing, but they are also suited to optical fiber coupling applications (for which bars in the 910–980nm wavelength range with an output of 80W are expected initially).

Samples of the new unmounted laser bars are already available. The product launch for standard industrial laser bars with a 50% fill factor is planned for this summer; structures for optical fiber coupling will be launched this autumn.

● The research project BRILASI (Brilliant High-Power Laser Diodes for Industrial Applications, FKZ 13N8601) was initiated by the German Ministry for Education and Research (BMBF), with VDI (the Association of German Engineers) as the executing organization and Osram acting as the project coordinator. The project team comprised partners from the laser system and end-user sectors as well as representatives from research institutes.

Osram says it has achieved the project's objective with laser bars that can be used at 100–170W in a 20,000 hour continuous wave (CW) or long-pulse mode (depending on the emission wavelength and mounting technology). The key was optimization of the epitaxial structures, particularly regarding minimizing electrical losses (reducing the electrical series resistances without increasing the optical absorption losses). The laser resonator was also improved, says Osram.

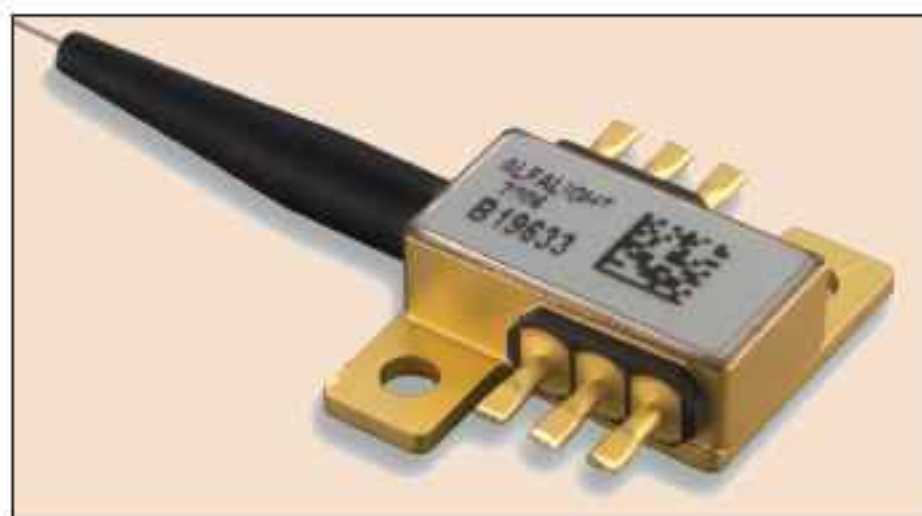
[www.osram-os.com](http://www.osram-os.com)

## Alfalight launches uncooled 10W 915nm pumps for industrial lasers

High-power diode laser manufacturer Alfalight Inc of Madison, WI, USA has launched the new AM6-915B family of laser pump diodes, which provide 10W of 915nm light output with a high-brightness 105µm diameter fiber with a numerical aperture (NA) of 0.15 or 0.22 (model AM6-915B-10-108 or AM6-915B-20-108).

The single-emitter diodes include a thermistor for temperature monitoring, and are available in an uncooled, compact 6-pin industrial-grade package that simplifies PCB mounting. The high-power pumps target cost-sensitive industrial markets including small continuous-wave (CW) lasers, small/low-cost pulsed lasers, and some mid-range CW and small military systems.

“This is an addition to the families of 9xxnm 10W devices that we are



Alfalight's 6-pin uncooled compact form-factor laser package.

introducing through 2008, as we drive down the \$/W ratio to meet industrial customer needs for greater value in high-reliability laser pump diodes,” says VP of sales and marketing Ron Bechtold. In January, at Photonics West in San Jose, CA, Alfalight launched the AM6-940B series of pump diodes, providing 10W of 940nm light output.

[www.alfalight.com](http://www.alfalight.com)

## DILAS opens Chinese facility

DILAS Diodenlaser GmbH of Mainz, Germany, which designs and makes high-power diode laser components, modules and systems (including fiber-coupled products), has opened its first manufacturing plant in China.

With a sales office currently in Shanghai managed by sales & marketing director Dr Lin Yang, the new plant is strategically located in Nanjing and will offer a full complement of customer support, product development and technical services.

“Our new manufacturing facility is a strategic move towards globalization necessitated by our growing customer base seeking high-power diode laser solutions in China, Asia and around the world,” says Dr Marcel Marchiano, president & CEO.

[www.DILAS.com](http://www.DILAS.com)

## Sharp boosts blue-violet laser to 250mW for 6x Blu-ray disc recording in laptops and plans 400mW for 8–12x by 2010

In late March, Japan's Sharp Corp gave a technical briefing of its latest developments related to laser diodes, including showcasing its latest series of high-power blue-violet lasers for Blu-Ray recorders.

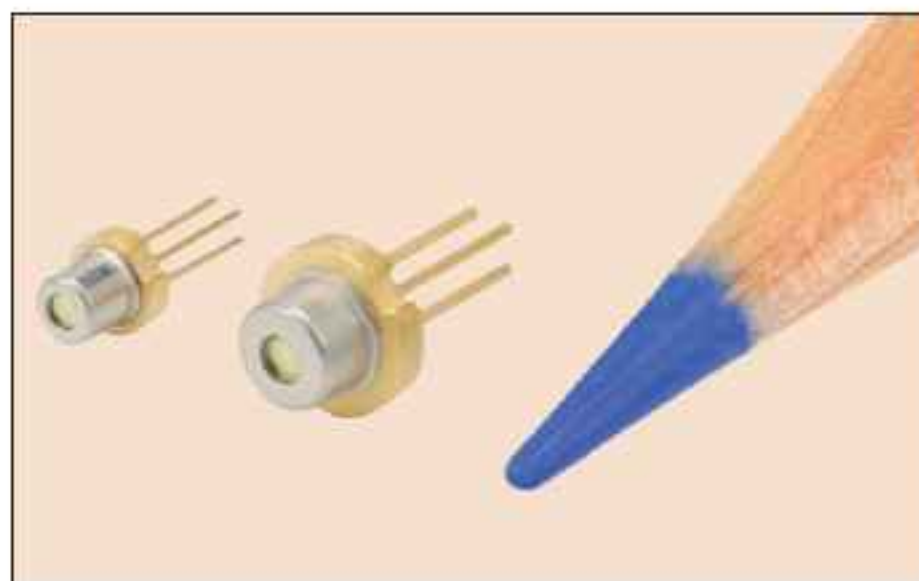
In February, the firm started shipping samples of two versions of a new generation of its blue-violet laser diodes with pulsed output power boosted to 250mW (sufficient for recording on dual-layer Blu-ray discs at 4-6x speeds).

The new GH04P25A2G has a 5.6mm-diameter CAN package and is intended for desktop PC drives and recorders ('half-height' drives). But in addition the new GH04P25A4G has the smaller 3.3mm-diameter CAN package as the previous lower-power version, intended for notebook PCs ('slim' drives). Using a proprietary facet structure, the power consumption of the laser chip has been decreased, and mounting on 3.3mm-diameter package was enabled by suppressing the rise in heat of the package, says Sharp.

Samples were priced at ¥50,000 (about \$462). Mass production of the 250mW blue-violet laser diodes was due to begin in April at a monthly capacity of up to 700,000 units. Blu-ray drives featuring the new 250mW lasers should enter the market in second-half 2008.

Sharp also announced plans to increase the power of its blue-violet laser diodes for Blu-ray disc players, according to a report from Nikkei's Tech-On. The firm aims to ship 300mW blue-violet laser diodes that can record at 8x or higher speeds on dual-layer discs early in 2009, followed by a 350mW diode towards the end of the year, then a 400mW version in 2010 (for multi-layer recording at 8–12x speeds).

Sharp expects global sales of around 22m low-power (read only)



Sharp's 3.3mm GH04P25A4G and 5.6mm GH04P25A2G Blu-ray lasers.

blue-violet laser diodes in 2008, with sales of high-power (read/write) blue-violet diodes reaching 2.2m as the market for Blu-ray compatible products starts to rise from the 2007 Christmas season.

To meet this growing demand, in April Sharp was due to complete a combined low- and high-power blue-violet laser diode capacity ramp, from 500,000 units per month last July to 700,000 units per month now.

Annual sales of low-power and high-power products are expected to exceed 100 million units in 2010 and 2012, respectively.

Also in April, Sharp was due to begin shipping mass-produced red laser diodes with pulsed output power boosted from the 350mW of the existing product to 400mW, enough for recording on dual-layer DVD discs at the highest available speeds of 20x (possibly the firm's final series of laser diodes for high-speed DVD recorders). The new GH16P40A8C laser diode is just 1.8mm thick, for use in notebook PCs.

The company is also increasing its monthly production rate of high-power red laser diodes, from 5m in fiscal 2007 to 7m in fiscal 2008. Sharp anticipates that, by 2009, annual sales of high-power red laser diodes will exceed 300m, and reach 400m in 2013.

[www.sharp.co.jp](http://www.sharp.co.jp)

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# QPC ships lasers for defense

QPC Lasers Inc of Sylmar, CA, USA, which manufactures high-power lasers for consumer, industrial, defense and medical markets, has shipped lasers to two more US defense contractors.

## High-power fiber-laser pump for airborne weapons

A BrightLase high-power laser has been delivered to a US Government Department of Defense customer for use as a fiber-laser pump engine in next-generation airborne directed energy weapons applications.

The shipment is a milestone in an ongoing development agreement that has awarded \$1.75m in contracts since April 2007. BrightLase leverages patented and proprietary laser technologies that are designed to achieve a ten-fold reduction in cost, size, and weight compared to conventional laser technology.

"Today's high-energy lasers are based on inefficient and bulky traditional technologies such as chemical lasers, but the future belongs to more efficient and compact diode-pumped lasers," says co-founder and CEO Dr Jeffrey Ungar. "High-power, compact and efficient chip-based diode lasers using QPC technologies are poised to become crucial elements in deployable high-energy weapons," he reckons.

"With this delivery, we continue the refinement of our Generation III laser technologies for both military and commercial applications.

These Generation III lasers enable a broad base of potential commercial applications and, since their launch in September 2007, have generated over \$13m of new commercial contracts for defense, laser TV, surgical and therapeutic applications," Ungar concludes.

## Miniaturized 300W Ultra laser

QPC has also shipped a compact custom Ultra laser exceeding 300W to a US Government prime contractor for an undisclosed defense application. By deploying its proprietary BrightLock chip technology in its high-brightness Ultra fiber-coupled product platform, the compact high-performance laser is the size of a small laptop.

The BrightLock Ultra is one of QPC's Generation III products announced in late 2007. The firm says that its BrightLock laser chip technology enables compact laser footprints by cutting system cooling requirements and eliminating the need for external components which are expensive, bulky and require routine maintenance. In particular, the Ultra is a high-performance laser engine, featuring a compact, lightweight footprint that uses an on-chip technology to produce a narrow stable emission spectrum designed for energizing solid-state and fiber-laser systems.

QPC claims that its Generation III technology (developed in part under US Government contracts)

offers up to a ten-fold improvement in cost, size, weight, power consumption, and ruggedness compared to existing conventional non-chip-based technology in solid-state and gas lasers, which it aims to replace. Also, QPC's technology offers significantly reduced power consumption, which is particularly important in aerospace, consumer, and industrial applications that require high-power lasers to operate on limited energy sources.

"High peak power operation is a critical requirement for several defense applications, including range-finding, targeting, and remote sensing," says VP of marketing & sales Paul Rudy. "Our BrightLock Ultra products meet this need uniquely with rugged and compact solutions that can endure demanding environmental conditions," he claims.

● At March's SPIE Defense & Security conference in Orlando, FL, USA, QPC exhibited several Ultra laser configurations (including a 120W eye-safe wavelength model and a 425W near-infrared model suitable for defense applications) as well as its BrightLase high-power single-mode eye-safe wavelength lasers. QPC also demonstrated its visible laser technology, which can be customized for next-generation laser head-up displays, dazzlers, or flight simulators.

<http://spie.org/defense-security.xml>

## QPC awarded two more US patents for laser technology

QPC Lasers has been granted two more US patents since the end of March (the firm's eighth and ninth in total, and its third in 2008):

● patent 342951 ('Laser Diode With Monolithic Intra-Cavity Difference Frequency Generator') for a new architecture using nonlinear optical frequency converters integrated onto the source chip to create new infrared output frequencies.

● patent 349453 ('Direct Impingement Cooling of a Laser Diode Array') for thermal management of extremely high-brightness arrays.

"QPC's unique surface-emitting array technology is an excellent match to this new technique for laser cooling," reckons Dr Jeffrey Ungar, president and CEO. "By eliminating temperature rise inherent in conventional heat removal technology, this new technique

provides greater power output in a smaller package, which is of critical significance for high-performance military and industrial lasers."

"There are a number of technologies unique to QPC, and we will continue to add to our already strong portfolio of patents and trade secrets," says Ungar.

QPC now holds eight issued patents and eight patents pending.

[www.qpclasers.com](http://www.qpclasers.com)



# Syntune takes control of Svedice

Stockholm-based single-chip tunable laser and transmitter manufacturer Syntune AB has taken a controlling equity stake in fellow Swedish firm Svedice AB of Järfälla, which provides indium phosphide-based foundry services (including III-V epitaxial growth, materials characterization, lithography, etching, metallization and testing). Svedice has substantial existing equity financing from a Swedish investor consortium consisting of Acreo, STING (Stockholm Innovation and Growth) and VINNOVA (the Swedish Governmental Agency for Innovation Systems).

Syntune has previously partnered with Svedice to produce an array of widely tunable products, including what it claims is the first commercially available, widely tunable transmitter on a single chip.

The tunable laser market has now passed 100,000 units per year and is expected to grow 25–30% annually through 2012.

“With the tunable laser market continuing to expand, it became imperative that we needed to strengthen our relationship with our chip supplier,” says Syntune’s CEO Patrik Evaldsson. “Syntune has a strong, guaranteed supply chain that is demanded by our expanding customer base, thanks to a

**With the tunable laser market continuing to expand, it became imperative that we needed to strengthen our relationship with our chip supplier**

controlling interest in Svedice and a cooperative agreement with CyOptics, our packaging partner.” Syntune is currently in full production of its S3500 C-band tunable laser and its corresponding Integrable Tunable Laser Assembly (ITLA). Placed in what it claims is the smallest tunable package, the single-chip design makes the lasers versatile and widely tunable. The S3500 can be combined with modulators to reach speeds of up to 40Gb/s and is small enough to be used in a variety of form factors, including SFF 300-pin transponders and XFP-E packages. Syntune adds that its patented MG-Y structure minimizes size, power consumption, and cost while still allowing the fastest possible speeds.

[www.syntune.com](http://www.syntune.com)  
[www.svedice.com](http://www.svedice.com)

## BeamExpress raises \$1.3m in first-round funding

BeamExpress SA of Lausanne, Switzerland has secured first-round funding of \$1.3m from early-stage venture capital firm I-Source of France. Proceeds will be used to expand the team and move from prototype to series production of its long-wavelength (1200–1650nm) vertical-cavity surface-emitting lasers (VCSELs), which it designs and manufactures in cooperation with EPFL (Ecole Polytechnique Fédérale de Lausanne, the Swiss Federal Institute of Technology).

BeamExpress SA was founded by Jean-Claude Charlier and professor Eli Kapon as a privately held spin-off from BeamExpress Inc of Sunnyvale, CA, USA when the latter was sold to NeoPhotonics Inc of San Jose, CA in September 2006 (retaining the intellectual property of the VCSEL technology). BeamExpress says that its long-wavelength VCSELs have low power consumption for next-generation high-speed computing and optical communication applications.

Because of the high drive currents of existing edge-emitting lasers (EELs), heat dissipation is becoming a limitation for the next-generation of high-bandwidth, high-density form-factor designs, argues CEO Charlier, favoring the alternative use of VCSELs due to their extremely low heat characteristics. Up to now, short-wavelength 850nm VCSELs have been adopted widely by optical component manufacturers. However, the market is now changing with the rapid adoption of silicon photonics, which requires light sources emitting in the long-wavelength range (1200–1600nm), adds Charlier.

“The secret of our VCSEL’s high performance lies in our ‘localized

**Heat dissipation is becoming a limitation for the next-generation of high-bandwidth, high-density form-factor [EEL] designs**

wafer fusion’ technology, which makes possible the use of InP- and GaAs-based materials giving a high-power, single-mode laser beam with a narrow line-width”, says chief scientist professor Eli Kapon (who is also director of EPFL’s Laboratory of Physics of Nanostructures).

“The mass adoption of broadband access, combined with the explosion of Web 2.0 applications, video streaming and peer-to-peer traffic, has caused the Internet to grow at an unprecedented rate over the last few years,” comments I-Source partner Nicolas Landrin. “Bottlenecks have appeared in various parts on the networks, and especially within the data centers for server-to-server communications.” Beam Express’ products enable the design of a new generation of optical components that will enable unprecedented levels of integration, he adds. “This will bring a ten-fold reduction in cost and power consumption.”

[www.beamexpress.com](http://www.beamexpress.com)

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## Innolume launches comb laser diode for O-band WDM

Innolume, which manufactures quantum-dot (QD) laser diodes and modules operating at 1.05–1.32 $\mu\text{m}$  for medical, industrial, communications and computer applications, is sampling the new InnoComb, which it claims is the first diode laser to emit tens to hundreds of pure, low-noise colors (a comb spectrum) from a single laser cavity.

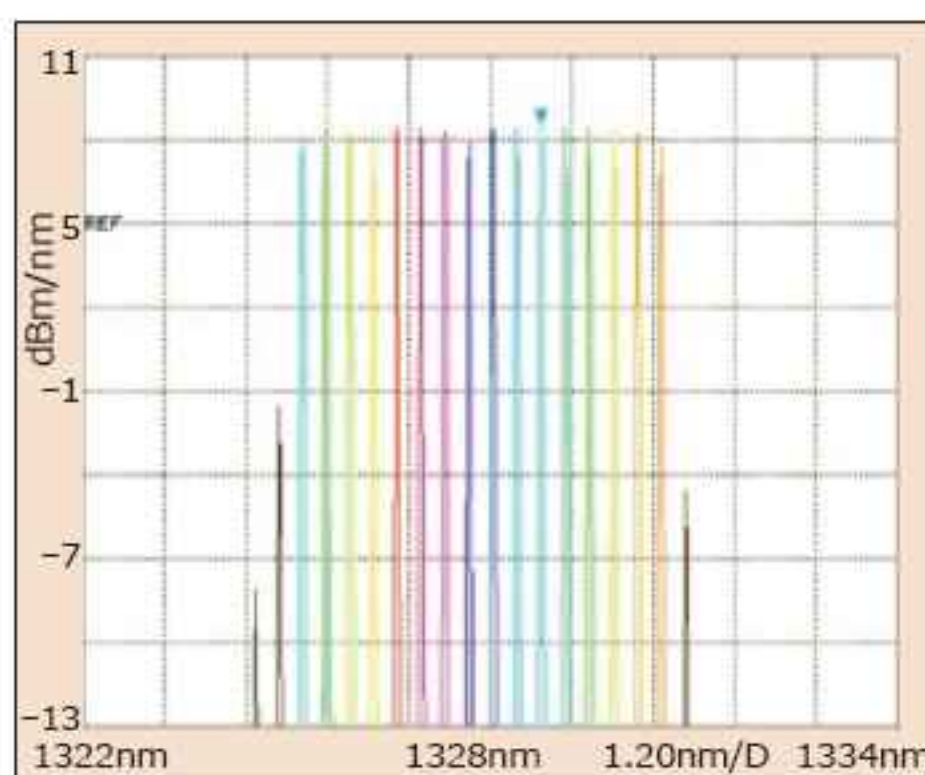
Powered by a single InnoComb, wavelength-division multiplexing (WDM) — previously restricted to telecoms due to the costly laser arrays required — can now be applied to low-cost, short-reach, high-bandwidth optical interconnects (e.g. in computers).

After last year demonstrating the first broad-spectrum Fabry-Perot (FP) laser (>70nm, *Opt. Lett.*, 2007, 32, p793), Innolume has reduced the relative intensity noise (RIN) of each spectral line, culminating in the diode comb laser as a practical computer communications source.

The laser offers increased integration and functionality at reduced size and cost, i.e. using cavity resonance with QD gain behavior to replace laser farms or integrated laser arrays, says president and CEO Jürgen Kurb. "Space- and cost-efficient WDM systems are enabled for the first time, offering new datacom opportunities with respect to cost, power and reliability," he adds. "Additionally, the comb laser simplifies system design by virtue of all channels moving in unison with shifting temperature."

InnoComb is a single FP laser emitting many lines/wavelengths/channels (longitudinal cavity modes) with nearly the same power on each. Innolume has demonstrated 10mW of power per channel over 16 channels and >1mW/channel over 100 channels. Channel spacing is currently available from <50GHz to 140GHz (<0.28nm to 0.8nm) centered at any wavelength between 1250nm and 1320nm (O-band).

For datacoms, the laser's channels are demultiplexed, then modulated externally at  $\geq 10\text{Gb/s}$ , and multi-



**Log spectrum of packaged, pig-tailed comb laser: 16 channels around 1328nm, spaced by 0.35nm (62GHz). Low RIN permits >10GHz Tx/channel.**

plexed for single-fiber transmission. External modulation on 16 comb channels was demonstrated by Fraunhofer Heinrich-Hertz-Institut (HHI) in Berlin, Germany (*Electron. Lett.*, **43** (25), p1430), with error-free transmission ( $\text{BER} < 10^{-13}$ ) due to the exceptionally low RIN ( $\sim 0.1\%$ ) on each lasing line.

"The diode laser as a multiple-wavelength source in high-speed communication systems has been something of a 'holy grail', but noisy longitudinal lasing modes in quantum well FP lasers made them a 'no-go'," says Dr Norbert Grote, head of HHI's Laser Group. Innolume's comb lasers show eye diagrams for each line comparable to the best single-frequency extended cavity lasers (ECLs), opening up opportunities for efficient 1300nm WDM communication systems based on a single laser, he adds.

Innolume originated as NL Nanosemiconductor, which was spun out of Russia's Ioffe Institute in 2003 by founder Nikolai Ledentsov to its fabrication plant in Dortmund, Germany. Last January it renamed itself Innolume and set up a headquarters in Santa Clara, CA, USA. "Ioffe graduates at Innolume have invented a new class of semiconductor lasers based on fundamental behaviors of quantum dots," says Ioffe professor Zhores Alferov (who won the 2000 Nobel Prize in Physics for the double heterostructure).

"With their enablement of comb laser diodes, quantum dots have found their key differentiator from conventional quantum wells, with huge potential for practical implementations," he adds. "Integration has been a major driving force for the electronic industry, and now quantum dot technology puts us on the same road, making it possible to embody hundreds of CW lasers inside a single diode laser cavity."

"Our single InnoComb device relies on conventional FP edge-emitter fabrication processes, providing a highly leveraged alternative to proposed arrays of 16, 32, or even 100 DFB lasers," says senior optical engineer Dongliang Yin. "Integrated DFBs can cost 10x more per laser than a single FP comb. The tradeoff is our need for an additional demultiplexer, an integrated arrayed waveguide grating, instead of multiple lasers." QD comb lasers therefore provide an attractive light source for commodity applications including WDM for short-to-medium range, he adds. "It also brings the right economics to future chip-to-chip optical communication. As silicon photonics technology matures to the point of economically managing light between processor chips, a single comb laser 'power supply', either off-chip or bonded to the silicon, will drive the many optical channels necessary for Terabit per second interconnects."

Conventional QW diode lasers with or without mode-locking remain too noisy to be practical comb lasers for high-speed communication. The firm claims its QD materials and laser designs overcome this, allowing novel applications. WDM's bandwidth advantages can now be migrated from expensive telecom systems to low-cost, short-reach transceivers, easing cost/power/weight/volume issues with server and backplane interconnects. Ultimately, the comb laser could drive high-speed WDM interconnects in a photonics switching layer 'under' future multi-core computer processors.

[www.innolume.com](http://www.innolume.com)

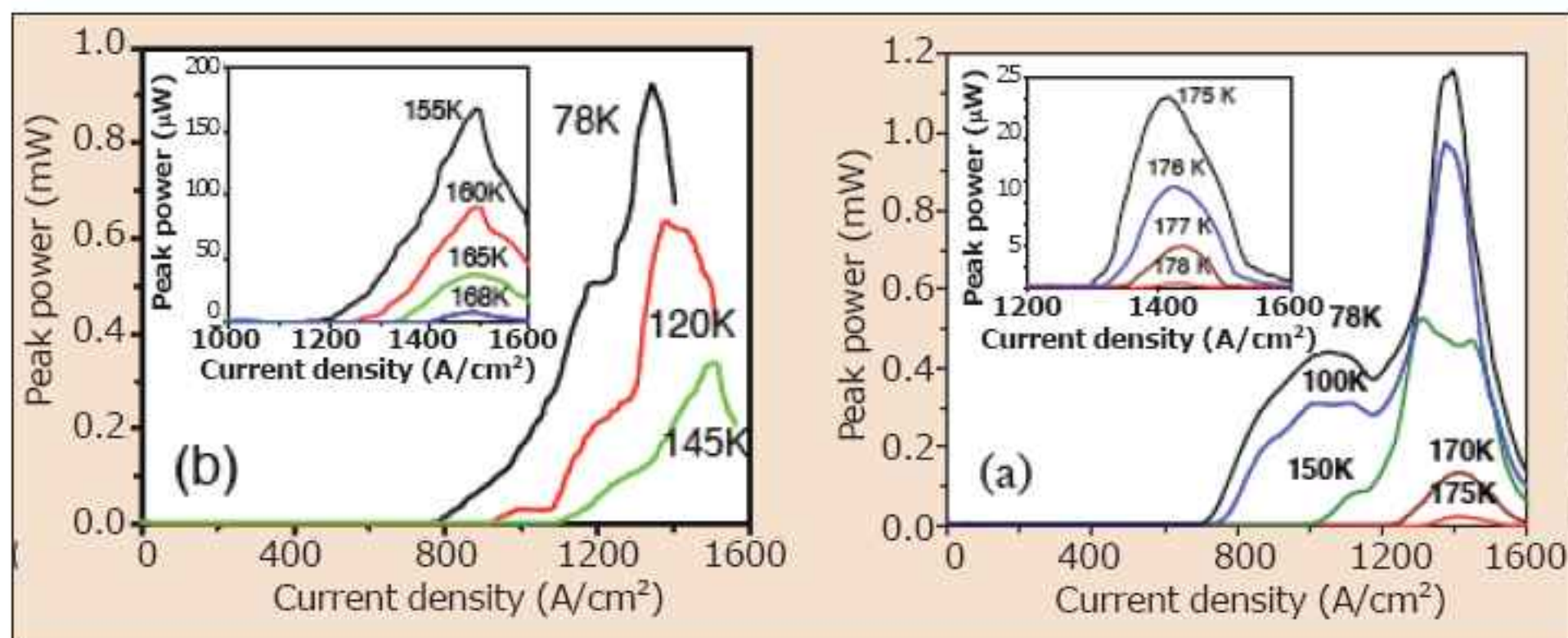
# Terahertz QCL operating temperature raised by 10°C

In collaboration with professor Federico Capasso's group at Harvard University, the UK's University of Leeds has raised the operating temperature for a terahertz quantum cascade laser (THz QCL) by nearly 10°C, from the previous record of just -104°C (169K) to -95°C (178K) — see Belkin et al, 'Terahertz quantum cascade lasers with copper metal-metal waveguides operating up to 178K', *Optics Express* **16** (5), p3242.

The QCL is an emergent compact source for narrowband radiation at frequencies of 1–5THz (wavelengths of 60–300µm). Capasso's group demonstrated the first QCL (at mid-infrared frequencies) in 1994. Meanwhile, supported by the UK's Engineering and Physical Sciences Research Council (EPSRC), the Leeds team is led by Edmund Linfield, professor of terahertz electronics, and Giles Davies, professor of electronic and photonic engineering, in the School of Electronic and Electrical Engineering, who in 2002 (while at Cambridge University) led the team that first demonstrated a QCL operating at terahertz frequencies. The latest laser operates in pulsed mode at an emission frequency of 3THz.

THz rays are useful for imaging defects within materials without destroying the objects or even removing them from their setting. They are invisible to the naked eye and can penetrate many dry, non-metallic materials (such as paper, clothing and plastics) with better resolution than microwave radiation. Also, unlike ultrasound, terahertz waves can provide images without contacting an object, and they don't pose the same health risks as X-rays.

"The potential uses for terahertz technology are huge," says Linfield.



**(a)** Light intensity-current density (LI) characteristics of the best-performing device with a gold metal-metal waveguide, 1.3mm-long and 150µm-wide. Inset: LI characteristics close to maximum operating temperature of 168K. **(b)** LI characteristics of a 1.4mm-long and 125µm-wide device with a copper metal-metal waveguide. Inset: LI characteristics close to maximum operating temperature of 178K.

"But at the moment they are limited to niche applications in, for example, the pharmaceutical industry and astronomy [as well as detecting explosive], as the current systems on the market are expensive and physically quite large," he adds. Since they operate only at cryogenic temperatures well below 0°C, they require liquid-helium-cooled detectors and bulky optical benches that make field work unfeasible.

"The availability of cheap, compact systems would open up a wide range of opportunities in fields including industrial process monitoring, atmospheric science, and medicine," says Linfield. The challenge is therefore to create a THz QCL laser that will work at room temperature (about 300K).

The latest THz QCLs comprise layers of a GaAs/AlGaAs structure grown on an undoped GaAs substrate using a molecular beam epitaxy (MBE) system purchased by Leeds through the Science Research Infrastructure Fund (SRIF). The structures were processed in Harvard University's Center for Nanoscale Science (CNS), which is a member of the US National

Nanotechnology Infrastructure Network.

The improvement in operating temperature was achieved by using an active region that has a three-quantum-well (rather than a four-quantum-well) resonant-phonon depopulation design and by using copper (instead of gold) for the cladding material in the metal-metal waveguides (in order to reduce optical losses from the waveguides).

The groups from Leeds and Harvard are still a long way from creating a QCL operating at room temperature. However, the researchers believe that they can raise the laser's operating temperature further. "We have some radically new design ideas, and also believe that we can make significant improvements in the way we fabricate the lasers," says Linfield. Such advances could bring practical handheld terahertz devices a further step closer to realization.

[www.opticsexpress.org/abstract.cfm?uri=OE-16-5-3242](http://www.opticsexpress.org/abstract.cfm?uri=OE-16-5-3242)  
[www.seas.harvard.edu/capasso](http://www.seas.harvard.edu/capasso)  
[www.leeds.ac.uk](http://www.leeds.ac.uk)

## Low-power XFP and X2 modules for 2.5 to 10Gb/s DWDM upgrade at 80km

Optical module and component maker Opnext Inc of Eatontown, NJ, USA has announced the availability of DWDM-XFP and DWDM-X2 pluggable modules, which complement its existing 10Gb/s DWDM 300-pin and XENPAK portfolio by delivering a smaller size and power footprint to DWDM networking applications.

The TRF7061FN DWDM-XFP and TRT7063EN DWDM-X2 wavelength-specific pluggable modules are offered at ITU-T 100GHz channel spacing. The module transmitter exceeds industry requirements of 80km of standard single-mode fiber or 1600ps of dispersion.

Both modules provide the cost and power savings inherent to the XFP and X2 form factors, enabling cost-effective 10Gb/s optical links for long-reach and metropolitan-area DWDM applications. The small footprint and low power consumption (of at most 4W) enable what is claimed to be the highest-board-density 10Gb/s applications in the industry. The XFP product is protocol independent and operates at multiple data rates, from the SONET 9.95Gb/s data rate to the 10GbE + FEC data rate of 11.1Gb/s.

"As energy costs continue to increase, Opnext has committed itself to producing components with low power consumption," says Takayuki Kanno, executive VP of the firm's modules business unit.



**Opnext's new DWDM-XFP pluggable module.**

Opnext's new pluggable transceiver modules for 10Gb/s DWDM applications over 80km fiber also maximize system scalability and increase operational flexibility, enabling customers to offer systems that minimize the initial cost of the network, he adds.

Opnext offers a full line-up of short-reach to DWDM in XFP and X2 modules for metropolitan core, metropolitan regional and metro access systems. The 10Gb/s module transceivers fully comply with industry standards from ITU-T G.691, G.709, and IEEE 802.3, and OIF recommendations, supporting electrical interfaces including SFI-4, XAUI and XFI, which ease integration onto system host boards. Opnext says that its transceivers also meet or exceed standards established by industry multi-source agreements (MSAs).

[www.opnext.com](http://www.opnext.com)

### IN BRIEF

#### Oplink lowers revenue guidance

Following softer-than-expected demand from customers in Europe, photonic component, module and subsystem maker Oplink Communications Inc of Fremont, CA, USA has lowered its guidance for fiscal third-quarter 2008 revenue (to end March) from the figure of \$41-45m (provided on 31 January) to \$39-40m (down on the prior quarter's \$48.9m).

The firm also expects to record a substantial charge relating to excess and obsolete inventory, leading to a net loss.

Oplink forecasts continued softness in sales in its fiscal Q4/2008 (to end-June) due to continued weakness in Europe, reduced sales of ROADMs (reconfigurable optical add/drop multiplexers) and lower product sales during the transfer of the manufacturing lines of Optical Communication Products Inc of Woodland Hills, CA, USA (acquired last October) to China.

"We remain optimistic that Oplink will realize the benefit of the broader product portfolio and increase shareholder return over time," says president and CEO Joe Liu.

Oplink will report its fiscal Q3 results on 1 May.

[www.oplink.com](http://www.oplink.com)

## Opnext Japan VP receives award for 10Gb/s work

On 25 April, the New Technology Development Foundation of Tokyo presented Atsushi Takai, VP of marketing for Opnext Japan Inc, with the 40th annual Ichimura Industrial Award for his work with 10Gb/s devices and transceivers. Also recognized were Shigehisa Tanaka and Shinji Tsuji of Hitachi Ltd's Central Research Laboratory.

Takai's 10Gb/s work is a result of collaboration between Hitachi's

Central Research Laboratory and Opnext (founded in 2000 as a subsidiary of Hitachi Ltd, Opnext was spun-out of Hitachi's fiber-optic components business in 2001). Since 2000, the two firms have worked together in a long-term partnership on optical devices and transmission technology.

"Being at Opnext has offered me an exciting opportunity to work with world class researchers on

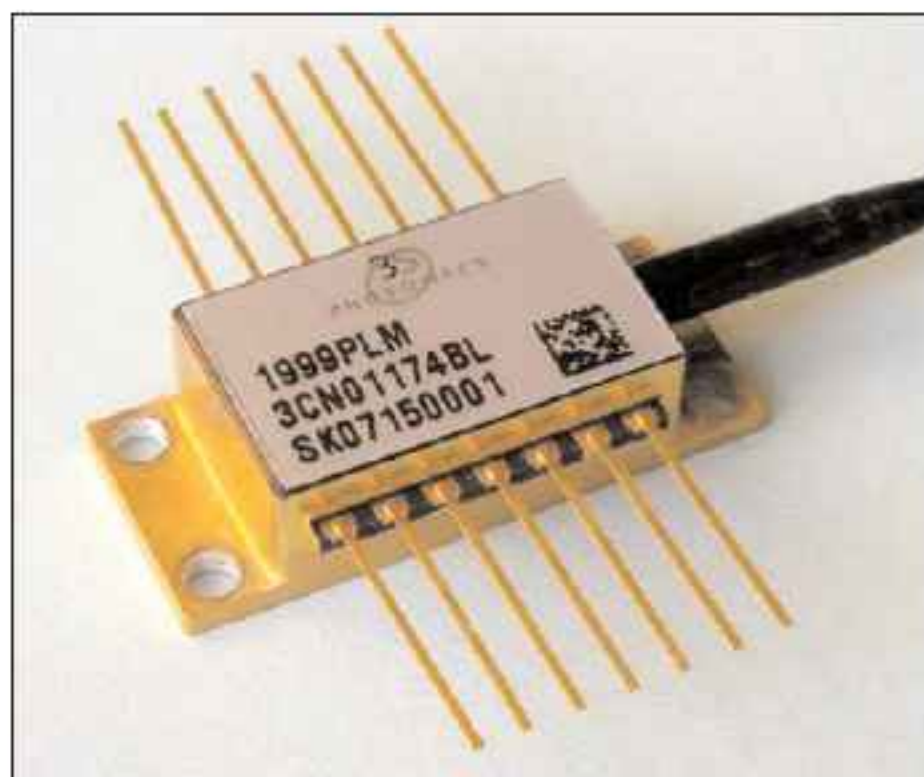
projects of great consequence to the development of 10Gbit technologies," says Takai.

"All of the recipients of this award work every day to advance current broadband technologies," says Opnext Japan's president Kei Oki. "Their work reminds us of the importance of continued investment in technology and the need for increased emphasis on basic research for corporations."

## 3S Photonics launches medium- and high-power 980nm terrestrial pump laser modules for metropolitan market

3S Photonics of Marcoussis, Essonne near Paris has announced general availability and volume production of its 1999 PLM series of medium-power and high-power (365mW kink-free) 980nm terrestrial pump laser modules, targeted at the metropolitan market. This follows January's launch of its 1999 CHP series of ultra-high-power (660mW kink-free) 980nm pump laser modules.

The new family of terrestrial products (announced last December) leverages 3S' expertise in pump lasers for submarine applications, says Yannick Bailly, VP of marketing, and also includes the low-power 1999 PLU (outputting up to 275mW in an uncooled mini-DIL package). "By introducing the 1999 PLM



**3S Photonics' 1999 PLM series 980nm terrestrial pump laser module.**

series, we put ourselves in position to address every telecommunication market segment, from low to high powers," adds Bailly.

The new FBG-stabilized 1999 PLM pump laser modules incorporate

the latest-generation 1999 LCv1 high-power 980nm laser chip, which has been developed internally by 3S. The laser delivers more than 450mW at 600mA and is fully qualified in accordance with Telcordia GR-468 CORE specifications. Also included is an integrated thermo-electric cooler (TEC), precision NTC thermistor, and back-facet monitor photodiode.

The 1999 PLM is hermetically sealed in a low-profile 14-pin butterfly package together with a single-mode fiber (SMF) pigtail.

Applications of the 1999 PLM include low-noise erbium-doped fiber amplifiers (EDFAs) and next-generation dense wavelength division multiplexing (DWDM) EDFAs

[www.3sphotronics.com](http://www.3sphotronics.com)

## Finisar chooses Agilent EDA software for telecom product development

Finisar Corp of Sunnyvale, CA, USA has selected the Advanced Design System (ADS) software of Agilent Technologies Inc of Santa Clara, CA to support the development of its optics products designed for the telecom market. Agilent's ADS software platform includes the Signal Integrity Design Suite and the Ptolemy system simulator.

"We purposely chose Agilent's EDA software because of its impressive simulation technology and flexible design environment," said Finisar's engineering director Kevin McCallion.

"The signal integrity design and simulation capabilities within ADS provide a critical toolset that, we believe, will be a huge help in getting our customers' products to market more quickly," adds Sanjeev Gupta, product marketing manager, Agilent's EEs of EDA division.

ADS is a high-frequency, high-speed electronic design automation (EDA) software platform. Recent software releases include new signal integrity

capabilities, such as the addition of serializer/deserializer (SERDES)/ Verilog analog mixed-signal co-simulation, for a more complete signal integrity design flow for serial links.

Ptolemy Simulator is a system-level simulator based on a hybrid of synchronous and timed synchronous dataflow technologies. It simplifies the design and simulation of digital (DSP), analog, and mixed-signal based RF systems and circuits, including wireless and wireline receivers, transmitters, modems, cellular phones, and radar.

Finisar says that it develops and manufactures fiber-optic components and subsystems using its patented chirp-managed directly modulated lasers to enable telecoms equipment makers to provide longer-reach optical transmitter solutions at lower cost, better performance and less complexity than those based on externally modulated lasers.

[www.agilent.com](http://www.agilent.com)

[www.finisar.com](http://www.finisar.com)

### IN BRIEF

#### Wolf joins board

Optical communications component and module maker Avanex Corp of Fremont, CA, USA has appointed Dennis Wolf to its board.

Wolf has financial management experience as chief operating officer, chief financial officer and co-chief executive officer, most recently as executive VP and CFO for MySQL AB. He has also held financial management positions for public companies including Omnicell Inc, Credence Systems, Centigram Communications, Apple, and Sun. Wolf is currently on the boards of Codexis and Quantum Corp, and has been a board member and chair of the audit committee for Nasdaq-listed Komag and Vitria Technology.

Wolf's strategic experience in the technology sector, coupled with his corporate finance background, provides a unique voice as a board member, says CEO Jo Major.

[www.avanex.com](http://www.avanex.com)

# Emcore buys Intel's enterprise, storage and optical cable assets

Emcore Corp of Albuquerque, NM, which makes components and subsystems for the broadband, fiber-optic and solar power markets, has agreed to acquire the enterprise and storage assets of Intel's Optical Platform Division as well as the Intel Connects Cables (ICC) business. In exchange, Emcore will issue 3.7 million shares of restricted stock (with certain adjustments based on its stock price 12 months after the transaction's close).

The assets include intellectual property, inventory, fixed assets and technology relating to optical transceivers for enterprise and storage networking customers, as well as optical cable interconnects for high-performance computing clusters.

Emcore says that the acquisition further enhances its presence in the optical communications market segments, especially in 10 Gigabit Ethernet datacoms and storage-area network transceivers, and allows it to provide a more complete product offering to a broad range of customers.

This latest acquisition comes after completing the earlier acquisition of the telecom-related assets of Intel's Optical Platform Division in February (see panel below). Together, the disposals by Intel represent that

firm's departure from the optical communications industry, as it focuses on its main market of microprocessors.

This second acquisition from Intel makes Emcore's Fiber Optics segment a significant supplier for both telecom and datacom products, says executive chairman Reuben F. Richards. "This acquisition will provide additional manufacturing efficiencies through economies of scale and vertical integration, benefiting our enterprise, storage, telecom, cable and high-performance computing customers," he adds.

Emcore projects that this asset will add \$45m in revenue for the next 12 months, increase gross margin from 23% to 29%, and be accretive to earnings.

"The Intel Connects Cables business provides an innovative solution for high-performance computing cluster interconnect applications, using embedded parallel optical transceivers with a multi-mode fiber ribbon," Richards continues. Emcore expects this

business to have gross margins exceeding 50% and to be the fastest-growing segment of the acquired assets.

"Customers are driving consolidation and vertical integration in the optical communications market segments," says Doug Davis, VP of the Intel Digital Enterprise Group and general manager of the Embedded and Communications Group. "We will work together to complete a smooth transition of these businesses, building upon the experience in the telecom optical components acquisition," he adds.

Intel says that the sale of these optical-related assets enables it to focus its investments on core communications and embedded market segments in line with its platform strategies. The firm will continue its efforts on the universal serial bus 3.0 specification, which is slated to support optical, as well as silicon photonics R&D.

www.emcore.com  
www.intel.com

**Customers are driving consolidation and vertical integration in the optical communications market segments, says Intel**

**This second acquisition from Intel makes Emcore's Fiber Optics segment a significant supplier for both telecom and datacom products**

## Acquisition of Intel's optical telecom business completed for \$85m

Emcore has completed its acquisition of the telecom-related portion of Intel's Optical Platform Division (announced on 18 December) for \$85m in cash and common stock.

Emcore has acquired intellectual property, assets and technology consisting of tunable lasers, tunable transponders, 300-pin transponders and integrated tunable laser

assemblies (ITLA). The assets will be integrated into Emcore's Digital Products Division (EDP).

"We are excited about the addition of the product portfolio, customer base, and the business and technical personnel from this acquisition," said Stephen Krasulick, VP & general manager of EDP. "Emcore is now one of a

very few companies able to offer customers products for long-haul telecom, DWDM, enterprise and storage applications," he claims. "Furthermore, Emcore will leverage its infrastructure of contract manufacturing and the vertical integration on both the long- and short-wavelength products to continue its cost reduction effort."

# New chairman & CEO elected and Fiber/PV split authorized

Following its annual shareholders' meeting, component and sub-system maker Emcore Corp of Albuquerque, NM, USA says that its board of directors has elected a new chairman and CEO, and authorized planning for the separation of its two business lines (Fiber Optics and Photovoltaics), as reported on page 46 of our February issue.

Pursuant to a succession plan announced in 2006, Reuben Richards (previously CEO) has been elected to the newly created position of executive chairman. Dr Thomas Russell (previously chairman of the board) remains on the board as chairman emeritus. "Everyone at Emcore is deeply grateful to Russell for his many years of service to the company



Richard (left) and Hou (right).

as its chairman and for his vision, passion, and leadership over this period," said Richards.

Also pursuant to the succession plan, Dr Hong Hou, currently president and chief operating officer, succeeded Richards as CEO and will continue to report to Richards. Richards and Hou will each be active in different aspects of running the company.

Emcore also announced that board member Thomas Werthan has resigned.

The firm also says that its board has authorized its management to prepare a comprehensive operational and strategic plan for the separation of the Fiber Optics and Photovoltaic businesses into separate corporations. In taking the first steps in this process, Richards believes that the split will allow Emcore to maximize the potential of both business segments. "We will be working closely with investment, accounting and legal advisors over the coming months to develop a structure for this separation that will maximize operating efficiencies as well as maximizing shareholder value," he adds.

[www.emcore.com](http://www.emcore.com)

## Emcore wins \$4.6m follow-on order for CPV assemblies

Emcore has been awarded a \$4.6m follow-on production order for solar cell receiver assemblies, to be incorporated into the 500x concentrator photovoltaic (CPV) system of Concentration Solar la Mancha S.L. of Manzanares (Ciudad Real), Spain and deployed throughout Spain and other locations in fully licensed and funded projects. Shipments are scheduled to start in the September quarter and complete in early 2009.

As part of Spanish renewable energy firm Renovalia Energy, CS la Mancha has been developing the CPV system for nearly two years, and recently started production and volume deployment. Last November, CS la Mancha was selected by Spain's Instituto de Sistemas Fotovoltaicos de Concentración S.A. (ISFOC) to install 300kW of CPV systems as part of a 3MW pilot-plant CPV project.

"Our CPV receiver assembly continues to penetrate the market and we see increasing global demand for this product line.

This order diversifies our customer base, a trend we expect will continue, as they transition their CPV systems from development to full-scale production," says David Danzilio, VP and general manager of Emcore's Photovoltaics Division.

"We are currently expanding our production capacity for both solar cells and receiver assemblies at

our Albuquerque facility and expect our second receiver production line to be operational in the June quarter," he adds.

"This demonstrates once again that CPV is being established as a cost-competitive and commercially viable technology for solar power applications," comments Dr Jeffrey Nelson, manager of the Concentrated Solar Power Group at Sandia National Laboratories.

Emcore recently introduced a line of integrated CPV receiver assemblies (optimized for operation at 500-1000x concentration) that can be integrated into existing CPV systems, providing terrestrial systems integrators with a complete solution for the PV section while enabling them to focus effort on developing their optical design and optimizing the balance of the system (reducing their time to market).

[www.cslamancha.com](http://www.cslamancha.com)

# Emcore to deploy CPV systems with China's XinAo Group

Emcore Corp of Albuquerque, NM, USA, which makes components and subsystems for the broadband, fiber-optic and solar power markets, has agreed to supply concentrator photovoltaic (CPV) systems to XinAo Group of Langfang, China (one of the country's largest energy companies, and known for its clean-energy technologies).

Emcore's CPV systems are powered by its high-efficiency multi-junction solar cells that operate with 500x concentration. The program will start with the delivery of a 50kW CPV system to be installed in Langfang for test and

evaluation purposes. Once the expected reliability and performance metrics have been demonstrated, XinAo plans to install CPV systems to provide electric power for its coal gasification project, which is estimated to have a requirement of 60MW of power.

**XinAo intends to build a plant in China, jointly owned by Emcore, to manufacture CPV systems designed and certified by Emcore for the Chinese market**

In addition, XinAo intends to build a plant in China, jointly owned by Emcore, to manufacture CPV systems designed and certified by Emcore for the Chinese market.

"This kind of distributed energy application is a strategic focus for Emcore," says Earl Fuller, VP and general manager of Emcore's Solar Power Division. Through its subsidiary Emcore China (also located in Langfang), Emcore will be able to form an efficient and cost-effective manufacturing capability to serve XinAo and other demands in the Chinese market, he adds.

[www.xinaogroup.com/en](http://www.xinaogroup.com/en)

## Spectrolab wins 350MW concentrator photovoltaic assembly order from Australia's Solar Systems

Boeing subsidiary Spectrolab Inc of Sylmar, CA, USA has received a third multimillion-dollar contract award from Solar Systems Pty Ltd of Hawthorn, Victoria, Australia for concentrator photovoltaic cell (CPV) assemblies.

Spectrolab will provide solar cell assemblies capable of generating more than 350MW of electricity. Combined with previous contracts awarded in April and August 2006, Solar Systems has ordered about 360MW of PV cells from Spectrolab.

The latest order will be used in the new 154MW solar power station to be built in the state of Victoria, in addition to other power stations throughout Australia and the USA.

"Solar energy is in high demand, and our record-breaking conversion efficiency of over 40% is an industry best," says Spectrolab's president David Lillington. "Our partnership with Solar Systems has resulted in the demonstration of affordable and reliable concentrating solar power systems."

Also, in late March, OPEL International Inc of Shelton, CT, USA, a manufacturer of high-concentration photovoltaic (HCPV) solar products, signed a five-year solar cell supply contract with Spectrolab, in which it will place individual incremental orders for solar cells every year.

To cover its initial HCPV production requirements, OPEL placed an initial firm purchase order for 10MW of high-efficiency triple-junction solar cells for delivery in 2008. Spectrolab has already started shipments.

OPEL's products are based on technology developed in cooperation with the University of

**Our partnership with Solar Systems has resulted in the demonstration of affordable and reliable concentrating solar power systems**

Connecticut and the Canadian National Research Centre in Ottawa, Ontario. The firm has been awarded 23 patents and has 23 more patents pending.

Used in conjunction with OPEL's concentrating PV technology, Spectrolab's triple-junction cells can each produce 15-17W, representing 37% efficiency.

"We look forward to supplying OPEL and its customers with even better efficiency ratings, reaching 40% in 2010," says Dr Raed Sherif, general manager, Terrestrial Photovoltaic Products for Spectrolab.

[www.spectrolab.com](http://www.spectrolab.com)

[www.solarsystems.com.au](http://www.solarsystems.com.au)

[www.opelinc.com](http://www.opelinc.com)

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# Infinera targeting PICs of 4Tb/s within 10 years

**At this year's OFC/NFOEC event, Infinera outlined its roadmap to integrating more components and wavelengths into InP-based photonic integrated circuits.**

**A**t February's Optical Fiber Communication/National Fiber Optics Engineers Conference (OFC/NFOEC 2008) in San Diego, CA, USA, Infinera Corp of Sunnyvale, CA, USA, which makes digital optical network systems incorporating its own InP-based photonic integrated circuits (PICs), unveiled its roadmap for PICs for telecom networks.

Ongoing growth in high-bandwidth services and Internet Protocol (IP) traffic is driving the need for significant scaling of optical transport networks, says Infinera, but scaling of network capacity alone will not meet the needs of carriers. What is needed is the simultaneous and proportionate advancement of capacity, cost, power consumption, size, reliability and complexity.

For the past decade the industry has focused on data rate per wavelength as a key measure of progress to address these challenges. While the jump from 2.5Gb/s to 10Gb/s led to a reduction in cost per gigabit-kilometer, the move from 10Gb/s to 40Gb/s using phase modulation architectures has addressed the question of spectral efficiency. However, it has not adequately addressed the issues of cost, power, reliability, and complexity associated with an increased number of optical components, says Infinera. "If you scale the capacity of a network without making that system simpler to manufacture, simpler to deploy, and more reliable, you haven't achieved anything," says chief marketing and strategy officer Dave Welch.

## Capacity per chip the key metric for capacity, cost and simplicity

Infinera believes that the fundamental driver of network cost is the number of components in the network, and claims that large-scale photonic integration is the only technology that can address the multiple challenges faced by carriers.

Since optical transmitter and receiver chips are the basic building blocks of network bandwidth, increasing the capacity per chip enables carriers to scale their networks by raising the data rate of the system, in order to accommodate the growth in bandwidth demand. But, equally importantly, it simultaneously

enables the system to reduce network complexity, cost, space and power consumption, while also improving reliability by reducing the number of components or packages within each line-card and reducing the number of line-cards per system. Fewer line-cards, or field replaceable units (FRUs), enables service providers to reduce installation and configuration tasks and eliminate failure points. If the capacity of the basic building blocks of bandwidth deployment are not continually increased, then network operators are forced into an inexorable increase in their operational workload and operating expenses as bandwidth grows, says Infinera. "Photonic integration is the only technology that can scale all the key parameters simultaneously," claims Welch.

By consolidating more than 60 optical components, Infinera's existing PIC has a capacity per chip of 100Gb/s (10 wavelength channels, each operating at 10Gb/s) integrated into the firm's DTN digital ROADM (reconfigurable optical add/drop multiplexer) and WDM (wavelength division multiplexing) platform. Just over three years after starting commercial shipments in 2004, the firm's PIC-based systems account for 13% of the multi-reach DWDM market, according to market research firm Ovum RHK. Infinera claims that the suitability of photonic integration technology to enable scaling in capacity per chip is underpinned by their PICs' track record for reliability in live commercial networks, with more than 50 million hours of operation now realized without a single failure.

Increasing capacity per chip further can be enabled by the application of several key technologies. These include: the integration of more wavelengths on a single chip; the use of advanced modulation techniques to code more data to each wavelength, and expanding the range of PIC operation across the full fiber spectrum. Photonic integration provides a technology platform that is well suited to the practical implementation of all these technologies, claims Infinera.

According to Infinera, advanced modulation techniques such as differential quadrature phase-shift keying (DQPSK) can enable an increase in the data rate on each DWDM channel to 40Gb/s, as it offers high spectral

efficiency, high tolerance to impairments (including dispersion), and superior optical signal-to-noise tolerance (maximizing optical reach).

However, DQPSK requires the use of many optical functions per channel where simple modulation schemes often require just a single laser and modulator. By integrating all the optical functions for an advanced modulation scheme onto a single PIC, photonic integration simplifies the design and manufacture of an advanced modulation system, reducing the number of discrete optical components and fiber couplings required, says Infinera.

Based on its three years of experience producing PICs for commercial deployment, Infinera believes that PIC manufacturing can follow a learning curve analogous to that seen in silicon chips. The firm therefore anticipates steady growth in the number of devices integrated onto a chip — from dozens today to hundreds, and beyond, over time — driving a doubling in the data capacity per chip approximately every three years. It expects the next increment in its commercially available PICs to be from the existing capacity of 100Gb/s per chip to 400Gb/s (for production in 2009) by PICs integrating 10 wavelengths operating at 40Gb/s per wavelength channel (using DQPSK).

"Our vision of a 400Gb/s chip next year and a doubling of capacity per chip every three years is based on many years of research and development at Infinera and the knowledge we've gained after deploying thousands of PIC-based systems worldwide," says Infinera's CEO Jagdeep Singh.

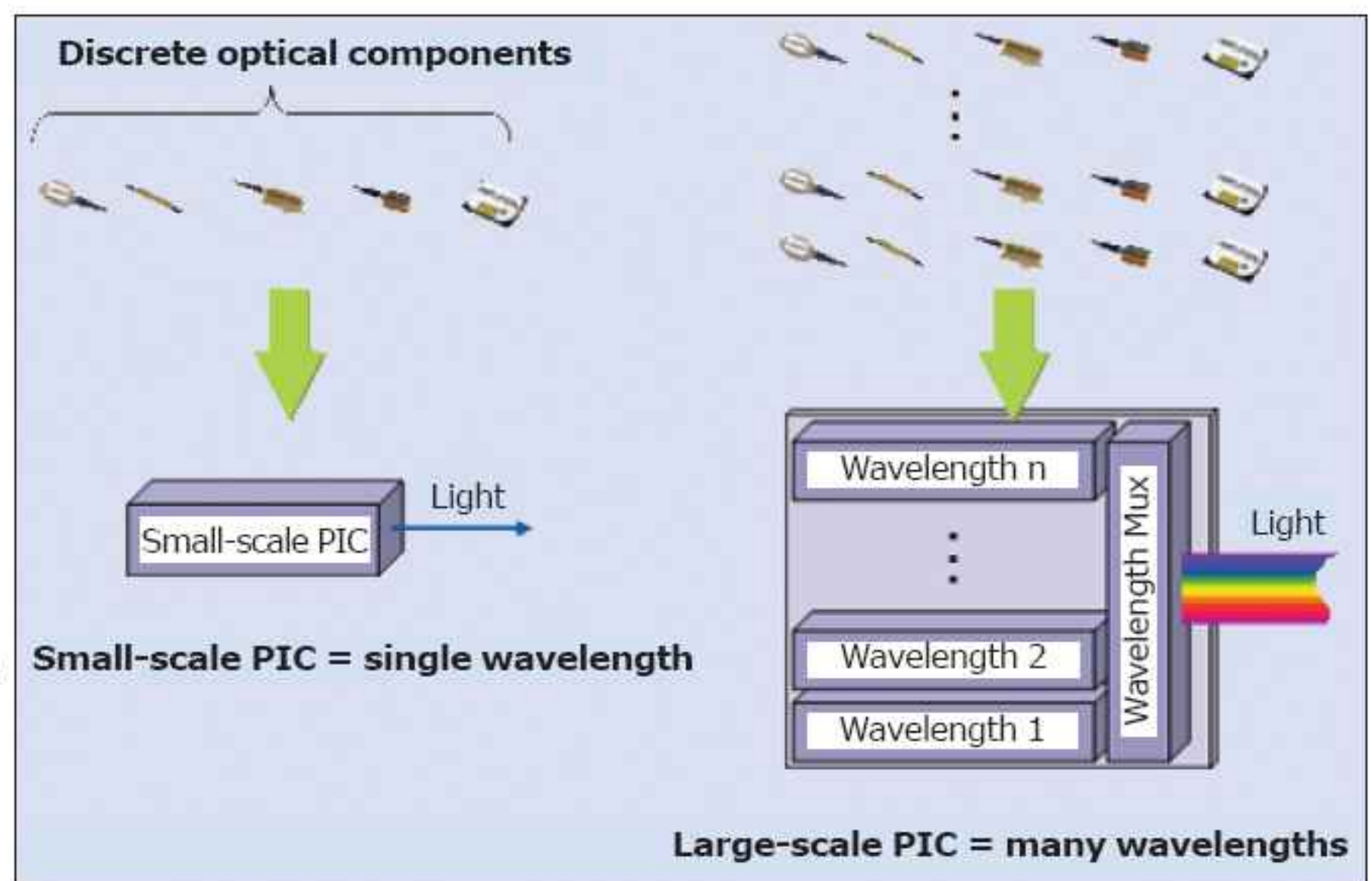
### Demo: 40Gb/s DQPSK modulation on a PIC

Indeed, at OFC, Infinera announced the results of its lab demonstration of 40Gb/s DQPSK modulation on a PIC.

By integrating more than 100 optical devices on a single chip (double that of the existing 100Gb/s PIC), Infinera has developed and tested a PIC that, using DQPSK, integrates 10 wavelengths modulated at 40Gb/s per wavelength. This should enable the commercial production of the next generation of PICs, with a capacity per chip of 400Gb/s.

"This implementation of a 400Gb/s PIC using 10 sets of Mach-Zehnder modulators at 40Gb/s achieves performance similar to discrete implementations of 40Gb/s DQPSK," says Dr Fred Kish, VP of development & manufacturing.

Infinera expects the growth in PIC capacity per chip to continue, leading within the next 10 years to the commercial production of PICs with a capacity per chip of 1Tb/s in 2012 and 4Tb/s in 2018 (40 times the capacity of today's 100Gb/s PICs).



Integration of more components and wavelengths into PICs.

### Demo: PIC with on-chip SOA, enabling 100Tb/s fiber capacity

Furthermore, most existing DWDM optical transmission systems currently operate in only a portion of the total optical fiber spectrum (typically the C-band), limited by the use of erbium-doped fiber amplifiers (EDFAs), which can only amplify effectively at 1530–1560nm; the C-band range therefore accounts for just 4.4THz out of a full fiber spectrum of 55THz. By integrating optical functions such as amplification into PICs in the form of semiconductor optical amplifiers (SOAs), which operate over a much wider wavelength span, Infinera expects photonic integration to also enable optical data transmission across the full fiber spectrum (1240–1650nm), enabling scaling of total fiber capacity up to 100Tb/s. Infinera reckons that this will allow network operators to significantly scale total network capacity while avoiding or deferring costly fiber overbuilds.

At OFC, Infinera therefore also demonstrated the use of a 100Gb/s PIC (10 wavelength channels x 10Gb/s) with on-chip integrated SOAs for error-free transmission of data in the 1490nm range of the S-band over 320km, without external dispersion compensation.

"Opening up the full potential fiber bandwidth into spectral regions inaccessible with EDFAs is a significant innovation for optical networks," says director of optical systems Steve Grubb. "Photonic integrated circuits enable cost-effective use of SOAs and thus offer the possibility of scaling optical networks across the full fiber spectrum," he adds. "As we look for ways to economically scale network capacity to respond to increased demand from IP traffic, this significantly expands the current WDM tool kit."

"We believe photonic integration is not only here to stay, but will before too long become the dominant and ubiquitous technology in optical networks," adds Singh.

[www.infinera.com](http://www.infinera.com)

## Index

- |   |  |
|---|--|
| <b>1 Bulk crystal source materials p50</b>        | <b>14 Chip test equipment p54</b>              |
| <b>2 Bulk crystal growth equipment p50</b>        | <b>15 Assembly/packaging materials p54</b>     |
| <b>3 Substrates p50</b>                           | <b>16 Assembly/packaging equipment p54</b>     |
| <b>4 Epiwafer foundry p51</b>                     | <b>17 Assembly/packaging foundry p54</b>       |
| <b>5 Deposition materials p51</b>                 | <b>18 Chip foundry p54</b>                     |
| <b>6 Deposition equipment p52</b>                 | <b>19 Facility equipment p54</b>               |
| <b>7 Wafer processing materials p52</b>           | <b>20 Facility consumables p54</b>             |
| <b>8 Wafer processing equipment p53</b>           | <b>21 Computer hardware &amp; software p55</b> |
| <b>9 Materials and metals p53</b>                 | <b>22 Used equipment p55</b>                   |
| <b>10 Gas &amp; liquid handling equipment p53</b> | <b>23 Services p55</b>                         |
| <b>11 Process monitoring and control p53</b>      | <b>24 Consulting p55</b>                       |
| <b>12 Inspection equipment p54</b>                | <b>25 Resources p55</b>                        |
| <b>13 Characterization equipment p54</b>          |  |

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## 4 Epiwafer foundry

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(see section 3 for full contact details)

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## 5 Deposition materials

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[www.praxair.com/electronics](http://www.praxair.com/electronics)

**Rohm and Haas Electronic Materials**

60 Willow Street,  
North Andover, MA 01845, USA  
Tel: +1 978 557 1700  
Fax: +1 978 557 1701  
[www.metalorganics.com](http://www.metalorganics.com)

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Tel: +1 716 837 1000

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[www.williams-adv.com](http://www.williams-adv.com)

## 6 Deposition equipment

**AIXTRON AG**

Kackertstrasse 15-17, Aachen 52072, Germany

Tel: +49 241 89 09 0

Fax: +49 241 89 09 40

[www.aixtron.com](http://www.aixtron.com)

**AIXTRON**

AIXTRON is a leading provider of deposition equipment to the semiconductor industry. AIXTRON's technology solutions (MOCVD, ALD, AVD®, CVD, OVPD) are used by a diverse range of customers worldwide to build advanced components for electronic and optoelectronic applications based on compound, silicon, or organic semiconductors. Several system configurations of AIXTRON, Epigress, Genus or Thomas Swan are available.

**EMF Semiconductor Systems Ltd**

Mitchelstown, Co. Cork, Ireland

Tel: +353 (0) 2586324

Fax: +353 (0) 2586331

[www.emfsemi.com](http://www.emfsemi.com)

**ETC (LPE subsidiary)**

Via Falzarego, 8,  
20021 Baranzate (Mi), Italy

Tel: +39 02 383 41 51

Fax: +39 02 383 06 118

[www.lpe-epi.com](http://www.lpe-epi.com)

ETC (Epitaxial Technology Center) developed and customized a SiC process for LPE ACiS M8 and ACiS M10 systems in order to perform the full range of epitaxial layers required for high-power and high-frequency applications, with low cost of ownership.

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Via Falzarego, 8,  
20021 Baranzate (Mi), Italy

Tel: +39 02 383 41 51

Fax: +39 02 383 06 118

[www.lpe-epi.com](http://www.lpe-epi.com)

LPE is a world leading Epitaxial Technology Company. Based on its silicon epitaxial reactor experience, LPE provides state-of-the-art SiC epitaxial reactors. Two systems are available: ACiS M8 and ACiS M10.

**Oxford Instruments Plasma Technology**

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Bristol, Avon BS49 4AP, UK

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Fax: +44 1934 837 001

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[www.svta.com](http://www.svta.com)

**Veeco Instruments Inc**

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## 7 Wafer processing materials

**Air Products and Chemicals Inc**

7201 Hamilton Blvd.,  
Allentown, PA 18195,  
USA

USA

Tel: +1 610 481 4911

[www.airproducts.com/compound](http://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](mailto:sales@microchem.com)

[www.microchem.com](http://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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[www.logitech.uk.com](http://www.logitech.uk.com)

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10050 16th Street North, Suite 100,  
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[www.oerlikonoc.com](http://www.oerlikonoc.com)

### Oxford Instruments Plasma Technology

(see section 6 for full contact details)

### Power + Energy Inc

(see section 8 for full contact details)

### SAMCO International Inc

532 Weddell Drive,  
Sunnyvale, CA,  
USA

Tel: +1 408 734 0459

Fax: +1 408 734 0961

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### Tegal Corp

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Petaluma, CA 94954,  
USA

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[www.tegal.com](http://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,  
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[www.goodfellow.com](http://www.goodfellow.com)

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Cambridge CB3 8SQ, UK

Tel: +44 (0)1954 786800

Fax: +44 (0)1954 786818

[www.cambridge-fluid.com](http://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](http://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](http://www.iemtec.com)

### Power + Energy Inc

106 Railroad Drive,  
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Tel: +1 215 942-4600

Fax: +1 215 942-9300

[www.powerandenergy.com](http://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](http://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](http://www.k-space.com)

### LayTec GmbH

Helmholtzstr. 13-14, Berlin, 10587  
Germany

Tel: +49 30 39 800 80 0

Fax: +49 30 3180 8237

[www.laytec.de](http://www.laytec.de)

### Optical Reference Systems Ltd

OpTIC Technium, St Asaph  
Business Park, St Asaph, LL17 0JD,  
UK

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Fax: +44 (0)1745 535 186  
[www.ors-ltd.com](http://www.ors-ltd.com)

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Furtwangen im Schwarzwald,  
Germany  
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Fax: +49 7723 9197 22  
[www.wepcontrol.com](http://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](http://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](http://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](http://www.jawoollam.com)

**Lake Shore Cryotronics Inc**  
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Westerville, OH 43082, USA  
Tel: +1 614 891 2244  
Fax: +1 614 818 1600  
[www.lakeshore.com](http://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](http://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](http://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](http://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](http://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](http://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](http://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](http://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](http://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](http://www.PalomarTechnologies.com)

## 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](http://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](http://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](http://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](http://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](http://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](http://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](http://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](http://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](http://www.ClassOneEquipment.com)

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Tel: +44 (0)20 7405 8411

Fax: +44 (0)20 7405 9772

[www.henrybutcher.com](http://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](http://www.mw-zander.com)

## 24 Consulting

### WSR Optical Device Solutions

P.O. Box 248, Flemington, NJ  
08822, USA

Tel: +1 908 428 4986

[www.wsr-ods.com](http://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](http://www.semi.org)

### Yole Développement

45 rue Sainte Geneviève,  
69006 Lyon, France

Tel: +33 472 83 01 86

[www.yole.fr](http://www.yole.fr)

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**7-8 May 2008**

**Blue 2008**  
(The 6th International Industry Review)

Hsinchu, Taiwan

**E-mail:** [Blue-2008@solidstatelighting.net](mailto:Blue-2008@solidstatelighting.net)

[www.Blue-2008.com](http://www.Blue-2008.com)

**8-9 May 2008**

**S2K 2008**

Cardiff, Wales, UK

**E-mail:** [jemi-enquiries@see.ed.ac.uk](mailto:jemi-enquiries@see.ed.ac.uk)

[www.semiconductor2k.com](http://www.semiconductor2k.com)

**11-16 May 2008**

**33rd IEEE Photovoltaic Specialists Conference (PVSC)**

San Diego, CA, USA

**E-mail:** [wendy\\_larsen@nrel.gov](mailto:wendy_larsen@nrel.gov)

[www.33pvsc.org](http://www.33pvsc.org)

**18-21 May 2008**

**WOCSDICE 2008**  
(32nd Workshop on Compound Semiconductor Devices and Integrated Circuits)

Leuven, Belgium

**E-mail:** [wocsdice@imec.be](mailto:wocsdice@imec.be)

[www.wocsdice2008.org](http://www.wocsdice2008.org)

**19-21 May 2008**

**3rd annual WiMAX World Europe 2008**

Munich, Germany

**E-mail:** [ehealey@trendsmmedia.com](mailto:ehealey@trendsmmedia.com)

<http://europe.wimaxworld.com>

**25-29 May 2008**

**IPRM 2008: 20th International Conference on Indium Phosphide and Related Materials**

Versailles-Paris, France

**E-mail:** [iprm08@see.asso.fr](mailto:iprm08@see.asso.fr)

<http://iprm2008.org>

**28-30 May 2008**

**Lightfair International 2008**

Las Vegas Convention Center, NV, USA

**E-mail:** [info@lightfair.com](mailto:info@lightfair.com)

[www.lightfair.com](http://www.lightfair.com)

**1-4 June 2008**

**EXMATEC 2008 (9th International Workshop on Expert Evaluation & Control of Compound Semiconductor Materials & Technologies)**

Lodz, Poland

**E-mail:** [sibinski@mail.p.lodz.pl](mailto:sibinski@mail.p.lodz.pl)

[www.exmatec08.p.lodz.pl](http://www.exmatec08.p.lodz.pl)

**2-4 June 2008**

**SEMI Expo CIS 2008**

World Trade Center Moscow, Russia

**E-mail:** [afamitskaya@semi.org](mailto:afamitskaya@semi.org)

[www.semi.org](http://www.semi.org)

**2-5 June 2008**

**SSDLTR 2008 — 21st Solid State and Diode Laser Technology Review**

Albuquerque, NM, USA

**E-mail:** [Cynnamon@deps.org](mailto:Cynnamon@deps.org)

[www.deps.org/DEPSpages/SSDLTR08.html](http://www.deps.org/DEPSpages/SSDLTR08.html)

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AXT	47	Rohm and Haas	11
euroLED	35	SAFC Hitech	13
EV Group	19	Surface Technology Systems Ltd	15
III/V-Reclaim	25	Temescal	29
IntelliEPI	57	Veeco Instruments — MBE	IFC
Laytec	37	Veeco Instruments — MOCVD	9
Oxford Instruments Plasma Technology	33		

**2-6 June 2008**

**ICMOVPE – XIV  
(14th International Conference of  
Metalorganic Vapor Phase Epitaxy)**

Metz, France

[www.movpe.umi2958.eu](http://www.movpe.umi2958.eu)

**3-5 June 2008**

**euroLED 2008  
(5th annual solid-state lighting conference  
and exhibition)**

Ricoh Arena, Coventry, UK

**E-mail:** [info@photonicscluster-uk.org](mailto:info@photonicscluster-uk.org)

[www.euroled.org](http://www.euroled.org)

**9-12 June 2008**

**MRS International Materials Research  
Conference**

Chongqing, China

[www.mrs.org/s\\_mrs/sec.asp?CID=7060&DID=178708](http://www.mrs.org/s_mrs/sec.asp?CID=7060&DID=178708)

**11-13 June 2008**

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including:**

**OPTO Taiwan 2008  
LED Lighting Taiwan 2008, and  
Solar Taiwan 2008**

Taipei World Trade Center, Taiwan

**E-mail:** [pamela@mail.pida.org.tw](mailto:pamela@mail.pida.org.tw)

[www.optotaiwan.com](http://www.optotaiwan.com)

**16-17 June 2008**

**Projection Summit 2008**

Las Vegas, NV, USA

**E-mail:** [dian@insightmedia.info](mailto:dian@insightmedia.info)

[www.projectionsummit.com](http://www.projectionsummit.com)

**17-18 June 2008**

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(Organic, Inorganic, Flexible, Printed: solar  
innovation, new markets)**

Denver, CO, USA

**E-mail:** [s.lee@IDTechEx.com](mailto:s.lee@IDTechEx.com)

[www.idtechex.com/photovoltaicsusa08](http://www.idtechex.com/photovoltaicsusa08)

**18-20 June 2008**

**Photovoltaics Summit 2008**

Hilton San Diego, CA, USA

**E-mail:** [john.buss@pira-international.com](mailto:john.buss@pira-international.com)

[www.intertechpira.com](http://www.intertechpira.com)

**24-27 June 2008**

**LED EXPO 2008**

KINTEX, Seoul, South Korea

**E-mail:** [led@exponu.com](mailto:led@exponu.com)

[www.ledexpo.com](http://www.ledexpo.com)

**27-29 June 2008**

**2008 China (Beijing) International LED  
Exposition (CILED)**

Beijing, China

**E-mail:** [ciled@ciled.cn](mailto:ciled@ciled.cn)

[www.ciled.cn](http://www.ciled.cn)

**3-5 July 2008**

**World Lighting Fair (WLF 2008)**

Yokohama, Japan

**E-mail:** [wlf@wlf.co.jp](mailto:wlf@wlf.co.jp)

[www.wlf.co.jp](http://www.wlf.co.jp)

**6-9 July 2008**

**ISGN-2 (Second International Symposium  
on Growth of III-Nitrides)**

Laforet Shuzenji, Izu, Japan

**E-mail:** [faifai@cc.tuat.ac.jp](mailto:faifai@cc.tuat.ac.jp)

<http://isgn.jp>


**7-10 July 2008**

**OECC and ICO 2008 (OptoElectronics and  
Communication Conference and Congress of  
the International Commission for Optics)**

Sydney Australia

**E-mail:** [OECC\\_ACOFT2008@iceaustralia.com](mailto:OECC_ACOFT2008@iceaustralia.com)

[www.iceaustralia.com/ICO2008](http://www.iceaustralia.com/ICO2008)



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