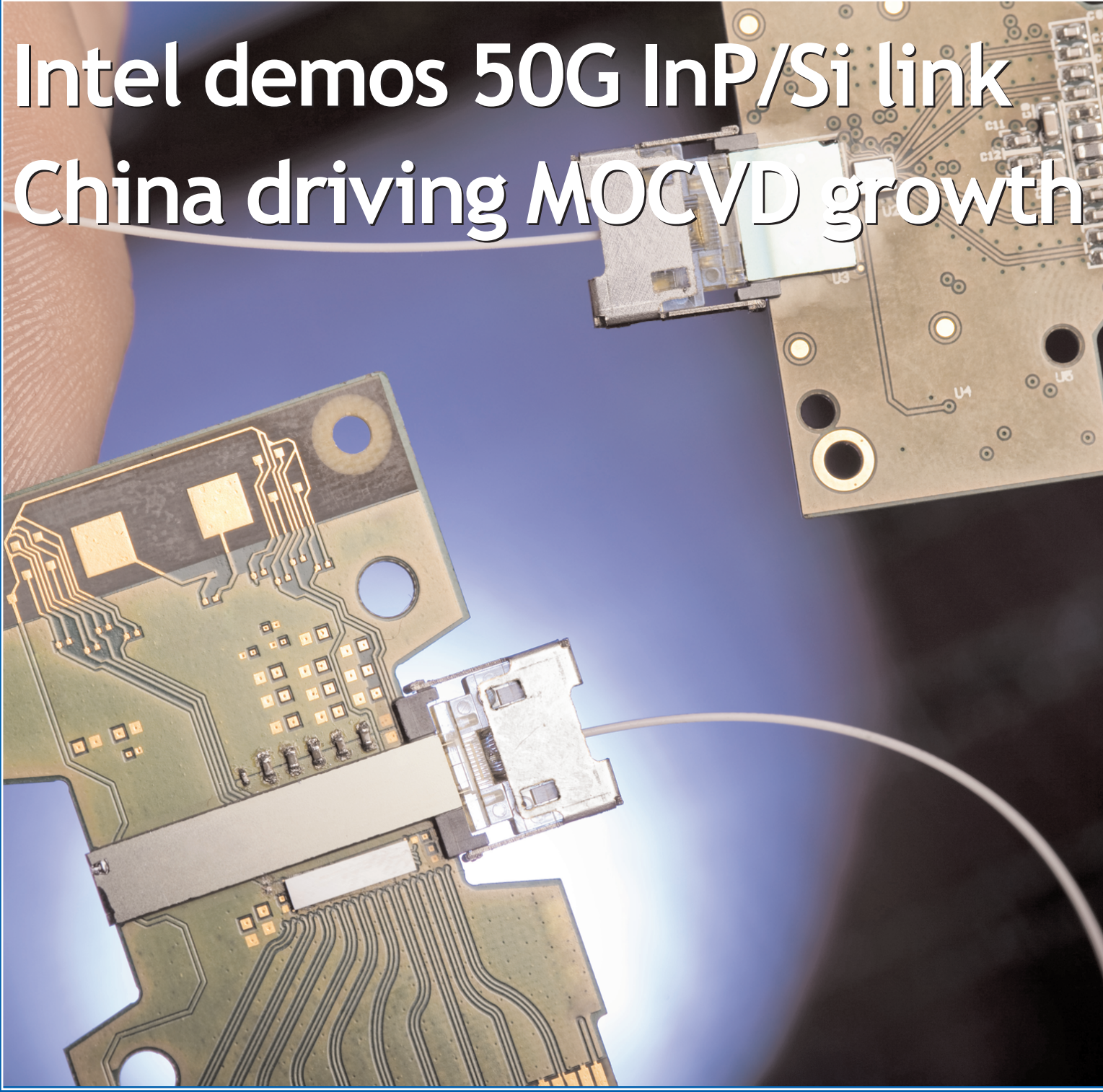


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COMPOUNDS & ADVANCED SILICON

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Intel demos 50G InP/Si link China driving MOCVD growth

Veeco sheds Metrology business • LED makers gear up for 6"
Emcore & San'an form Suncore • First 100W blue-violet laser

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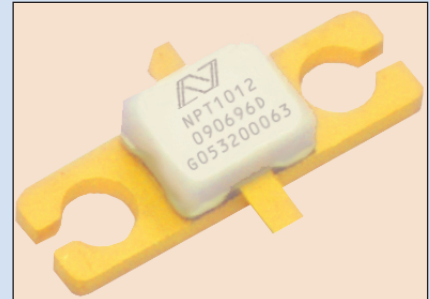
contents

Editorial	4
News	
Markets	6
SI GaAs epi market to grow 21% in 2010 • Samsung has Nokia in sights despite stumble • China LED growth driving MOCVD boom	
Microelectronics	12
Nokia-led RFMD's 5% Q2 growth lags 15–16% of Skyworks, TriQuint	
Wide-bandgap electronics	29
Panasonic's record 2.4W/mm GaN transistor power density at 60GHz	
Materials and processing equipment	32
First direct bonding of SiC–Si and GaN–Si at room temperature • Veeco sells Metrology unit • China's Elec-Tech orders first of 130 MOCVD tools • Rubicon wins \$71m LED chipmaker deal for 6" sapphire • Crystal IS and Asahi Kasei to co-develop large-diameter AlN	
LEDs	52
SemiLEDs' IPO to fund 6" line • Cree's lighting sales double	
Optoelectronics	65
DoD grant for Sb-based superlattice research	
Optical communications	66
Euro silicon photonics consortia form cluster • Oclaro buys Mintera	
Photovoltaics	75
Emcore and China's San'an form Suncore for CPVs • Sharp, Enel and ST form 3Sun • AQT starts production	
Technology focus: InP/silicon integration	86
Intel takes further step toward Terabit/s data transmission III-V/silicon hybrid demonstrates 50Gb/s transmission over fiber.	
Technology focus: Lasers	88
First 100W blue-violet ultra-fast pulsed semiconductor laser High-capacity optical disc storage and nano-fabrication targeted.	
Technology focus: Lasers	90
Low threshold for m-plane nitride semiconductor lasing UCSB grows m-plane violet lasers with comparable characteristics to state-of-the-art c-plane lasers.	
Technology focus: LEDs	92
Nitride superluminescence expands blue-violet capability Developments in nitride-based superluminescent LEDs.	
Technology focus: LEDs	96
AlN substrate used to make 260–240nm UV LEDs Reducing threading dislocations in strained active layers.	
Technology focus: LEDs	98
InAlN barrier strain used to shift nitride transistor thresholds Piezoelectric fields used to produce normally-off (E-mode) FETs.	
Suppliers' Directory	100
Event Calendar	106
Advertisers' Index	106

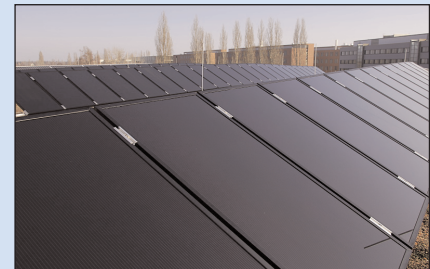
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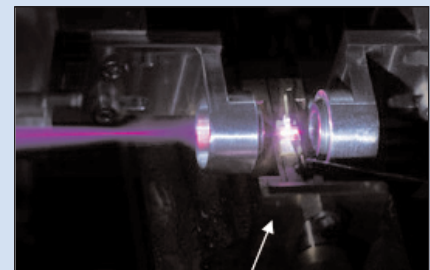
Vol. 5 • Issue 6 • July/August 2010



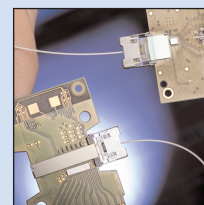
p26 Nitronex's new NPT1012 RF transistor, the first product of its second-generation GaN-on-Si platform.



p85 Berlin-based Sulfurcell is to supply 16MW of its copper indium sulfide (CIS) solar panels to China and India.



p88 Beam emitted by Sony and Tohoku University's 100W blue-violet ultra-fast pulsed laser (arrow indicates semiconductor optical amplifier).



Cover: Transmit module of Intel's prototype 50Gb/s silicon photonics link, which consists of four InP-based DBR lasers integrated directly into silicon waveguides using UCSB's wafer-bonding concepts (and claimed to be the first silicon-based optical data connection with integrated lasers). **p86**

Asia puts LEDs in spotlight as focus falls on MOCVD

The last few weeks have seen further evidence of the increasing influence of interest in energy-efficient applications through the entire compound semiconductor supply chain.

RF Micro Devices' growth in second-quarter 2010 was limited to 5% by its still significant dependence on selling power amplifiers to Nokia (which has been losing market share to Samsung — see page 10). This was mitigated to some extent by RFMD's diversification efforts (with Nokia falling from 59% of its total revenue a year ago to 43.5% now, and sales to other customers growing by 77% year-on-year and 18.3% sequentially — see page 12). However, rivals Skyworks and TriQuint grew 15–16% in Q2/2010, boosted by greater diversification into applications such as smart-grid technology (pages 16 and 18).

Most significantly, LED makers are continuing to show unprecedented growth, with Cree's June-quarter revenue up 79% year-on-year, driven by sales for lighting applications more than doubling (to now well over half of Cree's LED business) — see page 60. Meanwhile, US chip maker SemiLEDs has filed for a \$172.5m IPO to fund expansion of production in Taiwan, as well as construction of a test line using larger, 6"-diameter wafers (page 56).

Correspondingly, while growing a huge 37% in Q2/2010, sapphire substrate maker Rubicon is expanding capacity, particularly for 6" wafers. The firm has now also won a deal to supply \$71m worth of 6" substrates over one year (starting in November) from what is reckoned to be the "first LED chip manufacturer to move into volume production on this size material" (see page 50). In addition, silicon growth equipment maker GT Solar has entered the sapphire substrate sector by acquiring supplier Crystal Systems Inc (page 51).

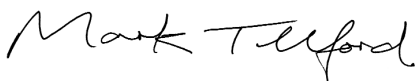
The LED industry is meantime seeing tightness in materials supply, with Rubicon having raised its average selling price 20% in Q1 and a further 16% in Q2/2010. Likewise, prices of metalorganic precursor gases have also risen due to demand outstripping supply (see page 54), leading to most metalorganic suppliers (including SAFC Hitech, AkzoNobel, and Dow) in recent months announcing capacity expansion plans.

The two main suppliers of MOCVD reactors (Veeco and Aixtron) are similarly expanding. Orders are accelerating from China in particular (from both local firms entering the sector as well as Korean and Taiwanese customers forming Chinese joint ventures: most recently Invenlux, Epilight and Neo-Neon in the case of Veeco, and Sanan, Silan and Yangzhou Longyao in the case of Aixtron) — see page 38–41. Such business is being driven by government-led LED lighting initiatives and subsidies estimated by Veeco to amount to \$500m for several hundred systems during 2010–2011. This is exemplified by the latest announcement of Elec-Tech planning to buy 130 reactors: reportedly 100 from Veeco and 30 from Aixtron (page 36).

Given such large and long-term commitments, the news came as little surprise shortly before we went to press that Veeco is shedding its Metrology business to Bruker for \$229m. This will allow Veeco to focus on the booming demand for MOCVD reactors, especially in Asia.

Mark Telford, Editor

mark@semiconductor-today.com



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Editor

Mark Telford
Tel: +44 (0)1869 811 577
Cell: +44 (0)7944 455 602
Fax: +44 (0)1242 291 482
E-mail: mark@semiconductor-today.com

Commercial Director/Assistant Editor

Darren Cummings
Tel: +44 (0)121 288 0779
Cell: +44 (0)7990 623 395
Fax: +44 (0)1242 291 482
E-mail: darren@semiconductor-today.com

Advertisement Manager

Jon Craxford
Tel: +44 (0)207 193 9749
Cell: +44 (0)7989 558 168
Fax: +44 (0)1242 291 482
E-mail: jon@semiconductor-today.com

Original design Paul Johnson
www.higgs-boson.com

Semiconductor Today covers the R&D and manufacturing of compound semiconductor and advanced silicon materials and devices

(e.g. GaAs, InP and SiGe wafers, chips and modules for microelectronic and optoelectronic devices such as RFICs, lasers and LEDs in wireless and optical communications, etc).

Regular issues contain:

- news (funding, personnel, facilities, technology, applications and markets);
- feature articles (technology, markets, regional profiles);
- conference reports;
- event calendar and event previews;
- suppliers' directory.

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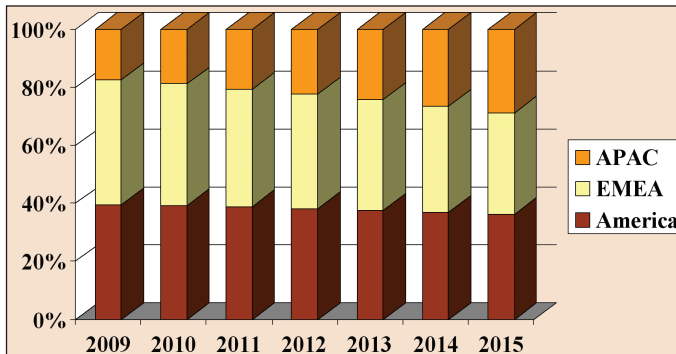
Americas to overtake EMEA in FSO

According to the 'ElectroniCast Executive White Paper: Free Space Optics Global Market Forecast & Analysis (2009–2015)', in 2009 the Europe, Middle East, Africa region (EMEA) held a slight lead in relative market share in FSO communication links in

non-military/aerospace applications.

However, ElectroniCast expects the Americas to grab the lead later in the forecast period. Growth in the consumption of FSO links there will come partly from the accelerating economic growth of major cities in Latin America, as well as an increase in communication links needed for infrastructure growth.

However, Asia Pacific (APAC) is forecast to experience the fastest growth in FSO during 2009–2015.



Free-space optics (FSO) market share (%) by region.

"The Asia Pacific region has advanced communication technology deployed especially in Japan, as well as strong growth potential in China, India and other countries," says Stephen Montgomery, ElectroniCast's president of International Business.

"By a 4-to-1 margin, FSO deployments with a link length of 500m or less are out-numbering the longer-distance optical wireless links being installed in 2010," Montgomery adds.

www.electronicast.com

Opto market to reach \$932bn by 2015

The opto market will reach \$932bn by 2015, according to 'Optoelectronics: A Global Strategic Business Report' from Global Industry Analysts (GIA). The market is being driven by expanding applications in several areas, including consumer products, medical and automotive, as well as the foray of flat-panel displays into new market segments, the shrinking size of PCs, and the explosive growth of mobile data.

GIA lists the wide array of applications spanned by optoelectronics as including lasers, LEDs, light detectors, communication transport systems, laptop computers, compact disk storage drives, digital cameras, optical fibres, cables, and optical disk players. The pivotal role played by optoelectronics in the IT industry is illustrated by the fact that opto components such as

lasers, optical discs, image sensors and optical fibres constitute a vital part of modern telecoms, the Internet, and CD/DVD/Blue-Ray drives on computers, without which reading data is virtually impossible.

The optoelectronics market is led by Japan. Of other leading markets (USA, Asia-Pacific, and Europe), the Asia-Pacific is the fastest-growing optoelectronics market globally.

Regarding the optical equipment and systems market, optical disk equipment and optical input-output equipment are the two main segments, while medical lasers represent the fastest-growing segment.

Meanwhile, the optical component market is projected to exhibit lucrative growth in future, driven mainly by growth in the display device and optical fiber market segments.

www.strategy.com

IN BRIEF

Global market for 40/100Gbps DWDM optical equipment to exceed \$3bn by 2014

40Gbps shipments to grow at CAGR of 55% over the next five years

Worldwide DWDM optical transport equipment revenue will rise to \$9.3bn in 2014, of which just over \$3bn will come from 40/100Gbps, predicts market research firm Dell'Oro Group in its latest 5-Year Forecast Report.

"The demand for 40Gbps DWDM was resilient in 2009, even as the market for optical equipment was under extreme pressure," says Jimmy Yu, senior director of Optical Transport research at Dell'Oro Group. "40Gbps DWDM revenues more than doubled in 2009, even though the overall DWDM market declined," he points out. "Despite the availability of 100Gbps DWDM, we think demand for 40Gbps DWDM will continue to expand, and are forecasting a 55% CAGR [compound annual growth rate] over the next five years, in large part because of the price premium of 100Gbps," he adds.

"This doesn't mean that there's no demand for 100Gbps," Yu remarks. "We think 100Gbps DWDM shipments will also grow, but that the higher volumes probably won't occur until late 2012, when we think the price of 100Gbps wavelengths will be lower than that of 40Gbps wavelengths," he concludes.

www.DellOro.com

SI GaAs substrates defy recession 10% growth in 2009 to be followed by 12% CAAGR through 2014

The slowdown in the GaAs industry supply chain in fourth-quarter 2008 extended through to first-half 2009. However, robust recovery in second-half 2009 resulted in semi-insulating (SI) GaAs bulk substrates volumes still growing a recession-busting 10% year-on-year in 2009, driven by trends in next-generation cellular handset platforms, according to the report 'Semi-insulating GaAs Substrate Markets: 2009-2014' from the Strategy Analytics GaAs and Compound Semiconductor Technologies (GaAs) service.

In particular, Germany's Freiburger Compound Materials GmbH (FCM) remained the leading merchant supplier of SI GaAs bulk substrates (37% of the total merchant market).

Orders started to filter through in second-quarter 2009 as end-users looked to re-build stock levels. Strategy Analytics' models showed that by the end of the quarter the market started to see robust demand for materials and devices

through the GaAs supply chain.

"The strong recovery was helped by an incumbent position in the overall power amplifier (PA) market for cellular terminals," notes Asif Anwar of Strategy Analytics. "This was further helped with the RF front-end architectural requirements of next-generation handsets," he adds.

"Next-generation handsets dictate an increase in the ratio of PAs per terminal as well as more complex switching requirements," Anwar continues. "This helped the market for SI GaAs bulk substrates to maintain recession-defying growth in 2009. It will also underpin growth moving forward," he concludes.

The report forecasts that volume demand will grow at a compound average annual growth rate (CAAGR) of 12% through 2014, with the market worth \$217m, based on examining supply chain dynamics, coupled with an extensive analysis of end-demand drivers for SI GaAs bulk substrates.

SI GaAs epi bouncing back from 7% growth in 2009 to 21% in 2010 Forecast doubled to 10% CAAGR through 2014

With GaAs heterojunction bipolar transistor (HBT) and pseudomorphic high-electron-mobility transistor (pHEMT) devices continuing to play a pivotal role in cellular radio terminals and a broad range of other markets, semi-insulating (SI) GaAs epitaxial substrate output is estimated to have still risen 7% year-on-year in 2009 (following 22% growth in 2008), according to the new report 'Markets for SI GaAs Epitaxial Substrates: 2009-2014' from market research firm Strategy Analytics. This was despite forecast in the firm's report a year ago of flat-to-negative growth for 2009.

In particular, output of Taiwanese epi foundry Visual Photonics Epitaxy

Co (VPEC) to the merchant market grew more than 57% year-on-year, accounting for 20% of merchant supply in 2009 (after overtaking Japan's Hitachi Cable in 2007). Meanwhile, IQE plc of Cardiff, Wales, UK maintained its status as the world's leading merchant supplier of SI GaAs epitaxial substrates.

Overall, SI GaAs epitaxial substrate volumes are forecast to bounce back to 21% growth in 2010, then grow at a CAAGR of 10% through 2014 to a market value approaching \$530m. By comparison, Strategy Analytics' forecast this time last year was for a CAAGR of just 5% for 2008-2013 to \$402m in 2013.

www.strategyanalytics.com

Handset semi revenue to rise 4% in 2010

After four quarters of decline, the mobile handset market began showing signs of life, starting in fourth-quarter 2009, according to the report 'Mobile Device Semiconductors Market Data' from ABI Research, which expects the trend to continue through the next five years.

"Due to the resurgence of the mobile handset market, the total revenue for handset semiconductors is forecast to increase about 4% this year," says analyst Celia Bo. "Major semiconductor components such as baseband processors and application processors, accounting for more than 60% of the revenue in this segment, are expected to show revenue increases of 3% and 8%, respectively, in 2010," she adds.

As well as the baseband processor, the application processor is another key component enabling mobile devices to deliver better performance, more reliable connectivity and longer battery life, as chipsets are becoming ever more compact and competitive, points out the market research firm.

In June, Qualcomm announced the dual-core Snapdragon processor, signaling a new era for technology architecture development, and the market is set to see some significant improvements in application processor performance and power consumption, reckons ABI. In 2010, application processor shipments are forecast to rise significantly while average selling prices (ASPs) drop.

"Connectivity chips will be key drivers of handset semiconductor market growth in the next five years," notes Bo. "Bluetooth has the highest attach rate: the average penetration rate is expected to be 57% in 2010," she adds. "The penetration rate of GPS is expected to double between 2010 and 2015. Wi-Fi chips will deliver the highest revenue of the three connectivity chips over the next five years."

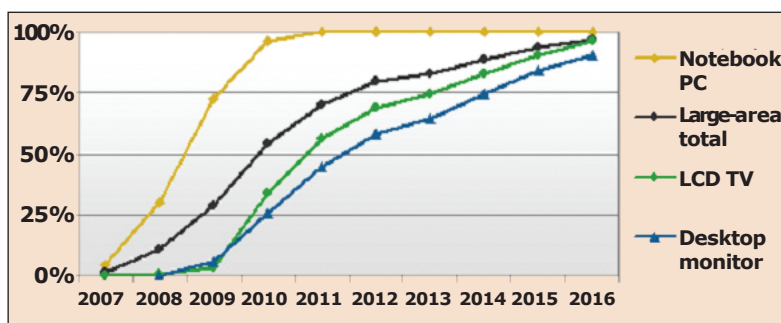
www.abiresearch.com

Component shortages limiting growth of LED backlights

The LED backlight unit (BLU) has emerged as a key factor in the TFT liquid-crystal display (LCD) industry, and is expected to maintain its growth momentum for the next several years as shipments surpass those of CCFL backlights in all large-area TFT LCD panels and achieve 80% penetration in fourth-quarter 2012, according to market research firm DisplaySearch's latest 'Quarterly LED Backlight Report'.

The firm asserts that, due to slim design, low power consumption and the fact that it enables high display performance, there is no doubt that the LED will be the mainstream light source in all LCD applications. This represents an opportunity for suppliers of display materials, e.g. optical polymethyl methacrylate (PMMA) used in light guide plates, white polyester (PET) for reflector film, and sapphire for LED wafer substrates.

However, in first-quarter 2010 LCD makers suffered from key component shortages related to LED backlights. PMMA shortages



LED backlight unit penetration rate in 10''+ TFT LCDs.

have limited the production of TV light guide plates, many reflector film suppliers were stretched between demand from LCD and solar cell applications, and many LED makers faced a sapphire substrate shortage.

"Many LCD makers didn't recognize the limited capacities of key material suppliers before fixing their LED TV panel shipment targets," says DisplaySearch research director Kevin Kwak. "In particular, PMMA and PET are in significant shortage. PMMA and PET suppliers are slowly expanding capacity, since they need time to add new plants and face financial limitations," he adds.

LED BLU design minimizing the number of chips can both help. Also, joint investments between LCD makers and PMMA suppliers can be a solution for securing light guide plate material.

"To expand the LED-backlit LCD TV business successfully, LCD TV panel or TV set makers need to consider product competitiveness — including effective procurement, design innovation, cell business models, and sales strategies — because many consumers feel the price of LED-backlit LCD TV sets are still too high," notes Kwak.

www.displaysearch.com

How can supply chain participants address component shortages? In the case of LEDs, multi-vendor LED qualification and improved

Taiwan to surge 43% in 2010 to 26% of global LED output Worldwide MOCVD shipments to rise 232% to 720 systems

With the growing popularity of LED-backlit LCD TVs fueling sales growth, the production value of Taiwan's LED industry is forecast to soar sharply by 43% from 2009 to US\$2.6bn in 2010, accounting for 26% of total output of US\$9.6bn globally, according to Topology Research Institute (TRI) in a report in Taiwan Economic News.

In response to huge business potential from the emergence of LED-backlit LCD TVs, LED makers have been expanding their production lines with metal-organic chemical vapor deposition equipment. TRI hence projects that MOCVD shipments will jump by 232% from last year to more than 720 systems this year, with 36% going to Korea, 32% to China and 26% to Taiwan.

TRI also reckons that smaller Taiwanese LED chipmakers may be unable to take a share of the market for LED-backlit LCD TVs unless they raise the number of MOCVD systems that they have each to more than 50 in the coming three years in order to secure sufficient production capacity, which is key to attracting orders from large international clients.

At present, Taiwan's largest LED chipmakers, such as Epistar Corp, Formosa Epitaxy Inc and Lextar Electronics Corp, have achieved sufficient economies of scale in production to compete advantageously with overseas rivals. However, TRI notes that smaller LED chipmakers will have to build closer ties with either larger LED chipmakers or their downstream clients, such as display maker AU Optronics Corp (AUO).

Another phenomenon that will probably be seen in the future, reckons TRI, is that Taiwanese LED makers will focus their output expansions in China rather than Taiwan in order to explore more effectively the huge local consumer market.

In the meantime, expansion in global LED output will also help to accelerate the application of LED lighting, mainly because LED makers will make good use of their increased capacity to turn out such power-saving products, says TRI. Presently, Hon Hai Group, Delta Electronics Inc, AUO and silicon wafer foundry Taiwan Semiconductor Manufacturing Co Ltd (TSMC) are deploying resources in this field, TRI notes.

http://news.cens.com/cens/html/en/news/news_inner_33045.html

LED market to double to \$20.4bn in 2012

China driving expected 662 MOCVD shipments worldwide in 2010

The LED market made a great leap in second-half 2009, expanding dramatically from \$7bn in 2009 to \$10.7bn in 2010, according to the 'Global and China LED Industry Report 2009–2010' from market research firm Research In China.

Penetration of LED backlighting into notebook PCs has surged from 15% at the end of 2008 to about 60%, and could hit 88% (or 98%, say some) by end 2010. On the other hand, the use of LED backlighting in LCD TVs has risen from 0.01% at the end of 2008 to 10% now, and should reach 27% at the end of 2010, while the use of LED backlighting in LCD displays has grown from just 0.01% at the end of 2008 to 5%.

Along with rising LED brightness and falling prices, penetration of LEDs into general lighting (a \$100bn market) should rise greatly. The LED market could reach \$20.4bn in 2012.

Research In China categorizes the global LED market in three camps:

- Japan, Europe and the America, including the world's five biggest LED makers — Nichia, Toyoda Gosei, Lumileds, Cree and Osram — as well as Toshiba, Panasonic and Sharp, with high-end technologies and patents, and dedicated to UHB-LEDs (targeting both general and automotive lighting markets). Japanese firms pay little heed to consumer electronics backlights and European and American none at all.
- Manufacturers in South Korea and Taiwan — with an integrated supply chain and interest in LEDs for backlighting consumer electronics, firms are experiencing rapid growth despite the technology gap to European and American firms.
- LED makers in mainland China, which are small scale, scattered and low-tech. There are nearly 1000 packaging plants (versus no more than five in South Korea), many dealing with resin packages of minimum technical content (with few engaged in SMD packaging). Annual revenue for all these manufacturers fails to reach that of Taiwan's lead-

	2008 (US\$ mln)	2009 (US\$ mln)	2010 (US\$ mln)
NICHIA	1321	1233	1368
CREE	493	543	808
OSRAM	555	587	618
EPISTAR	313	397	653
SAMSUNG LED	188	516	928
PHILIPS (LUMILEDS)	213	260	418
OPTO TECH	197	169	220
TOYODA GOSEI	204	331	465
TOSHIBA	182	202	388
SHARP	142	150	368
FOREPI	44	65	119
ROHM	80	76	80
ARIMA	76	45	68
GENESIS	42	34	65
HUGA	61	68	115
SANAN	31	78	105
TEKCORE	30	41	81
LEXTAR		63	162
TYNTEK		81	101
LG INNOTEK		206	690
SEOUL SEMICON	258	319	603

The world's 21 biggest LED epitaxy manufacturers by revenue, 2008–2010.

ing LED firm Everlight, and there are also large discrepancies between Everlight and South Korean manufacturers. Mainland China LED makers possess low-level technologies, with many producing quaternary green/yellow LEDs (mainly for outdoor landscape lighting, decoration or advertising). China is the world's largest consumer electronics production base, but purchasing power is centralized on Taiwanese and South Korean manufacturers. So, mainland firms can see the rapid development of the LED market in consumer electronics but cannot benefit from it. As for general lighting, it is more beyond their reach due to their low-level technology, says the report.

Although mainland China firms cannot share in the highest-growth LED market, they have the greatest enthusiasm for investment, the report adds, with LED projects starting up everywhere. Many MOCVD growth systems for fabricating LEDs have been bought, with the LED manufacturing project in Wuhu alone needing more than 200.

Shipments of MOCVD systems worldwide are forecasted to reach 662 units in 2010 (equal to the total for the past three years), and 2011 will maintain or even exceed this. The unit selling price is \$1–2m and the Chinese government offers a subsidy of up to 50%, so there is currently an upsurge of LED-related investments and a boom in MOCVD purchases in China. In 2010, the number of systems registered with the National Development and Reform Commission (NDRC) alone is nearly 700, and some manufacturers purchase directly rather than wait for the NDRC subsidy. Since the MOCVD market is dominated by Germany's Aixtron and the USA's Veeco Instruments, output capacity of both firms is limited and order periods stretch into 2012.

However, Research In China warns it is not easy for LED start-ups to produce qualified products, and there are many thresholds for patents. Incaution can cause trouble, with some firms (e.g. Nichia) often resorting to lawsuits.

www.researchinchina.com

Year-on-year handset growth slows from 17% to 13% in Q2 Samsung takes market share from Nokia and LG Electronics

Mobile phone shipments grew 13% year-on-year from 273m in Q2/2009 to 308m units in Q2/2010, according to Strategy Analytics. Such growth is less than the 17% average over the prior two quarters, but well above the -8% year-on-year drop in Q2/2009, says senior analyst Bonny Joy.

"Handset volumes slowed a little in the second quarter," says director Neil Mawston.

"There are no credible signs yet of any major double-dip downturn in the handset industry."

Blackberry-maker RIM and Samsung outgrew their major top five rivals, due to robust demand for QWERTY phones and touchphones. RIM maintained fourth place, growing market share from 2.9% in Q2/2009 to 3.6% in Q2/2010 (with unit shipments growing 40% from 8m to 11.2m). Second-place Samsung grew market share from 19.1% in Q2/09 (and 19.8% for full-year '09) to 20.7% in Q2/2010 (growing shipments 22% from 52.3m to 63.8m). Yet despite the rising market, its turnover, average selling price (ASP) and profit all fell.

Shipments (millions), market share and year-on-year growth (top 5 vendors).

Shipments	Q2/09	2009	Q2/10
Nokia	103.2	431.8	111.1
Samsung	52.3	227.1	63.8
LG Electronics	29.8	117.9	30.6
RIM	8.0	34.5	11.2
Sony Ericsson	13.8	57.0	11.0
Others	66.0	277.2	79.8
Total	273.1	1145.5	307.5
Market share	Q2/09	2009	Q2/10
Nokia	37.8%	37.7%	36.1%
Samsung	19.1%	19.8%	20.7%
LG Electronics	10.9%	10.3%	10.0%
RIM	2.9%	3.0%	3.6%
Sony Ericsson	5.1%	5.0%	3.6%
Others	24.2%	24.2%	26.0%
Growth y-o-y	Q2/09	2009	Q2/10
Nokia	-15.4%	-7.8%	7.7%
Samsung	14.4%	15.5%	22.0%
LG Electronics	7.6%	17.0%	2.7%
RIM	42.9%	46.8%	40.0%
Sony Ericsson	-43.4%	-41.0%	-20.3%
Others	-8.2%	-5.2%	20.9%
Total	-8.1%	-2.8%	12.6%

Samsung continues to edge ahead of third-place LG (whose market share has dropped from 10.9% to 10%, as shipments grew just 2.7% from 29.8m to 30.6m) and nearer

to first-place Nokia (whose share has dropped from 37.8% to 36.1%, with its shipments growing a below-industry-average 7.7% from 103.2m to 111.1m).

Likewise, to bolster revenue and margins in second-half 2010, Samsung has finally begun its first serious assault on the smartphone market.

Both fifth-place Sony Ericsson (whose share has fallen from 5.1% to 3.6%, as shipments fell 20.3% from 13.8m to 11m) and former top-5 firm Motorola are continuing their transformation into smartphone specialists, as they ramped up their Android portfolios. Smartphones are now a third of Motorola's total shipments, and the high-value devices are helping to stabilize the firm's financial outlook.

Apple's iPhone shipments rose 61% from 5.2m in Q2/09 to 8.4m in Q2/2010, with market share edging up from 2% to almost 3%. However, Apple had a mixed Q2/2010, as criticism about its products and production methods mounted.

www.strategyanalytics.com

Handset shipments exceed 321 million in Q2/2010 Samsung still has Nokia in sights despite stumble

Q2/2010 was a solid quarter for the handset market, with shipments growing 5.9% quarter-on-quarter and 19.4% year-on-year to 321.2m, (31% WCDMA), according to ABI.

"The smartphone is starting to appeal to a very wide market cross-section," says practice director Kevin Burden. "The smartphone is about to go multi-generational, and the popularity of the number-one handset form-factor, the 'candy-bar', could be waning."

Nokia continued to shed market share, falling to 34.5%. It has been undertaking some serious reorgani-

zation, says ABI. R&D has been more closely aligned with business priorities. The firm has been piling on resources to iron out the code needed to meet expectations for Symbian OS and MeeGo.

LG's market share rose to 9.5%, but compatriot Samsung's seven-quarter streak of rising market share has ended (attributed to the decline in the European economic outlook). "We will have to see if Samsung's recent smartphone launches, such as the Galaxy S, will help it resume its march on Nokia," comments VP for forecasting Jake Saunders.

Apple's iPhone 4 antenna media melee hit Q2 shipments, as market share shrank slightly to 2.6%. Sales should have "wowed more" at this stage of product release, says ABI.

RIM, with market share of 3.5%, has built cachet around its messaging platform, combining strong design with entertainment-oriented features.

Motorola's Q2 was down on Q1, at 8.3 million (market share of 2.6%). It has won acclaim for its latest smartphones, but faced challenges ramping up product awareness and access to markets, says ABI.

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RFMD's revenue grows 29% year-on-year

Diversification more than offsets Nokia's market share losses

For its fiscal first-quarter 2011 (to 3 July 2010), RF Micro Devices Inc of Greensboro, NC, USA has reported its fifth quarter of sequential revenue growth, to \$273.8m (up 5% on \$260.8m last quarter and up 28.8% on \$212.5m a year ago).

Demand was strong for both the cellular products group (CPG) and multi-market products group (MPG), with both achieving revenue growth sequentially and year-on-year.

President & CEO Bob Bruggeworth believes that results are impressive considering that sales to RFMD's largest customer Nokia (which has been losing market share) have fallen to 43.5% of total revenue, from 59% a year ago.

RFMD says that it achieved key diversification initiatives, with sales to customers other than this largest customer growing by 77% year-on-year and 18.3% sequentially (adding \$270m in annualized incremental revenue). Sales into Asia were particularly strong as RFMD continues to build on relationships with Samsung, HTC, Walway, ZTE, and with MediaTek's hundreds of customers.

On a non-GAAP basis, though up on 37% a year ago, gross margin of 39.2% was down slightly on 39.6% last quarter due to a temporary rise in the product mix of low-margin legacy Polaris transceivers (to nearly 15% of total revenue). However, RFMD's core business (excluding the effect of Polaris transceivers) achieved gross margin of 42% (closely matching the firm's recently updated financial model).

"RFMD's markets are expanding quickly with the deployment of broadband data across both fixed and mobile networks," says Bruggeworth. "This is accelerating demand for always-on mobile data," he adds. "RFMD is a major beneficiary of these secular trends. We benefit as fixed broadband infrastructure is deployed, as demand grows for these mobile broadband devices, and as these devices increasingly

offer more modes of wireless connectivity," Bruggeworth continues. "Over the past four quarters RFMD has outpaced the market, expanding sales and diversifying our customer base significantly to drive strong earnings and cash flow."

Net income has risen from \$18.9m a year ago and \$43.8m last quarter to a record \$44.3m. During the quarter, RFMD generated \$46m in free cash flow. Cash, cash equivalents, short-term investments, and trading security investments was \$281.4m, reflecting \$10m of convertible bond repurchases. Since spring 2008, RFMD has repurchased 30 million shares of common stock, retired \$372m of convertible debt, and reduced net debt from \$375m to under \$50m (after a recent bond repurchase).

"We have made significant progress in broadening our customer base and generating superior free cash flow, which has strengthened our balance sheet and given us the flexibility to fund our growth strategies," comments chief financial officer Dean Priddy.

RFMD says that its product development engine continued to execute to plan, delivering 92 new and derivative products for diverse market segments including SmartEnergy, high-performance WiFi, 3G/4G wireless infrastructure, fixed and mobile broadband, and 3G/4G smart phones.

"On the strength of our product leadership and diversification initiatives, we believe we've secured the major design wins that will power the next wave of our revenue growth," says Bruggeworth. During the

quarter, RFMD secured design wins including handset and smart-phone platforms, SmartEnergy, high-power gallium nitride (GaN) and 4G wireless infrastructure applications at new and existing customers that are expected to ramp to volume beginning in calendar year 2011.

RFMD believes that the demand environment in its end-markets remains strong. It also expects to continue ramping new customer programs to offset declining end-of-life legacy products. Hence, for the September quarter it expects revenue to be flat to maybe slightly up on the June quarter, with largest customer Nokia falling further (to below 40% of revenue). In particular, legacy Polaris transceiver products will ramp down to about 10% of revenue (followed by well below 10% in the December quarter, then below 5% in the March quarter), reducing the drag on margins. When the roll-off of legacy products is complete in early fiscal 2012, RFMD expects an acceleration in revenue growth to drive continued margin expansion.

In particular, Priddy says RFMD is on track to grow revenue and achieve double-digit earnings growth in fiscal 2011 as it offsets end-of-life products with incremental wins while transitioning to a more diversified revenue base. With \$189m in trailing 12-month free cash flow, for fiscal 2011 RFMD expects free cash flow to be consistent with fiscal 2010's \$177m. "We are very confident in our ability to achieve a positive net cash position sooner than originally anticipated [as early as the September quarter]," adds Priddy. "Our potential future uses of cash include share buybacks, additional bond repurchases and incremental investment in our growth."

RFMD also expects revenue growth to accelerate in fiscal 2012 as major programs at new and existing customers ramp into volume production.

www.rfmd.com

Sales to RFMD's largest customer Nokia (which has been losing market share) have fallen to 43.5% of total revenue, from 59% a year ago.

RFMD adds front-end module for ZigBee-based smart energy and ISM

RF Micro Devices has announced the availability of the RF6515 front-end module (FEM). The firm says that the feature-rich FEM improves the performance of 2.4–2.5GHz ISM-band wireless applications requiring longer-range operation at high efficiency, including WLAN, Zigbee, smart energy/advanced metering infrastructure (AMI) and home-area networks (HANs).

The RF6515 integrates a 20dBm power amplifier (PA), harmonic transmit filtering and a double-pole, double-throw (DPDT) switch. Also, an integrated balun provides a balanced 50Ω match for the receive

(Rx) and transmit (Tx) signal paths.

The 3.5mm x 3.5mm x 0.5mm package is five times smaller than competitive offerings, claims RFMD, minimizing customer product footprints and greatly reducing assembly costs and external component counts.

The RF6515 was designed in collaboration with Ember Corp of Boston, MA, USA. Used together, the RF6515 and Ember's EM250 can shorten customer design time and accelerate product time-to-market, RFMD says.

Volume pricing of the RF6515 begins at \$1.44.

www.rfmd.com

RFMD repurchases and retires \$110m of convertible notes

RFMD has used cash on hand to repurchase and retire \$110m aggregate principal amount of its outstanding convertible subordinated notes: \$100m due in 2012 (equal to 51% of all outstanding 2012 notes) and \$10m due 2010 (all outstanding 2010 notes). The 2012 notes were repurchased and retired early (paying \$0.97 per \$1.00 of par value) and the 2010 notes at maturity (paying the principal, or face, amount). The aggregate principal amount of 2012 notes outstanding is now \$97.7m.

RFMD expects to eliminate future cash interest expense of about \$1.3m between now and when the 2012 notes mature in April 2012.

"RFMD's robust business model and resulting strong free cash flow are enabling us to enhance our capital structure significantly," says chief financial officer Dean Priddy. "Looking forward, we are forecasting continued strong free cash flow, and our potential uses of cash include share buybacks, additional bond repurchases and incremental investment in our growth strategy."

Shareholders approve all proposals at AGM

RF Micro Devices says that, at its 2010 annual meeting of shareholders, all agenda items were approved:

- (1) the election of eight directors to serve a one-year term;
- (2) amendment of the Employee Stock Purchase Plan to increase the number of shares authorized for issuance;
- (3) amendment of the 2003 Stock Incentive Plan to increase the number of shares authorized for

issuance and approval of certain terms designed to preserve the tax deductibility of certain compensation paid under 2003 Stock Incentive Plan, pursuant to the provisions of Section 162(m) of the Internal Revenue Code of 1986, as amended; and

- (4) ratification of the appointment of Ernst & Young LLP as RFMD's independent registered public accounting firm for fiscal 2011 (ending 2 April).

IN BRIEF

RFMD launches 2.5mm x 2.5mm WiFi front-end module

RF Micro Devices has announced availability of the highly integrated RF5365 WiFi front-end module (FEM), which suits the need for aggressive size reductions for typical 802.11b/g front-end designs and reduces the number of components outside the core chipset.

The RF5365 integrates a 802.11b/g power amplifier with a single-pole three-throw (SP3T) switch for 2.4–2.5GHz ISM-band applications. By integrating SP3T switch functionality, the RF5365 can route WLAN and Bluetooth receive/transmit signals to two system-on-chip (SOC) transceivers, accommodating a common implementation in high-performance consumer electronics and handset/handheld WiFi applications. The SP3T switch can also act as a splitter to transmit or receive Bluetooth and WLAN signals simultaneously.

The RF5365's 802.11 b/g power amplifier delivers 18dBm of linear output power for higher efficiency and lower EVM for 11n applications. Also, integrated 2170MHz filtering and harmonic attenuation reduce the need for a high-loss/attenuation filter at the FEM output, increasing output power at the antenna.

An integrated Rx balun eliminates requirements for tuning components between the FEM and the SoC, and a direct-to-battery connection eliminates the need for additional DC circuitry. Finally, an integrated power detector boosts immunity to power supply, temperature and VSWR fluctuations and improves the accuracy of the device's closed-loop power control.

The RF5365 is fully tested and packaged in a 2.5mm x 2.5mm QFN package.

IN BRIEF

Skyworks keeps lead in power amplifier market share

The rapid resurgence in handset production pushed the power amplifier (PA) market to more than \$2.4bn in 2009, driving the two largest suppliers Skyworks Solution Inc of Woburn, MA and RF Micro Device Inc of Greensboro, NC, USA, according to the report 'Skyworks Maintains Power Amp Share Lead' from the Strategy Analytics RF & Wireless Component market research service, which explores changes in the handset and cellular device PA market brought about by the economic slowdown and consequent contraction in cellphone shipments.

Led by success in GSM/GPRS/EDGE, Skyworks maintained its number one position, which it took over from RFMD in 2008. However, RFMD remains the leading supplier of W-CDMA PAs.

"It is gratifying to see last year's prediction play out, as the acquisition of CMOS PA supplier Axiom Micro Devices helped Skyworks maintain share in the recession-resistant low-cost segment of the market," says Christopher Taylor, director of Strategy Analytics' RF and Wireless Components service. "At the same time, demand for ultra-low-cost and grey-market GPRS handsets expanded rapidly, helping all vendors, but particularly boosting RDA Microelectronics [of Shanghai, China] out of obscurity," he adds.

"Compound semiconductor-based PAs will continue as the enabling technology for the high-growth 3G and emerging 4G markets," comments Asif Anwar, director of the Strategy Analytics GaAs and High Speed Semiconductor service.

www.strategyanalytics.com

Smartphone demand drives 54% year-on-year growth in Kopin's III-V revenue in Q2

Skyworks HBT purchase and supply agreement extended through July 2012

For second-quarter 2010, Kopin Corp of Taunton, MA, USA has reported revenue of \$30.2m, up 19% on last quarter's \$25.4m and up 7% on \$28.2m a year ago.

Revenue for CyberDisplays was \$14.3m, down on \$17.9m a year ago but up on \$10.9m last quarter, driven by military applications. Revenue for III-V products was \$15.9m, up 7% on \$14.5m last quarter and up a huge 53.6% on \$10.4m a year ago, driven by global demand for smartphones.

"The positive momentum we experienced during the first quarter continued as we reached the midpoint of 2010," comments president & CEO Dr John C.C. Fan.

However, gross margin has fallen from 25.7% a year ago to 25% due to a drop year-on-year in sales of military products (which have a higher gross margin than other display products).

Almost still only half the \$3.7m of a year ago, net income has rebounded to \$1.9m (from last quarter's dip to just \$1m). Despite this, cash and marketable securities fell during the quarter from \$119m to \$115.3m.

"Industry projections indicate that the sale of smartphones and other 3G and 4G mobile devices should be strong for several years," Fan says. "This trend is significant to Kopin, as these next-generation wireless devices contain up to three times greater heterojunction bipolar transistor (HBT) content than is contained in a traditional wireless handset, resulting in the strong III-V revenue growth we are experiencing."

Kopin has also announced a two-year extension of its HBT purchase and supply agreement with Skyworks Solutions Inc of Woburn, MA (which manufactures linear products, power amplifiers, front-end modules and radio solutions) to supply the vast majority of its HBT wafer requirements through July 2012. Kopin had previously extended the agreement from April 2008 through to July 2010.

"To meet Skyworks Solutions' and our other valued customers increasing demands, we are continually investing in additional people, advanced technologies and the industry's most advanced growth reactors," comments Fan.

In May, Kopin completed a multi-year purchase and supply agreement with Aixtron for additional high-volume (7x6"-wafer) 'Integrated Concept (IC) Platform' MOCVD reactors, beginning Kopin's plan for an additional 50% capacity expansion in its facilities in the USA and Taiwan. The first two systems are scheduled to be installed at Kopin Taiwan Corp (KTC) in Hsinchu Science Park, Taiwan by the end of this year.

"Our business continues to gain momentum," Fan comments. "Kopin's future looks strong, with smartphone proliferation just commencing and expected to remain robust for a number of years, while TWS [Thermal Weapon Sights], our key display product category, was recently reaffirmed as a critical weapons platform by the DoD [US Department of Defense]," he adds. "We remain on pace to achieve our revenue guidance of \$120-130m for full-year 2010, and expect 2011 will be an even better year."

www.kopin.com

Next-generation wireless devices contain up to three times greater HBT content

Skyworks increases outsourcing to GaAs foundry AWSC

Skyworks Solutions Inc of Woburn, MA, USA, which makes linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment (including supplying components for Apple's iPhone 4), is expected to significantly increase its outsourcing to Taiwanese

contract GaAs foundry partner Advanced Wireless Semiconductor Company (AWSC) in the third and fourth quarters of 2010, according to a report in the Chinese-language Commercial Times.

Compared with about 50 wafers per week in the second quarter, Skyworks' orders placed with

AWSC's 6-inch fab are likely to reach 200 wafers per week in third-quarter 2010, and may ramp up further to 400 wafers per week in fourth-quarter 2010, the Commercial Times indicated.

www.skyworksinc.com

www.awsc.com.tw

<http://ctee.com.tw>

Taiwan GaAs foundries post further growth in July

Taiwanese gallium arsenide foundries WIN Semiconductors Corp and Advanced Wireless Semiconductor Company (AWSC) have both reported continuing revenue growth for July, reports Digitimes.

WIN has raised its monthly revenue record again, from June's NT\$660m to NT\$662m (US\$20.83m) in July, up 44% year-on-year. This follows 41.1% year-on-year growth for second-quarter 2010.

Digitimes noted in May that the foundry has enjoyed growing demand from its integrated device manufacturer (IDM) customers, which have been turning to outsourcing due to cost considerations. It has also obtained new orders from China-based design houses.

WIN's 6" GaAs capacity is about 12,000 wafer per month, but should rise to 14,000 by the end of 2010. In late June, shareholders approved a plan to issue 100 million new shares to raise funds for ramping up manufacturing capacity, while also soliciting equity investments from upstream and downstream production partners, reported Digitimes at the time.

AWSC has reported a fifth consecutive month of record revenue, following 4.5% growth from May's NT\$156m to June's NT\$163m with 7.4% growth in July to NT\$175m. This follows quarterly growth of 17% from Q1's NT\$397.3m to NT\$464m in Q2 (due mainly to increasing orders from GaAs device maker Skyworks).

To meet increasing demand, AWSC is planning to boost its 6" GaAs production capacity from 100-200 wafers per week in Q2/2010 to 400 wafers per week in Q4 by adding a second production line. AWSC also said in January that it was expanding by migrating all of its 4" GaAs production lines (with a capacity of 1600-1700 wafers per week) to 6" wafers.

Compared to the particularly strong second quarter, sequential revenue growth for both GaAs foundries is expected to be more modest in Q3/2010, albeit still more than 10% due to continuing strong demand for power amplifiers (PAs) for wireless and, in particular, smartphone applications.

www.digitimes.com

VPEC sees record revenue in July due to new orders from Skyworks

Although its June revenue dropped slightly from its record of NT\$180m (US\$6m) in May, gallium arsenide (GaAs) epiwafer foundry Visual Photonics Epitaxy Company (VPEC) of Ping-Jen City, Taoyuan, Taiwan saw revenue reach a new record in July after new orders from GaAs device maker Skyworks Solutions Inc of Woburn, MA, USA started to register in its financial figures, according to a report in Digitimes.

VPEC is also a major epiwafer supplier to GaAs device maker TriQuint Semiconductor Inc of Hillsboro, OR, USA.

Previous reports cited industry sources saying that VPEC has been a beneficiary of TriQuint's role as a supplier to Apple. Both TriQuint and Skyworks are among the component suppliers for the new iPhone 4, according to market analyst firm iSuppli.

VPEC's revenue in 2010 through May totaled NT\$719m, up 60.8% year-on-year. Furthermore, the firm's revenue for third-quarter 2010 is expected to be more than 15% up on Q2/2010.

www.vpec.com.tw

www.digitimes.com

Maxtek launching GaAs products for smartphones

In second-half 2010 Taiwanese design house Maxtek Technology is unveiling integrated GaAs products (incorporating power amplifiers and LNAs) for space saving in smartphones. Most smartphone vendors currently buy integrated solutions from Skyworks, TriQuint or Avago Technologies.

Maxtek's GaAs products are made in the 4" fab of AWSC, but the firm may also release orders for the new product to WIN Semiconductors (which uses 6" wafers), according to Digitimes.

www.maxtek.com

Skyworks grows revenue 44% year-on-year to \$275.4m

Diversification into new markets to drive strong second-half ramp

For its fiscal third-quarter 2010 (to end June), Skyworks Solutions Inc of Woburn, MA, USA, which manufactures linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, has reported record revenue of \$275.4m, up 44% on \$191.2m a year ago and up 16% on \$238.1m last quarter (exceeding guidance of 10–15%).

Driven by momentum in mobile Internet and continued penetration into new vertical markets and a broad set of diversified analog applications, Skyworks also exceeded guidance for gross margin and operating margin.

On a non-GAAP basis, gross margin has risen from 40.5% a year ago and 42.3% last quarter to 43.3%. This is attributed to a product mix that increasingly includes higher-margin vertical markets and 3G solutions, volume ramp of new products, continued manufacturing productivity enhancements, product and yield improvements, and significant cost reductions.

Operating income has continued to rise from \$28.6m a year ago and \$48.7m last quarter to \$63.5m. Correspondingly, operating margin has risen from just 14.9% a year ago to 23.1%, more than rebounding from a brief dip to 20.5% last quarter. Non-GAAP net income has risen from \$27m a year ago and \$44.2m last quarter to \$58.7m.

Cash and cash equivalents have risen from \$370m a year ago to \$390m. Although down from \$411.5m last quarter, this is after spending \$33m to retire another \$20.4m of March 2012 convertible debt (leaving only \$27m of convertible debt due in March 2012) and investing \$25m in capital expenditure (as the firm expects a strong second-half ramp).

"Skyworks is outpacing analog semiconductor market growth, driven by momentum across

mobile Internet, smart energy and diversified linear products applications," comments president & CEO David J. Aldrich.

"The smartphone segment is poised to grow at 3–4x the 8–10% growth rate anticipated for the overall cellular handset market," reckons Aldrich.

"For Skyworks, this market is growing at an even faster pace, given our increasingly customized solutions and our strong relationships with leading OEMs along with the rising tide of analog content, as carriers and consumers shift to band-intensive 3G and 4G platforms," he adds. "We're shipping to virtually all cellular OEMs and smartphone providers."

Also regarding mobile Internet, during the quarter Skyworks was selected to power Samsung's 4G USB modem (the world's first commercialized LTE device). Embedded wireless is a rapidly growing segment that is often overlooked, says Aldrich. Skyworks estimates that sales of USB modems, tablets, and mobile hotspots will rise at a compound growth rate of 83% from 50 million units in 2009 to about 250m by 2013. "This could prove conservative, given the opportunity to easily upgrade the world's online computers with 3G and 4G USB modems on top of this entirely new tablet category, which is off to a very strong start," he comments.

"We continue to gain traction on the other side of the mobile internet connection as well within network infrastructure, as mobile operators begin to install new base-

stations, routers, and back-haul network equipment to avoid network traffic jams and to preserve their highly profitable data service revenue stream," says Aldrich.

"To support this growth we've developed a portfolio of network infrastructure solutions that include attenuators, VCO synthesizers, mixers, low-noise amplifiers and demodulators," he adds.

During fiscal Q3, Skyworks unveiled new mid- and high-power front-end modules for multiple in/multiple out (MIMO) access points, routers and gateways; launched next-generation monolithic microwave integrated circuit (MMIC) amplifiers for infrastructure receiver applications; launched high-performance broadband synthesizers spanning ultra-wide frequency ranges to support the world's leading 3G and 4G base-station providers; started shipping attenuators and amplifiers for Cisco's multi-room DVR in support of Verizon's FIOS deployments; and ramped DBS solutions in support of DirecTV and Dish Network services.

Also, regarding new vertical markets such as smart grid, home & building and automation applications, during the quarter Skyworks ramped smart metering solutions in support of Itron's OpenWay platform. According to a study by ABI Research, cumulative growth investment in smart grid will exceed \$45bn in the next five years, as both government and utilities repair, upgrade, and transform their aging infrastructure.

"After more than a decade, we see the home & building automation market gaining real momentum, given demand for green technologies, for enhanced security and energy conservation," says Aldrich.

"We're providing ZigBee-based solutions for security monitoring and management," he adds. Applications include lighting control, door and window sensors, as well

Skyworks is outpacing analog semiconductor market growth, driven by momentum across mobile Internet, smart energy and diversified linear products applications

as wireless appliance and temperature controllers. Customers include Honeywell, GE, LG, and Whirlpool.

Regarding diversified linear products, Skyworks says that its standard analog catalog business has over 2500 analog products and more than 1000 customers, with wide ranging applications including automotive, avionics, satellite, medical, military and industrial. As well as a diversified customer base, the business increasingly provides higher margins and long, almost annuity-like product life cycles, comments Aldrich.

"At a higher level, we believe that, by focusing on new end-markets, introducing margin-rich products and executing operationally, our revenue growth will translate into improving returns going forward," he adds.

Based on specific program ramps and backlog coverage, for fiscal fourth-quarter 2010 Skyworks expects revenue to rise 9% to \$300m, gross margin to rise to 43.5–44%, and a rise in operating margin to 25% (on track to achieve the firm's medium-term operating

model target). "Further, we expect to deliver sustainable growth and operating leverage from our current \$1.2bn annualized revenue run-rate," says VP & chief financial officer Donald W. Palette.

"Volume and scale will allow us to continue to expand margins," says Aldrich, explaining that completion of Skyworks' migration from 4" to 6" GaAs wafers gives plenty of headroom to increase margin through use of internal manufacturing capacity during what is expected

to be a strong ramp up in second-half 2010. "There is tightness of GaAs supply elsewhere in the market but that's not a concern of ours because we can do it internally." In fiscal fourth-quarter 2010, CapEx should be roughly level with the last few quarters, at \$20–25m, adds Palette.

Migration from 4" to 6" GaAs wafers gives plenty of headroom to increase margin through use of internal manufacturing

IN BRIEF

Skyworks launches \$200m stock buy-back program

Skyworks says that its board of directors has authorized the repurchase of up to \$200m of its common stock from time to time, either on the open market or in privately negotiated transactions.

The timing and amount of any shares repurchased will be determined by management based on its evaluation of market conditions and other factors. The repurchase program may be suspended or discontinued at any time. Any repurchased shares will be available for use in connection with its stock plans and for other corporate purposes.

The repurchase program will be funded using the firm's working capital (cash, cash equivalents and temporary investments of \$390m, as of 2 July).

www.skyworksinc.com

Skyworks' PA module used in first commercial LTE device

Skyworks Solutions Inc of Woburn, MA, USA says that one of its power amplifier (PA) modules is being used by Samsung Electronics for its GT-B3710, a high-speed fourth-generation (4G) USB modem that is claimed to be the world's first long-term evolution (LTE)-commercialized device.

The SKY77706 LTE PA module (PAM) is designed for multiple handset and data-card applications and allows consumers to enjoy the benefits of high-speed data services such as web TV broadcasting, online gaming and web conferencing. Skyworks says that today's 4G systems offer a comprehensive solution where data and streamed multimedia can be given to users anytime, anywhere at higher data rates than previous generation networks.

LTE network commitments are increasing worldwide, says Skyworks' senior director of engineering Dr Gene A. Tkachenko. Skyworks is providing next-generation solutions to help boost network throughput, improve efficiency and performance, and simplify roaming regardless of the platform, he adds.

Samsung's GT-B3710 LTE USB modem can be connected to laptop computers or other portable devices via universal-serial bus (USB). It incorporates Samsung's in-house developed LTE modem chip supporting the 2.6GHz band for LTE service. The firm's LTE solution is fully compliant with the latest third-generation Partnership Project (3GPP) LTE Release 8 (Rel-8) standard.

The SKY77706 PAM is a fully matched, surface-mount module

developed for LTE/EUTRAN applications that packs full coverage of LTE FDD Band VII into a single compact package. Skyworks says that the device meets the stringent spectral linearity requirements of LTE modulation with QPSK/16QAM modulations from 1.4MHz to 20MHz bandwidth and full or partial resource block allocations with high power-added efficiency (PAE).

The single GaAs MMIC contains all active circuitry in the module, including the PA, input, and inter-stage matching. The SKY77706 is manufactured using Skyworks' bipolar field-effect transistor (BiFET) process, which provides for all positive voltage direct current (DC) supply operation while maintaining high efficiency and good linearity.

TriQuint grows 14.7% in Q2 after Networks product revenue rebounds faster than expected

CapEx to be increased to support 20% annual growth

For second-quarter 2010, RF front-end product and foundry services provider TriQuint Semiconductor Inc of Hillsboro, OR, USA has reported revenue of \$207.5m (up 14.7% on \$180.8m last quarter and 22.7% on \$169.1m a year ago). Foxconn was the only customer comprising more than 10% of revenue.

Of total revenue, 61% came from Mobile Devices; 27% Networks; and 12% Defense & Aerospace (compared to 68%, 20% and 12% a year ago, continuing the shift from Mobile to Network business).

In particular, Networks product revenue continued to show a strong rebound from the lows of 2009, growing a more-than-expected 19% on last quarter and 64% on a year ago.

Within Mobile Devices (the largest of TriQuint's three major markets) revenue was up 10% sequentially, and 31% year to date compared to first-half 2009. Consumer demand for wireless broadband is fueling rapid smart-phone growth, bringing 4-6 times the RF dollar content per smart-phone compared to a voice-only phone, says president & CEO Ralph Quinsey.

TriQuint also has wide customer penetration, he adds. "We have content with all leading smart-phone providers." The RF section has become more complex within smart-phones, with requirements for voice, multiple databands, Wi-Fi and GPS. "TriQuint is unique as a single supplier for this complete

solution, regardless of standard, band, or technology. For example, integrating duplexers with amplifiers for improved size and battery life is an area where TriQuint has a competitive advantage," Quinsey claims.

On a non-GAAP basis, gross margin improved for a fifth consecutive quarter from 33.2% a year ago and 39% last quarter to 42.3%, due to strong factory utilization, a greater mix of Networks and Defense products (which have higher-than-company average margins), and favorable product mix.

"TriQuint had a strong second quarter, passing the \$200m a quarter revenue milestone and exceeding our non-GAAP operating income target of 15% [achieving 16%] on a healthy mix of higher-margin Networks products," says Quinsey.

On a non-GAAP basis, net income was \$33.1m, up from \$17.7m last quarter and \$11.5m a year ago. Cash flow from operations was \$27.9m (up on \$12.1m last quarter). With capital spending of \$18.4m (compared with depreciation of \$12m), total cash investments rose about \$17m to just over \$175m.

"Strong earnings results were due to a higher mix of networks, defense and aerospace revenue, improved factory performance, and lower-than-expected legal expenses [which included \$1.3m related to litigation with Avago]," says Quinsey.

During Q2, TriQuint received a Quarterly Quality Award from Samsung recognizing its performance.

It was also awarded a US Air Force contract to design and build gallium nitride (GaN) modules for new Drone aircraft. In addition, TriQuint is ramping bulk acoustic wave (BAW) filter products for 4G mobile hotspots.

Based on continued strong smartphone design wins and strong growth in mobile devices markets, for third-quarter 2010 TriQuint expects revenue of \$215-225m, up about 6% sequentially and 25-30% year-on-year (compared to 24 February's guidance of about 20%), with strong factory utilization leading to non-GAAP gross margin of 40-41%.

For full-year 2010, TriQuint expects revenue to grow 25-30%. "Early in 2010, I took an aggressive stance and guided for 20% year-over-year growth on the strength of smart-phone demand and a recovering economy," Quinsey says. "I am aware of economic headway, but I now believe I was not aggressive enough," he adds.

"I also expect increased capital expenditures in second-half 2010 to support long-term growth," says Quinsey. The goal is a sustainable 20% compound annual growth rate (which TriQuint should exceed this year) and more than 20% operating margin. "It reflects our conviction that the RF market will be strong for years to come. And we have margin opportunity that comes with growth," believes Quinsey.

www.triquint.com

TriQuint wins Samsung Quarterly Quality Award

TriQuint has received Samsung's Quarterly Quality Award.

TriQuint supplies a variety of RF solutions to Samsung of Seoul, South Korea, such as power amplifiers and multi-function integrated modules, for use in wireless com-

munication devices for GSM/GPRS, EDGE, WCDMA and HSPA+.

The award is part of Samsung's 'Quality First' initiative, which is intended to encourage excellence among its subcontractors and improve overall product quality.

TriQuint was one of two suppliers recognized among a total of Samsung's 180 suppliers. Samsung Electronics manufactures high-tech electronics and digital media and is the number 1 mobile phone provider in the USA.

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IN BRIEF

Inphi adds TI veteran to Technical Advisory Panel

Inphi Corp of Sunnyvale, CA, a fabless provider of high-speed analog ICs for the communications and computing markets (using InP, GaAs, SiGe or silicon bipolar as well as CMOS), says that John Scarisbrick has joined its Technical Advisory Panel.

Inphi's Technical Advisory Panel was formed to provide strategic counsel on technology, strategy and direction. Its global experience spans a variety of key industries, including communications, computing, networking and semiconductors.

The firm says that Scarisbrick has broad experience in creating value in start-up, growth-phase and top-tier semiconductor businesses, having held executive management and independent director positions. He currently serves on the boards of micro-processor intellectual property firm ARM Holdings plc of Cambridge, UK and floating body effect memory technology firm Innovative Silicon of Lausanne, Switzerland. He is also executive chairman of Netronome Systems Inc of Cranberry Township, PA, USA, which develops network flow processors.

Scarisbrick has served as CEO of CSR plc and also worked at Texas Instruments (TI) for 25 years in Texas, France and England. As senior VP at TI, Scarisbrick was responsible for all aspects of its \$5bn World Wide Application Specific Products chip business in Dallas, TX, including ASIC, broadband, digital signal processor (DSP), LCD, SPARC and wireless. He also served as president of Texas Instruments Europe, and led the team that created TI's DSP business. He retired from TI in 2000.

www.inphi.com

Anadigics enters profit as sales rise 18.7% in Q2 to \$51.7m Further growth of 11% expected in Q3

For second-quarter 2010, GaAs-based broadband wireless and wire-line communications component maker Anadigics Inc of Warren, NJ, USA has reported a fifth consecutive quarter of revenue growth, to \$51.7m. Compared to guidance of 12% growth (to \$48.7m), this is up a more-than-expected 18.7% on Q1's \$43.5m, and up 64.2% on \$31.5m a year ago.

"We are growing faster than all the other competitors, so we're taking market share," says president & CEO Mario Rivas. "We're the smallest, but we're growing."

Growth was driven by wireless sales of \$38.3m, up 26% on Q1's \$30.4m (compared to the expected 20% growth) and up 65% on a year ago. Broadband sales were \$13.4m, up 2% on Q1's \$13.1m and up 61% on a year ago. In particular, broadband saw sequential growth of 20% (to \$6m) for tuner and active splitters business for cable TV set-top boxes and growth of 3% (to \$4.7m) for cable TV infrastructure business, offset by revenue drops of \$600,000 in WiMAX and of \$400,000 in wireless LAN.

With fab utilization moving into the mid-60s, gross margin rose from Q1's 32.3% to 35.6% (more than the targeted 35%).

Compared to a net loss of \$11.3m a year ago and \$2.7m in Q1, in Q2 Anadigics moved into profit, with net income of \$1.1m on a non-GAAP basis (excluding non-cash stock compensation expense of \$2.3m, recoveries in auction rate securities of \$0.3m and the sale of a building in Kunshan, China for \$1.7m).

Cash flow from operations was up \$3.3m on last quarter. So, after capital expenditure of \$1.9m, cash, cash equivalents and short- and long-term marketable securities rebounded from \$90.4m to \$91.8m.

"The results of our second quarter reflect the continued execution of

our business initiatives highlighting increasing revenue, operational excellence, expanded market share and achieving profitability [several quarters ahead of prior expectation]," comments Rivas. "Our participation in a fast-growing 3G & 4G wireless market, which will require increasing power amplifier content over time, coupled with our strong product breadth provides for continued opportunities to build our revenue, increase our market share and improve our financial results," he adds.

In mid-July, Anadigics unveiled a new range of power amplifiers for the booming 3G mobile device market. "The continued expanded high demand of wireless connectivity in a growing number of consumer devices including smart phones, datacards, netbooks, notebooks and tablets provide for substantial opportunities," says Rivas. "By the end of 2010 the 3G market is expected to be roughly 25% of the handset market, with a forecasted compound annual growth rate upgraded on 30% through 2014," he adds.

In addition, Anadigics is well positioned to capitalize in the evolution of the 4G LTE (long-term evolution) market, reckons Rivas. The firm sampled LTE products as early as February 2009. "Our highly favored HELP4 LTE power amplifier is specifically tailored to cover UMTS and LTE bands 1, 2, 4, 12 and 13," he adds. According to ABI Research, there are about 132 networks with trials or plans to launch LTE.

For Q3/2010, Anadigics expects sales up 11% sequentially to \$57.5m. Gross margin should rise to nearly 37%. "As we continue to scale, we expect to realize additional operational leverage," says Rivas. The longer-term target is 40%.

www.anadigics.com

Anadigics launches 4th-gen HELP power amplifiers for 3G

Broadband wireless and wireline communications component maker Anadigics Inc of Warren, NJ, USA has launched the new AWT66xx family of HELP4 WCDMA single-band power amplifiers (PAs), designed for 3G mobile devices running on the WCDMA (wideband code division multiple access) standard. The HELP4 WCDMA family includes the AWT6621, AWT6622, AWT6624, AWT6625 and AWT6628 PAs, each designed for specific wireless bands. All the devices are now ramping into volume production, with complete evaluation kits available on request.

First introduced in 2004, Anadigics says that its HELP products quickly became the preferred choice for CDMA and WCDMA designs due to technology that enables longer battery life and extended talk time. Subsequent generations have continued to raise the performance of CDMA and WCDMA/HSPA devices.

Anadigics says that its fourth generation of HELP (High-Efficiency-at-Low-Power) PAs suits a broad spectrum of mobile device applications as they deliver maximum efficiency at various power levels, including a 50% reduction in current consumption where mobile devices operate most frequently. They also enable up to 75% longer battery life, resulting in much longer talk time in handsets.

The AWT6621, AWT6622, AWT6624, AWT6625 and AWT6628 each include high-performance directional couplers in a 3mm x 3mm x 1mm footprint. Each is HSPA and HSPA+ compliant for the highest data levels and offers three mode states to achieve high power-added efficiencies at several power levels during phone operation. The devices also enable low quiescent current and leakage current in shutdown mode.

Anadigics says that it has worked with leading chipset makers in the development of the HELP4 WCDMA family to provide the highest level of flexibility, integration and ease-of-use to mobile handset designers.



Anadigics' AWT66xx family of HELP4 WCDMA single-band power amplifiers.

Specific applications for each product include:

- AWT6621 — Band 1 (IMT) WCDMA/HSPA wireless devices, and Band Class 6 CDMA/EVDO wireless devices;
- AWT6622 — Band 2 (PCS) WCDMA/HSPA wireless devices, and Band Class 1 (PCS) CDMA/EVDO wireless devices;
- AWT6624 — Band 4 (along with Band 3 and Band 9) WCDMA/HSPA wireless devices, and AWS/KPCS CDMA/EVDO wireless devices;
- AWT6625 — Band 5 (Cell) WCDMA/HSPA wireless devices, and Band Class 0 CDMA/EVDO wireless devices; and
- AWT6628 — Band 8 (EGSM) WCDMA/HSPA wireless devices.

"Even with the emergence of 4G mobile technology today, we continue to see a tremendous opportunity in WCDMA as the 3G smartphone market continues to expand at an astounding pace," says Marcus

Wise, VP, Wireless RF Products. "We have realized tremendous success in the global marketplace with our broad portfolio of 3G products that cover every major standard. We are also paving the way to 4G with a strong portfolio of our forthcoming LTE and WiMAX products," Wise adds. "Our HELP4 products deliver the efficiency,

flexibility, performance and reliability our customers demand to differentiate and deliver the technologically advanced solutions that consumers expect from their mobile devices."

With the proliferation of technologies like HSPA+, which improves wireless network performance, the global 3G WCDMA market remains the most pervasive 3G system globally, says Anadigics.

According to the Global mobile Suppliers Association (GSA), 3G/WCDMA is the leading 3G system globally, with commercial service in 135 countries. 97% of WCDMA operators have commercially launched HSPA. Yet mobile broadband downlink and uplink speeds using HSPA are evolving. The Network Update reports on 80 operator commitments to deploy HSPA+, including 41 commercial systems launched in 26 countries.

www.anadigics.com

Hittite grows 52% year-on-year to \$60.3m in Q2

Income rises to record \$19.2m

For second-quarter 2010, Hittite Microwave Corp of Chelmsford, MA, USA, which designs and supplies analog and mixed-signal RF, microwave and millimeter-wave ICs, modules and subsystems, has reported revenue of \$60.3m. This is up 52% on \$39.7m a year ago and 11.3% on \$54.2m last quarter, driven by the increasing demand for additional wireless data bandwidth and network capacity.

About 45.6% of total revenue (\$27.5m) came from customers in the USA and 54.4% (\$32.8m) from outside the USA, compared to Q1's 44.3%:55.7% (\$24m from the USA and \$30.2m from outside the USA). Sequential growth was 15% in the USA (driven by the military market) and 8.6% outside the USA (driven by the microwave communication markets).

About 84% of revenue came from three of Hittite's eight markets: cellular infrastructure, microwave and millimeter-wave communications, and military. The remaining markets (automotive, broadband, fiber-optic, space and test & measurement) accounted for 16%.

Gross margin has risen further, from 70.4% a year ago and 73.4% last quarter to 74.8%, due mainly to product mix.

Operating expenses rose by 5% in Q2, due mainly to R&D expenses rising from \$5.2m a year ago and \$7m last quarter to \$7.8m (13% of revenue) as expanding activities in the firm's design centers drive up personnel costs (which will continue throughout 2010). Sales & marketing expenses have risen

from \$3.7m a year ago and \$4.6m last quarter to \$4.9m (8.1% of revenue), due mainly to commission for third-party representatives.

Despite the rise in overall expenses, net income has continued to rise, from \$10.6m a year ago and \$16.1m last quarter to a record \$19.2m. This exceeded guidance, due to slightly higher-than-expected revenue, stronger-than-expected gross margin, and lower-than-

Despite the rise in overall expenses, net income has continued to rise to a record \$19.2m

expected general & administrative (G&A) expenses, which have been cut from \$3.1m last quarter to \$2.7m (4.4% of revenue), due mainly to a reduction in third-party professional fees.

During the quarter, total cash and cash equivalents rose by a further \$3.6m to \$241.8m.

Hittite's strategy is to expand its product portfolio to capitalize on the demand for additional wireless data bandwidth and network capacity and to take market share. In Q2, the engineering and product development team launched 23 new products, making 55 year-to-date and bringing the standard product portfolio to 857.

Three new IC product lines (broadband time delay products for 40G and 100G fiber optics; mux & demux for 40G and 100G fiber and test systems; DC power control products for amplifier biasing) also expand Hittite's offerings for the

cellular, fiber and microwave markets, as well as boosting the total number of product lines to 28. "Each new product line will offer unique products, which will enable us to capture more performance-based non-commodity business," reckons chairman & CEO Stephen Daly. Hittite expects that, as the new product lines expand, they will increase its addressable market by more than \$75m as well as expanding its customer base.

"Over the past four years, we have launched many new product lines, and many are just beginning to ramp up in revenues," comments Daly.

For third-quarter 2010, Hittite expects revenue of \$62-64m (up 6% on Q2/2010 and 54% year-on-year) and net income of \$19.1-19.8m, assuming gross margin of 72-73% and operating expenses up 5-6% due to expansion activities.

In particular, Hittite expects cellular, military, test & measurement, space, and fiber-optic markets to be strong, automotive and microwave communications markets to be neutral, and the broadband market to be weak.

www.hittite.com

Hittite acquires license to IBM millimeter-wave technology

Hittite Microwave has acquired a license from IBM to manufacture and market silicon IC millimeter-wave transceivers developed by IBM. Also covered by the license are certain 57-64GHz IC, package

and antenna technology, as well as 71-76GHz and 81-86GHz IC intellectual property. Hittite aims to apply the technology to markets requiring highly integrated solutions.

The firm has also entered into a joint development agreement with IBM related to millimeter-wave technology.

Financial terms of the transaction were not disclosed.



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Teledyne completes acquisition of Intelek

Labtech Microwave division to enhance range of GaAs- and GaN-based solid-state amplifier systems

Teledyne Technologies Inc of Thousand Oaks, CA, USA has completed its acquisition of Intelek plc of Swindon, UK (announced on 16 June).

Intelek's ordinary shareholders will receive 32 pence in cash for each Intelek share, valuing its entire existing issued ordinary share capital at £28m. The aggregate value for the transaction will be £35m (\$52m), taking into account Intelek's stock options, net debt and pension deficit as of the end of March. For the year to end-March 2010, Intelek had sales of £38m.

Teledyne Technologies designs and manufactures custom electronic subsystems, instrumentation and communication products, engineered systems, aerospace engines, and energy and power generation systems, primarily in the USA, the UK and Mexico.

Intelek is a group of companies that primarily designs and manufactures electronic systems for satellite and microwave communications. Expertise includes microwave frequency design, digital signal processing, thermal modeling, and microwave circuit processing and sub-assembly.

Intelek's CML Group division manufactures precision machined and composite aerostructures for military and commercial aircraft. Also, through its Paradise Datacom division of State College, PA, USA, Intelek designs and manufactures satellite modems, transceivers, block up-converters, solid-state power amplifiers, low-noise amplifiers and associated equipment for the terrestrial segment of the satellite communications market. Intelek's Labtech Microwave division manufactures custom microwave packaging solutions and microwave components, mainly for the defense electronics, global

telecoms, space and satellite communications markets.

In particular, Labtech Microwave Packaging Group of Presteigne, UK (founded in 1984) specializes in the design and manufacture of low-cost custom packaging solutions using organic materials for monolithic microwave integrated circuits

Labtech Microwave Components Group is a designer and manufacturer with experience in producing high-performance microwave components including DLVAs and broadband amplifiers from 10MHz-40GHz

microwave components including DLVAs and broadband amplifiers from 10MHz-40GHz, PIN switches up to 26GHz and custom active and passive microwave components for multifunction sub-systems, which use discrete and MMIC designs. All of Labtech's broadband amplifiers and microwave components are manufactured in a purpose-built class 10,000 cleanroom containing thin-film processing, automated chip and wire assembly, microwave testing and laser welding.

Following the acquisition, the three divisions will change their names to Teledyne Paradise Datacom, Teledyne Labtech and Teledyne CML Group.

"The directors of Intelek have focused our strategy on further

developing our satellite and microwave communications businesses," said Intelek's CEO Ian Brodie when the acquisition was first announced on 16 June. "This offer is at a substantial premium... Teledyne will continue to support and further develop Intelek's microwave businesses and employees," said Brodie.

The acquisition further expands Teledyne's capabilities in microwave systems, said Teledyne's chairman, president & CEO Robert Mehrabian. "The operations of Intelek are highly complementary with Teledyne's existing microwave businesses.

In particular, Paradise Datacom's high-power solid-state amplifiers

By combining our capabilities, we believe that Teledyne will be able to offer, over time, an enhanced range of complete high-power TWT and GaAs- and GaN-based solid-state amplifier systems for communications, radar and electronic warfare

and modems for commercial customers complement Teledyne's strong position in broadband high-power traveling wave tube (TWT) and lower-power solid-state subsystems, primarily for military customers," he added. "By combining our capabilities, we believe that Teledyne will be able to offer, over time, an

enhanced range of complete high-power TWT and GaAs- and GaN-based solid-state amplifier systems for communications, radar and electronic warfare applications."

www.teledyne.com
www.intelek.plc.uk

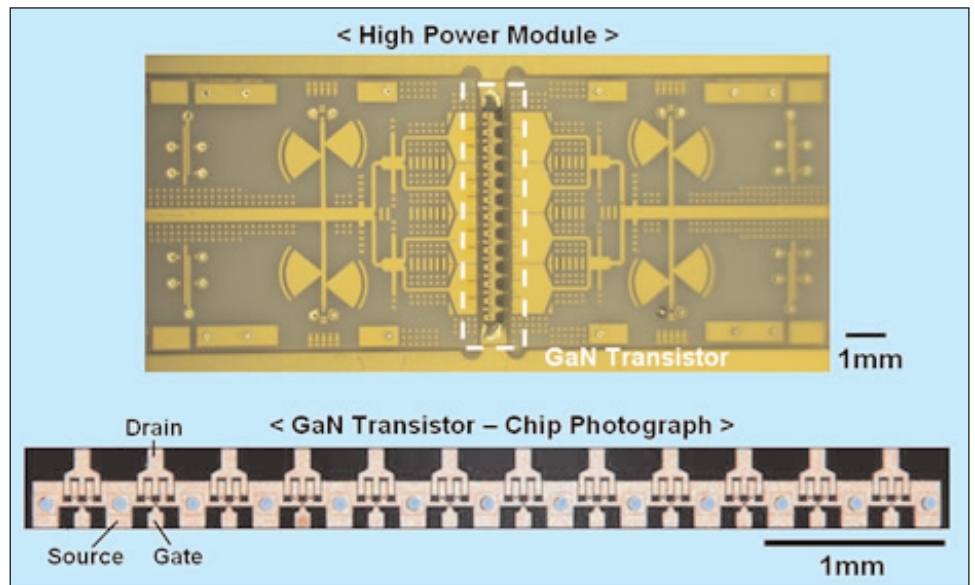
Panasonic claims GaN transistor power density record of 2.4W/mm at 60GHz

Record 10.7W at 25GHz for GaN-on-Si enables 84km mm-wave coms

Panasonic Corp of Osaka, Japan says that it has developed a high-power gallium nitride transistor for long-distance communication at millimeter-wave frequencies, and has used it to fabricate a 25GHz wireless transceiver. The device exhibits maximum output power of 10.7W at 25GHz, enabling communication over 84km in theory.

The high-power GaN transistor is fabricated on a silicon substrate, making it compatible with mass production on large-diameter wafers. Panasonic says that a novel epitaxial structure on Si improves the crystal quality, resulting in high drain current of 1.1A/mm with high carrier concentration. A metal-insulator-semiconductor (MIS) gate structure with crystalline silicon nitride (SiN) film used as a gate insulator greatly increases the gate breakdown voltage, and thus a high drain voltage of 55V can be applied to the device.

Panasonic says the high current and high breakdown voltage of its proprietary GaN device enables record power output for a GaN-on-Si transistor of 10.7W at 25GHz, as well as record power density for GaN transistor of 2.4W/mm at 60GHz.



High-power GaN transistor for long-distance millimeter-wave communications.

The transceiver that was fabricated uses orthogonal frequency division multiplexing (OFDM), which is suited to high-capacity data communication. The averaged output power of 2W out of the 10W from the GaN transistor can achieve 84km communication in theory. The high-power GaN transistor enables far longer reach than that for conventional GaAs transistors, it is claimed. Panasonic reckons that the GaN transistor is

promising for future long-distance millimeter-wave communication systems at high speed and high data capacity.

Applications for 18 domestic and 3 overseas patents have been filed. The development work is partially supported by 'The research and development project for expansion of radio spectrum resources' of Japan's Ministry of Internal Affairs and Communications.

<http://panasonic.net>

Mitsubishi launch GaN HEMTs for L-C-band amplifiers

Tokyo-based Mitsubishi Electric Corp has developed three models of GaN high-electron-mobility transistor (HEMT) with power outputs of 10W, 20W and 40W for L-, S- and C-band (0.5-6GHz) amplifiers, which are incorporated into base-stations for mobile phones, very small aperture terminals (VSAT) and other transmission equipment. Sample shipments are beginning in August.

With high-voltage operation of 47V (drain to source), the three models — with output power, linear power gain, and power-added efficiency

(at P3dB, frequency = 2.6GHz), respectively — are as follows:

- MGF0846G: 46dBm (40W), 12dB and 46%;
- MGF0843G: 43dBm (20W), 13dB and 48%;
- MGF0840G: 40dBm (10W), 12dB and 50%.

For microwave transmitters, GaAs power amplifiers are most commonly used, but GaN is now garnering more attention, due to its high breakdown voltage and high saturated electron speed. Mitsubishi Electric claims that in

March it became the first firm to manufacture GaN HEMTs for C-band space applications, launching four models. HEMTs that use GaN have higher power density, which helps to save energy and contributes to making transmitters more compact and lightweight, as well as extending operating lifetime.

The three new models have small-sized packages of 4.4mm x 14.0mm, which helps to reduce the mounting surface in amplifiers.

<http://global.mitsubishielectric.com>

IMEC's GaN-on-silicon research program adds Micron, Applied Materials and Ultratech

At July's Semicon West event in San Francisco, CA, USA, nanoelectronics research center IMEC of Leuven, Belgium announced that Micron Technology, Applied Materials and Ultratech have joined its IMEC industrial affiliation program (IIAP) on gallium nitride on silicon technology.

Launched in July 2009, the multi-partner R&D program focuses on the development of GaN-on-Si process and equipment technologies for manufacturing solid-state lighting (e.g. LEDs) and next-generation power electronics components on 8-inch silicon wafers, aiming to reduce the cost and improve the performance of GaN devices.

IMEC says that gallium nitride is a promising material for optoelectronics and advanced power electronic components (offering higher breakdown voltage and current capacity than incumbent silicon technology). But, to make GaN-

based devices a competitive alternative to silicon devices, GaN manufacturing technology needs to achieve the same economies of scale. Existing LED manufacturing processes are typically performed on costly 4-inch sapphire substrates. By depositing GaN on 8-inch silicon, the productivity of GaN-based device manufacturing can be raised significantly, reckons IMEC. In addition, the GaN-on-Si program is using an Applied Materials mainframe to develop 8-inch GaN-on-Si technology that is compatible with CMOS fab infrastructure, which can further enhance productivity and lower device cost.

The program brings together integrated device manufacturers (IDMs), foundries, compound semiconductor companies, equipment suppliers and substrate suppliers to develop 8-inch GaN technology. The IIAP builds on IMEC's track

record in GaN epi-layer growth, new device concepts and CMOS device integration.

Micron Technology, Applied Materials, and Ultratech will actively participate in the IIAP at IMEC. Such on-site participation will enable the partner firms to have early access to next-generation LED and power electronics processes, equipment and technologies, says IMEC.

"Less than a year after the program's launch in July 2009, we have assembled a strong consortium, including IDMs and equipment suppliers, and we expect more companies to join in the near future," says Rudi Cartuyvels, VP & general manager Process Technology at IMEC. "This collaboration reflects the value of IMEC's research on GaN-on-Si as a reliable cost-effective solution for next-generation LED and power electronics devices."

www.imec.be

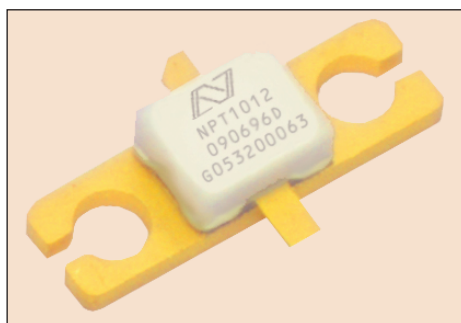
Nitronex launches thermally enhanced 25W GaN transistor for military applications

First product of firm's second-generation platform

Nitronex Corp of Durham, NC, USA, which designs and makes GaN-on-Si RF power transistors for the defense, communications, and industrial & scientific markets, has launched the NPT1012, a thermally enhanced 25W device for applications from DC to 4GHz.

The NPT1012 is the first transistor to be released as part of Nitronex's second-generation platform, which was developed to meet growing demand for wideband, high-power and robust RF power amplifiers in the military communications, jammer and radar market segments.

"The new NPT1012 25W GaN power transistor has been designed specifically to improve broadband power performance by addressing thermal management," says VP of sales & marketing Gary Blackington.



Nitronex's NPT1012 RF transistor.

"Designers can use the NPT1012 transistor to develop compact, multi-octave power amplifiers that simultaneously meet RF and thermal requirements," he adds. "The NPT1012 will be well suited for applications that require wide bandwidth, high efficiency and low thermal resistance." He explains that this is the firm's second-generation

25W discrete GaN RF transistor, which has a track record of being used in advanced tactical radios.

"Thermal optimization requires attacking the problem from every angle," says VP of engineering Ray Crampton. "We made improvements in the full thermal stack from the die itself to packaging and assembly," he adds. "With these enhancements, we achieved a 25% reduction in thermal rise in our customers' applications."

The NPT1012 provides more than 20W of output power and over 50% drain efficiency in a broadband application circuit across 1–2.5GHz. It is available in a thermally enhanced air-cavity bolt-down package, is lead-free and RoHS compliant.

www.nitronex.com

Tuning GaN growth for Schottky barrier diodes with record 1.7GW/cm² figure of merit

SEI optimizes GaN crystal quality by reducing yellow luminescence and finding best balance for Ga/N sources

Researchers at Japan's Sumitomo Electric Industries Ltd (SEI) have created nitride semiconductor vertical Schottky barrier diodes (SBDs) with low specific on-resistance of 0.71mΩcm² and high breakdown voltage of 1100V [Yu Saitoh et al, Appl. Phys. Express, vol3, p081001, 2010].

Nitride semiconductors are of increasing interest as an electronic material capable of handling high power, high frequency and high temperature. These applications use the interconnected characteristics of large energy bandgap, high breakdown field and high saturation electron velocity. Potential applications include high-frequency power amplification for mobile phone network base-station transmissions and power switching devices.

The latest Sumitomo results were achieved by creating high-quality n-type gallium nitride (GaN) drift layers with an electron mobility of 930cm²/V-s. The researchers comment that this estimated electron mobility is as high as the theoretically predicted value, which indicates that the n-GaN layers on GaN substrates are of high crystal quality.

The conditions for the GaN growth were optimized by reducing the yellow emissions in photoluminescence measurements. These yellow emissions are associated with crystal defects.

In fact, the reduced yellow luminescence was achieved by increasing the nitrogen/gallium (V/III) molar ratio in the MOCVD growth process. The nitrogen source was ammonia and the gallium came in the form of trimethyl-gallium (TMG). The yellow luminescence is thought to be due to impact ionization centers that can encourage unwanted current leakage under reverse bias.

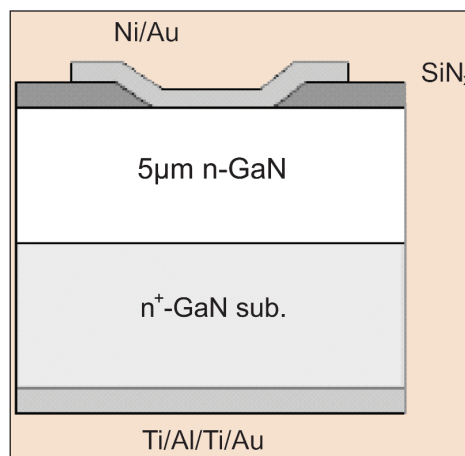


Figure 1. Schematic cross section of GaN vertical Schottky barrier diodes (SBDs) with field plate (FP) structure.

The material was grown on free-standing GaN substrates produced using hydride vapor phase epitaxy (HVPE). The threading dislocation density in the substrate was less than 1x10⁶/cm².

The optimized material was used to create vertical Schottky barrier diodes (Figure 1). The vertical SBD structure is designed to reduce

current densities and electric fields, compared with lateral structures. Field plates were used to prevent premature breakdown due to electric fields concentrated at electrode edges.

The devices had a value of 1.7GW/cm² for the figure of merit $V_B^2/R_{on} \cdot A$, where V_B is the breakdown voltage, R_{on} is the on-resistance and A is the area of the device. The researchers claim that this is "the highest value among previously reported SBDs for both GaN and SiC" (Figure 2).

For a 1.1mm x 1.1mm SBD device, the blocking voltage was 600V and, at 6A forward current, the voltage drop was 1.46V.

However, the researchers believe that, on the basis of simulations, even better results can be achieved through improvements in the quality of the GaN epilayer and device processing technology.

<http://apex.ipap.jp/link?APEX/3/081001>

Author: Mike Cooke

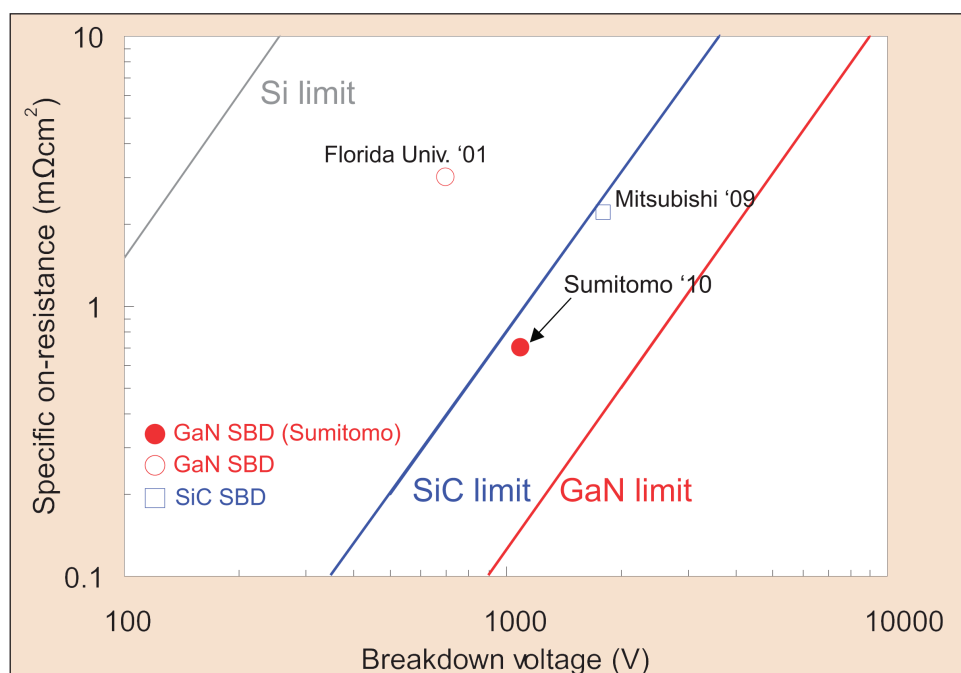


Figure 2. Specific on-resistance versus breakdown voltage for Sumitomo's new GaN SBDs on GaN substrate and previously reported GaN and SiC SBDs.

Microsemi extends SiC RF power transistor range to 2200W for UHF-band pulsed radar applications

Microsemi Corp of Irvine, CA, USA, which designs and makes analog mixed-signal integrated circuits, high-reliability semiconductors and RF subsystems, has launched 2200W peak RF power silicon carbide (SiC) transistor, extending its portfolio of SiC devices for high-power UHF-band pulsed radar applications.

With the new model 0405SC-2200M device, Microsemi says that it supports next-generation UHF pulsed radar designs with a full series of SiC transistor options from 100W, 500W, 1000W, 1500W and now 2200W for both weather and long-range over-the-horizon radar applications.

"This 2200W device results from our long-term commitment to the military and aerospace markets, aggressively investing in SiC technology," says Microsemi RFIS vice president Charles Leader.

"In addition to supporting next-generation UHF designs, we're developing high-pulsed-power SiC transistors for both L-band and S-band radar systems... initial L-band devices are scheduled for demonstration this fall," he adds.

The 0405SC-2200M is a Generation 3 chip in its geometry, materials, processing and packaging. It is designed in a single-ended package for common-gate 2200W Class AB performance at UHF frequencies of 406–450MHz. A hermetically sealed package built with

In addition to supporting next-generation UHF designs, we're developing high-pulsed-power SiC transistors for both L- and S-band radar

100% high-temperature gold metallization and wires provides highest reliability and improved system yields, claims Microsemi. Its SiC design provides high power in what is claimed to be the industry's smallest transistor and circuit size for the specified frequency range.

Typical power gain is greater than 8dB, drain efficiency is 55% at 450MHz, and typical compression is 1.0dB. Additional system benefits include simplified impedance matching, a high 125V operating voltage (drastically reducing power supply size and dc current demand), low conducting current (minimizing system noise), and what is claimed to be the industry's highest peak power for reduced system power combining (4-way combination yields 8kW with margin).

www.microsemi.com

USAF awards GE \$7m to demo SiC-switched solid-state primary power distribution technology

GE Aviation of Oshkosh, WI, USA (an operating unit of GE that provides jet engines, components and integrated systems for commercial and military aircraft) has announced an R&D contract worth more than \$7m to provide the first solid-state primary power distribution technology using silicon carbide (SiC) power switches applicable to the latest and future US Air Force platforms. The contracting office is Wright-Patterson Air Force Base, Air Force Research Laboratories in Ohio.

"Solid-state switching is critical to the smart-grid concept of intelligent power management, control and protection," says Austin Schaffter, vice president, Electrical Power Systems for GE Aviation. "This is a critical win and proves that the technologies and products that we are investing in are at the cutting

edge of the industry," he adds. "Aircraft electrical power system designs and architectures are rapidly evolving toward higher degrees of both intelligence and fast control, and the SSEDU is a critical technology step in that evolutionary path."

An electrical distribution unit (EDU) is the first or primary power distribution point on an aircraft after the generators create the electrical power, and historically that initial power distribution has been accomplished by relatively slow electro-mechanical contactors.

Evidence is growing rapidly that more electric aircraft need fast, intelligent switching at the primary distribution point

However, evidence is growing rapidly that more electric aircraft need fast, intelligent switching at the primary distribution point in order to manage both peak power and regenerative energy absorption, as well as to perform system protections within as little as 1 millisecond.

Accomplishing high-power switching this fast is possible with emerging SiC devices such as those being designed and developed at GE's Global Research Center (GRC) in Niskayuna, NY, the firm says.

The project includes the design, development, fabrication, test and shipment of a prototype solid-state electrical distribution unit, and will be executed within GE's advanced engineering group's facilities at the Vandalia, Ohio and Cheltenham, UK.

www.ge.com/aviation

First direct bonding of SiC–Si and GaN–Si at room temperature

Mitsubishi Heavy Industries aims to speed production, cut costs and expand applications

Tokyo-based machinery maker Mitsubishi Heavy Industries Ltd (MHI) claims that it has achieved the world's first direct bonding of both silicon carbide (SiC) and gallium nitride (GaN) with silicon (Si), respectively, at room temperature. The company has also achieved direct bonding of sapphire with Si at room temperature.

Realized by an MHI-developed room-temperature wafer bonding machine that enables highly efficient, high-quality bonding of these materials, the firm reckons that the achievement opens up possibilities for various applications, as well as facilitating new device development while also enhancing productivity. Leveraging its Mitsubishi Bonding Support Program (MBSP), which supports users' room-temperature wafer bonding manufacturing and product development activities, MHI aims to expand applications of room-temperature bonding to new fields.

MHI's bonding machine uses a method to bond atoms of various materials at room temperature by activating the surface of the materials with ion beam radiation in a vacuum. It can bond various materials, for which optimized ion beam radiation (set according to the characteristics of each material) is a critical factor. Room-temperature bonding of SiC, GaN and sapphire, respectively, with silicon was achieved through optimized precise ion radiation. For all three materials, solid and rigid bonding has been confirmed.

Due to its high-voltage durability and suitability for high-speed and high-efficiency switching, SiC has been in the spotlight for applications for next-generation power semiconductor devices, including as a component of inverters for electric vehicles (EV). The application of GaN for blue LEDs, as well as high-frequency and low-loss



Room-temperature wafer bonding machine.

power devices, has also been growing. Sapphire, which is growing in use as a material in optical devices, can also be used as a substrate for high-frequency circuits when bonded with silicon to produce silicon on sapphire (SOS).

By eliminating the heating process required in conventional heated bonding processes, room-temperature bonding not only frees devices from heat stress and strain, enabling rigid and highly reliable bonding, but also significantly reduces the processing time that previously included a heating/cooling cycle, says MHI. With these advantages significantly shortening production time and enabling a higher yield ratio, room-temperature bonding can realize reductions in device production costs, reckons MHI.

MBSP is a program to support users of MHI's room-temperature bonding machine at each stage of development (conceptual design, functional prototype production, trial mass production and mass production). In implementing the program, MHI says that it will use its own engineers and facilities to liaise closely with customers and provide support relating to device bonding and evaluation.

MHI exhibited samples of SiC–Si, GaN–Si and SOS at Micromachine/ MEMS 2010 in Tokyo (28–30 July).

www.mhi.co.jp/en

IN BRIEF

SOITEC president & CEO made chairman of SEMI Europe Advisory Board

San Jose-based global semiconductor industry association SEMI has appointed Dr André-Jacques Auberton-Hervé, president & CEO of SOITEC of Bernin, France — which makes engineered substrates silicon-on-insulator (SOI) wafers and (through its Picogiga International division) III-V epi-wafers — as chairman of the Advisory Board of Brussels-based SEMI Europe. He succeeds Thin Materials AG CEO Dr Franz Richter (chairman for the past year).

"I will continue to carry forward the SEMI message and work with the European Commission as a member of the High Level Group on Key Enabling Technologies," vows Auberton-Hervé. "SEMI Europe works towards concrete results for a competitive playing field in Europe, especially maintaining manufacturing in Europe and allowing member states to contribute to investments in manufacturing equipment." SEMI recognizes that semiconductors are critical to the European economy and welfare and must therefore be prioritized on the EU agenda to keep leading European industries competitive.

"The semiconductor industry is a cornerstone of competitiveness and innovation in Europe, the world's largest business market," says Auberton-Hervé. "We have strategic assets in our clusters of excellence, R&D facilities, suppliers and manufacturers," he adds. "However, to attract new national and international investment and invigorate the manufacturing base, we must streamline funding mechanisms, broaden incentives and facilitate avenues for cooperation."

www.semi.org/europe

IQE's first-half 2010 revenue up 50% year-on-year Smartphone-driven wireless recovery, VCSELs, CPV and silicon epitaxy rebound to continue into second-half/2010

In an interim trading update for first-half 2010, due to stronger-than-expected wireless product sales and rising demand for optoelectronic and silicon-based wafers, epiwafer foundry and substrate maker IQE plc of Cardiff, Wales, UK says that it expects first-half 2010 performance to be significantly ahead of market expectations, with revenue of at least £32.8m (up more than 50% on first-half 2009), earnings before interest, tax, depreciation and amortization (EBITDA) above £5.3m (up 178%, illustrating the group's powerful operational leverage), and retained profit of more than £2m.

First-half growth was driven by good recovery in the wireless market, with particularly strong demand for smartphones. IQE achieved higher-than-expected sales in the normally weak first quarter, with demand accelerating in Q2 and looking robust for the remainder of the year.

Demand increased strongly for optoelectronic products, particularly IQE's vertical-cavity surface-emitting laser (VCSEL) technology, which it believes will soon play a key

enabling role in a number of high-volume consumer applications. These notably include finger navigation, optical heating, internal interconnectors and external optical connectors such as active optical cables (AOCs) and Intel's Light Peak technology, which will provide data transfer speeds 10–200 times faster than existing connectors such as USB cables.

In addition, demand continues to grow strongly for wafers to create energy-efficient products such as concentrator photovoltaics (CPV) based on compound semiconductors as well as light-emitting devices based on gallium nitride, with notable milestones achieved in bringing both these products to mass markets.

First-half performance was boosted by a return to growth for IQE's silicon-based epitaxy services for electronic products, with a high level of interest in new products such as germanium on insulator (GeOI), launched in 2009, and silicon on sapphire (SOS).

IQE says that the outlook for second-half 2010 remains positive, with the board expecting continued

strength in sales volumes driven by increasing demand for smartphones and high-speed wireless technology, as well as for consumer optoelectronic devices. Demand-driven growth is being reinforced by an increasing trend towards outsourcing across all the market sectors in which IQE operates.

"Strong growth has returned in IQE's key markets, with higher-than-expected sales of smartphone products in Q1/10 and accelerating growth for optoelectronic products and silicon-based epiwafers for innovative consumer technologies," says chief executive Dr Drew Nelson. "In addition, demand for energy-efficient third-generation CPV solar products and solid-state lighting (SSL) devices continues to grow strongly," he adds.

The group's operationally geared model has translated strong revenue growth into even stronger growth in profits, and the board remains confident of strong demand for IQE's products in second-half 2010, Nelson concludes.

IQE expects to report its interim results on 1 September.

www.iqep.com

Bath University graduates receive awards for optoelectronics

IQE sponsored final-year prizes awarded to engineering graduates as part of July's graduation ceremony at the UK's University of Bath.

The winners were:

- James Berry — best final-year project in optoelectronics/optical communications;
- Alexis Petrides — best final-year project in the area of sensors; and
- Talini Pinto Jayawardena and Abulquadir Baruwa (jointly) — best examination result in optical devices and communications systems.

All prize winners earned first-class Masters of Engineering degrees.



IQE prize giving at University of Bath.

"The Electronic and Engineering Department has a strong presence in the field of optoelectronics, which is emerging as an important

technology for the next generation of consumer and communications devices," said IQE's Chris Meadows on presenting the awards. "The IQE prizes recognize the commitment, knowledge and enthusiasm of entrants that we believe will lead to today's graduates becoming future world-class engineers."

In October 2009, IQE acquired NanoGaN Ltd, a University of Bath spin-off specializing in GaN materials for optoelectronic products.



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IQE demonstrates 40GB/s VCSEL epitaxy for next-generation optical communications

EU program 'VISIT' steps up from 25 to 40GB/s 850nm transmission

Epiwafer foundry and substrate maker IQE plc of Cardiff, Wales, UK has published a joint paper in *Electronic Letters* '40 Gbit/s error-free operation of an oxide-confined 850nm Vertical Cavity Surface Emitting Laser (VCSEL)' reporting the demonstration of its VCSEL materials capability for optical transmission at the high data transfer rates required for applications such as active optical cables (AOCs) and Intel's LightPeak.

Existing copper interconnects between consumer devices such as BluRay DVD and high-definition (HD) TVs are limited to data transfer rates of 0.48GB/s. Furthermore, transmission distances for copper interconnects decrease significantly at higher transmission rates.

The first generation of optical cables is designed to support data transfer

speeds of up to 10GB/s, which is well within the 40GB/s demonstrated by IQE and its partners in the European Union funded program 'Vertically Integrated Systems for Information Transfer' (VISIT).

Other VISIT program members are Intel (Ireland), VI Systems (Germany), Chalmers University of Technology (Sweden), University of Cambridge (UK), University College Cork (Ireland), The Technical University of Berlin (Germany) and the Russian Academy of Sciences (Russia).

In July 2008, IQE's epiwafer material was used to demonstrate 25GB/s VCSEL capability as part of the initial phase of the program. IQE says that the devices demonstrated in this project set a new world record for data transmission at 850nm (the standard wave-

length used for peripheral and LAN optical interconnects).

"IQE has established a clear leadership position in VCSEL technology, which has uniquely positioned the group to exploit its expertise in the next generation of high-speed optical cables to meet the demands of ever increasing data transfer rates for consumer, industrial, automotive and aerospace applications," says product director Andrew Joel.

"High-speed optical interconnects such as Intel's LightPeak are designed to operate at 20 times the speed of today's copper technology and will be scalable to 100GB/s in the coming years," he adds. "In addition to the higher data speeds, optical connectors can be used over significantly longer distances than would be possible with copper based cables."

NanoGaN granted patents for nanocolumn technology

IQE says its gallium nitride substrate subsidiary NanoGaN Ltd has been granted two separate patents in relation to its nanocolumn technology for the production of blue and green lasers and LEDs.

Granted by the Japan Patent Office, patent 2008-549935 ('Growth method using nanostructure compliant layers and HVPE for producing high quality compound semiconductor materials') protects IQE Group's proprietary nanocolumn technology for the production of free-standing GaN substrates, which are critical for manufacturing high-quality blue and green semiconductor lasers and ultra-high-brightness LEDs for solid-state lighting (SSL).

Granted by the UK patent office, patent 2446471 ('Production of semiconductor devices') protects the manufacturing of semiconductor devices (including laser diodes, LEDs and solar cells) directly onto

the nanocolumn platform, expanding the number and type of substrates that can be used for epitaxy.

The production of blue and green semiconductor lasers and ultra-high-brightness LEDs requires stable, high-quality substrates with minimal crystalline defects (such as threading dislocations) to increase yield and hence reduce manufacturing costs. IQE acquired NanoGaN in October 2009 with the aim of helping it complete the development of commercial products and then to transfer the technology to its high-volume production facilities.

The acquisition complemented and enhanced IQE's product portfolio by accelerating its strategic plans in the emerging high-growth markets for advanced laser projection, high-definition optical storage (including BluRay products), high-resolution laser printing, and SSL for industrial, commercial and residential lighting.

It is envisaged that NanoGaN's core technology may also be used to enhance IQE's position in the supply of GaN products for high-power RF applications.

"The granting of these patents covers all of the essential technologies for producing free-standing GaN using our proprietary hydride vapor phase epitaxy (HVPE) process and nanocolumn growth technique," says NanoGaN's founder professor Wang Nang Wang (chief scientific adviser to IQE's board).

"Adding these new patents to our existing portfolios, combined with strong internal practices to protect intellectual property and know-how, plays a vital role in ensuring IQE's position as a global leader in the manufacture and supply of advanced semiconductor wafer products for the wireless, optoelectronic and solar industry sectors," comments IQE's CEO & president Dr Drew Nelson.

www.iqep.com

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Source Materials

Laser

LPE

VPE

InAs

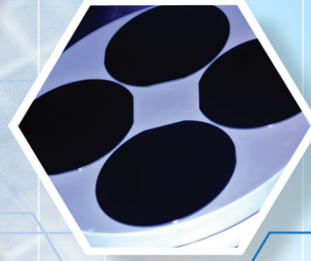
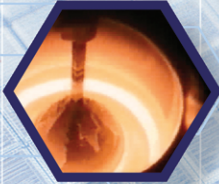


InSb

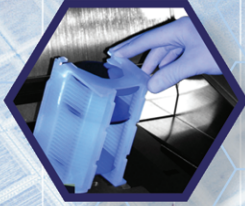


VCSEL

PIN



MOCVD



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APD

Polycrystal

Solar Cell

HBT

InP



Hall Sensor

MBE

GaSb

LED

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5N's profits still down despite further revenue growth Growth driven by CdTe and aided by Firebird acquisition

After completing its 10th year of operation, for fiscal 2010 (to end-May 2010) 5N Plus Inc of Montreal, Quebec, Canada has reported (in Canadian dollars) record revenue of \$70.8m, up 2% on fiscal 2009's \$69.4m. This was boosted by a second consecutive quarter of record sales in Q4 of \$19.7m, up 2.6% on \$19.2m last quarter and 9.3% on \$18.1m a year ago.

5N Plus produces high-purity metals such as tellurium, cadmium, selenium, germanium, indium and antimony, as well as II-VI semiconducting compounds such as cadmium telluride (CdTe), cadmium sulphide (CdS) and indium antimonide (InSb) as precursors for the growth of crystals for applications including infra-red detectors for night-vision systems, radiation detectors for medical imaging, thermoelectric modules for cooling, and thin-film photovoltaic cells for solar panels. The firm is an integrated producer (with both primary and secondary refining) and recycler.

"The quarter and the year proved decisive for our flagship product cadmium telluride as our main customer [First Solar] continued to expand and demonstrate a significant cost advantage over compet-

ing technologies, leading in turn to an increasing demand for our products," says president & CEO Jacques L'Écuyer. "Despite some currency headwinds, we turned in record revenues in fiscal year 2010 and net profit margins exceeded 20% for a third consecutive year as our facility in Germany [subsidiary 5N PV GmbH in Eisenhuttenstadt] operated for the first time throughout the year and contributed accordingly to both our sales and net profits," he adds. "We have also seen a positive contribution from our new subsidiary Firebird Technologies Inc [of Trail, Canada], which turned in positive earnings in both quarters since joining us [last December]." Firebird produces indium antimonide (InSb) wafers as well as antimony, indium and tin pure metals.

Though up on fiscal Q3's \$6.25m, Q4 earnings before interest, taxes,

depreciation and amortization (EBITDA) of \$6.7m were down on \$8.6m a year ago. For fiscal 2010, EBITDA has fallen to \$24.1m from fiscal 2009's \$31.4m.

Cash flow from continuing operating activities was \$6.2m for Q4 (up on \$4.97m a year ago) and \$16.8m for fiscal 2010 (up on fiscal 2009's \$16.24m). During the year, cash and cash equivalents rose from \$65m to \$68m.

"In the year ended, we have laid the foundation for sustainable growth as we made great strides to strengthen our business, leverage our existing facilities and position ourselves to play a larger role in recycling," says L'Écuyer. "We also broadened our product portfolio to include semiconductor wafers, germanium and products for other thin-film photovoltaic technologies as we successfully completed the acquisition of Firebird Technologies," he adds.

During fiscal 2010, the backlog of orders expected to translate into sales over the following 12 months rose only slightly, from \$52.2m to \$52.65m. However, changes in currency exchange rates had an adverse impact of about \$4.3m.

www.5nplus.com

Jordan Valley launches first HR-XRD/XRR SiGe, Si:C and strained Si metrology tool, meeting ITRS production throughput for 45/22nm

X-ray metrology tool maker Jordan Valley Semiconductors Ltd (JVS) of Migdal Haemek Israel has launched the JVX7200, which targets challenging silicon germanium (SiGe) in-line process monitoring.

The system is claimed to be the first production-worthy tool to combine HR-XRD (high-resolution x-ray diffraction) and XRR (x-ray reflectance) technologies for strain, composition and thickness

measurement of SiGe stacks for sub-45nm technology nodes.

"SiGe metrology has traditionally been very slow with only a few measurements per hour, which limits fab productivity," says CEO & president Isaac Mazor. "The new JVX7200 tool addresses the challenge, solving this process bottleneck with more than an order-of-magnitude throughput improvement, thereby reducing

response time to crises," he adds.

The firm claims its new JVX7200 leapfrogs contemporary in-line SiGe metrologies and combines a fast 2D HR-XRD detector for composition and relaxation measurements with an ultra-small-spot, fast XRR detector. The tool is compatible with fully automated modern fabs, and features both a small carbon footprint and a low cost of ownership.

www.jvsemi.com

AXT's profit doubles as revenue rises 25% in Q2 to \$23.2m Wireless and LED demand driving GaAs substrate growth

For second-quarter 2010, AXT Inc of Fremont, CA, USA, which manufactures gallium arsenide, indium phosphide and germanium substrate and raw materials, has reported revenue of \$23.2m, up 25% on \$18.6m last quarter and up 77% on \$13.1m a year ago.

"Demand for gallium arsenide substrates continues to grow at a healthy pace, fueled by strong sales of wireless devices and the increasing worldwide adoption and investment into LED technology in many applications," says CEO Morris Young. Total gallium arsenide (GaAs) substrate revenue was \$16.2m, up 21% on \$13.4m last quarter and up 60% on \$10.1m a year ago. "As a result, we are enjoying solid increases in our sales of semi-insulating and semi-conducting gallium arsenide substrates and strong increases in the sales of

gallium raw material," adds Young. Raw materials sales were \$4.2m, up 56% on \$2.7m last quarter and more than quadruple the \$1m a year ago.

"In addition, the demand for our indium phosphide substrates is also growing, reaching nearly 5% of our total revenues in the second quarter," says Young. InP substrate revenue was \$1.1m, up 26% on \$875,000 last quarter and up 61% on \$684,000 a year ago.

Though up 34% on \$1.22m a year ago, germanium (Ge) substrate revenue of \$1.6m is down slightly from \$1.64m last quarter. However, Young comments that AXT expects to see increasing contribution from germanium substrates in second-half 2010.

Gross margin was 36.8%, up from 36.1% last quarter and almost double the 19.3% a year ago.

Operating expenses have been cut slightly from \$3.8m a year ago and \$3.9m last quarter to \$3.6m. Compared with an operating loss of \$1.3m a year ago, income from operations has risen from \$2.9m last quarter to \$5m.

Compared with a net loss of \$1.3m a year ago, net income has risen from \$2.6m last quarter to \$4.3m. However, including a \$1.2m sales tax refund, net income more than doubled to \$5.5m.

"We believe that the trends fueling growth in all of these areas [GaAs, InP, Ge and raw materials] will create meaningful opportunity for AXT and we are strongly positioned to benefit given our raw material access and attractive cost-structure," says Young.

For Q3/2010, AXT expects revenue to rise about 8% to \$24.7-25.5m.

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Veeco sells Metrology business to Bruker

Firm to focus on LED, solar and data storage process equipment

Veeco Instruments Inc of Plainview, NY, USA has agreed to sell its Metrology business to Bruker Corp of Billerica, MA, USA (a provider of scientific instruments and solutions for molecular and materials research as well as industrial and applied analysis) for \$229m.

The deal has been approved by the board of directors of both firms and is expected to close in fourth-quarter 2010, subject to regulatory review and customary closing conditions. Veeco expects proceeds to be about \$160m (net of tax and transaction fees).

The sale includes Veeco's Atomic Force Microscope (AFM) business in Santa Barbara, CA and its Optical Industrial Metrology (OIM) business in Tucson, AZ, plus its associated global AFM/OIM field sales and support organization. Bruker intends to combine Veeco Metrology with its global Bruker Nano instruments business, which sells systems and analytical solutions for materials and nanotechnology research.

"Veeco expects to benefit from greater focus on and investment in our LED & Solar and Data Storage Process Equipment businesses," says Veeco's CEO John R. Peeler. "The sale of Metrology will allow us to accelerate our progress developing new products, gaining share, and aligning with key customers in markets with large growth opportunities, including several 'clean tech' markets. The sale is also expected to give us additional financial flexibility to pursue acquisitions and expand customer support for our growing Asia business," he adds.

"Veeco Metrology is a great business that is strong, growing and profitable," Peeler continues. "Even so, it lacks meaningful synergies with our Process Equipment businesses in technology, distribution and customers. It will be a better fit as part of a large and successful instrumentation company, such as Bruker, where the focus will be on continued development of innovative scientific instruments," he concludes.

"We are excited to add Veeco's industry-leading scanning probe microscope (SPM) and optical metrology systems to the Bruker product portfolio of high-performance materials research and nanotechnology instruments," says Bruker's president & CEO Frank H. Laukien.

Veeco will account for the Metrology business segment as a 'discontinued operation' effective 15 August. It is therefore updating guidance for third-quarter 2010 revenue from \$290-315m to \$255-280m from continuing operations, with earnings per share of \$1.45-1.72 (\$1.13-1.33 non-GAAP) rather than \$1.55-1.82 (\$1.23-1.43 non-GAAP). Full-year 2010 revenue should now be \$1bn (rather than "over \$1bn"), with about 90% from the LED & Solar business segment (compared with 73% for Q3/2010, and just 54% for full-year 2009).

www.bruker.com

www.veeco.com

China's Elec-Tech selects Veeco MOCVD for new LED fabs

Initial order placed as part of 130-system plan worth \$337.5m

Veeco says that China's Elec-Tech International Co Ltd has selected its TurboDisc K465i MOCVD systems as its 'tool of choice' for two new LED factories in Wuhu and Yangzhou.

Elec-Tech is a Shenzhen-listed electronics firm that earlier this year signed a cooperative agreement with South Korean LED epiwafer and chip maker EpiValley to jointly develop the Chinese LED market.

In August, Veeco booked the initial systems in a large multi-tool order

from subsidiary Elec-Tech Optoelectronic Technology (Wuhu) Co Ltd.

"Our board of directors has approved our plan to purchase 130 MOCVD tools to ramp production capacity at our two LED factories," says Elec-Tech chairman Tony Wang. "Our goal is to become one of the top three LED companies by output and sales revenue in China within two years, focusing mainly on the general lighting and back-light unit market, but on other applications as well."

"We selected Veeco as our preferred and primary supplier for the vast majority of the 130 MOCVD systems," Wang adds. "Veeco's MOCVD systems have low cost-of-ownership and proven high productivity."

"We are extremely pleased that Elec-Tech has chosen Veeco for their production requirements as they build out their aggressive plans in China," comments Bill Miller, executive VP, general manager of Veeco's MOCVD Operations.

In mid-July, SinoCast Daily Business Beat reported that Elec-Tech's two subsidiaries aimed to order 130 MOCVD reactors and accessories (worth \$337.5m): 100 from Veeco (\$255m, at \$2.6m per reactor) to

be shipped in batches by the end of 2011; and 30 from Aixtron (\$83m, at \$2.8m per reactor,) to be shipped by March 2011. Wuhu Elec-Tech Optoelectronic will order 70 Veeco and 30 Aixtron reactors.

Yangzhou Elec-Tech Optoelectronic is to order 30 Veeco reactors.

Elec-Tech is applying for Wuhu and Yangzhou city government subsidies of \$1.2-1.5m per reactor after order downpayments are made.

Riber expects strong H2/2010 to compensate for first half Record order backlog of €16.9m to drive 9% growth in full-year 2010

Riber S.A. of Bezons, France, which manufactures MBE systems as well as evaporation sources and effusion cells, has reported revenue of €1.5m in second-quarter 2010 (about half the €2.9m in Q1). First-half 2010 revenue is €4.4m, down 26% on €5.9m in first-half 2009.

In first-half 2010, Riber delivered just two systems (worth €1.1m) compared to four in first-half 2009 (worth €3.1m). However, not included are two systems worth a total of €4m that were produced but only delivered in second-half 2010 due to contractual timeframes. Also, sales of evaporation sources & cells of €0.5m are half of the €1m of first-half 2009, since this year's delivery schedule is concentrated over the second half of the year. However, revenue from services & accessories grew a record 58%, from €1.7m in first-half 2009 to €2.7m in first-half 2010.

Of total first-half 2010 revenue, 51% came from Europe, 20% from Asia and 30% from North America.

Nevertheless, order backlog is a record €16.9m (up 178% on €6.1m a year ago), giving good visibility for business in second-half 2010. System orders include 10 MBE reactors (two for production and eight for research) worth €13.4m (almost triple the system backlog of just €4.6m a year ago). The cells & accessories backlog is €3.5m (up 130% on €1.5m a year ago). This includes the firm's largest ever effusion cell orders, reflecting Riber's arrival in the fast-growing solar and organic LED sectors.

Full-year 2010 revenue is expected to be about €19m (up 9% on 2009's €17.4m), enabling Riber to confirm its target for growth in profitability.

Riber will announce its earnings for first-half 2010 on 7 September.

Riber sells MBE reactors to two European research institutes

Riber has received orders from two European research institutes: one for a Compact 21 reactor and one for an Epineat reactor.

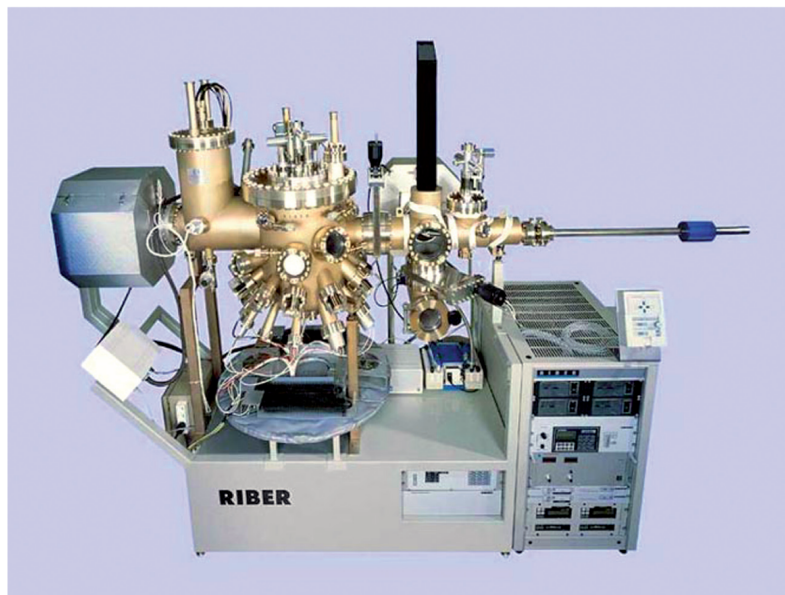
Riber claims that Compact 21 (said to be the world's best-selling MBE research reactor) offers unrivalled flexibility for use in the ultra-vacuum development of compound semiconductors.

The firm adds that Epineat systems represent the most effective solution for the small-scale development or production of compound semiconductor materials on 4" substrates.

www.riber.com

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INNOVATIVE SOLUTIONS FOR SEMICONDUCTOR INDUSTRY

RIBER

Veeco's record Q2 driven by LED & Solar revenues growing 66% from Q1

China's LED industry subsidies spurring strong order quoting

For Q2/2010, epitaxial deposition, process, and metrology equipment maker Veeco Instruments Inc of Plainview, NY, USA has reported record revenue of \$253m (up 55% on \$163.2m last quarter and 250% on just \$72m a year ago).

Of this, 73% came from LED & Solar revenues of \$185.6m (up 66% on \$111.5m last quarter and 482% on just \$31.9m a year ago). About \$175m was for MOCVD, after shipping 81 systems (exceeding the target of 75, and quadruple the shipments of Q3/2009).

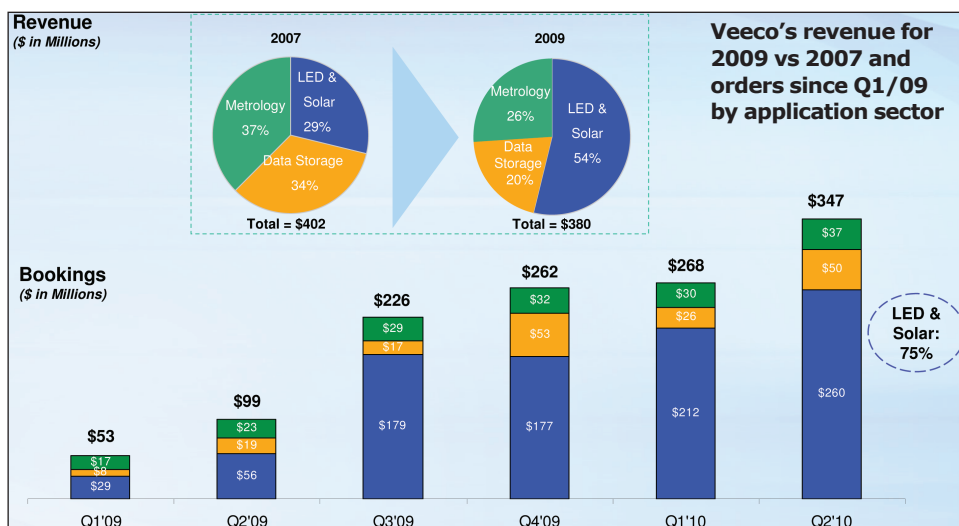
Date Storage was 14% of total revenue (\$35.7m, up 54% on \$23.2m last quarter and 103% on \$17.6m a year ago). Metrology revenue was 13% of total revenue (\$31.7m, up 11% on \$28.5m last quarter and 40% on \$22.5m a year ago).

"All three of our businesses, LED & Solar, Data Storage and Metrology, continue to execute extremely well, with sequential improvements in revenue and EBITA [driven by MOCVD]," says CEO John R. Peeler.

Gross margin has risen from 33.9% a year ago and 43.1% last quarter to 45%. EBITA (earnings before interest, income taxes and amortization) was a record \$68.4m (27% of sales) versus \$32.8m (less than half) last quarter and -\$6.4m a year ago. Compared with a loss of \$14.7m a year ago, net income has doubled from \$26m last quarter to \$52.4m.

During Q2, Veeco generated about \$67m in cash from operations (up from \$42m last quarter). Capital expenditure was about \$5m, mainly for R&D lab tools.

Bookings were a record \$347m (up 30% on \$267.8m last quarter and 250% on just \$98.7m a year ago). Of this, 75% came from record LED & Solar orders of \$260.4m (up 23% on \$211.7m last quarter and 362% on just \$56.3m a year ago). Of this, MOCVD orders were a record \$251m (from 17 customers), with



wins in all regions, including the US, Europe, Taiwan, Japan and Korea, as well as accelerating demand from LED firms expanding facilities in China. Veeco notes a continued customer focus on TV and PC backlighting, as well as general illumination.

At the end of Q2, order backlog was a record \$597m (\$490m LED & Solar; \$78m Data Storage; \$29m Metrology).

"Business conditions in LED remain at a similar pace to what we have experienced the last several quarters, and we believe that Q3 will be another very strong bookings quarter for our MOCVD business," Peeler says. "China's initiative to subsidize the LED industry via seven national 'industrial parks' is spurring strong order quoting patterns for Veeco, both from local companies as well as from Korean and Taiwanese customers that are partnering with Chinese entities," he adds. With customers anticipating continued investment into 2012, Veeco estimates that there is the opportunity for several hundred MOCVD units and more than \$500m in subsidies in 2010-2011. Veeco's TurboDisc K465i MOCVD system (launched in January) is also enabling the firm to continue to win business. The firm reckons that it is capturing more than half of the market in China and Korea, and is gaining traction

in Taiwan and Japan, as well as having a strong position in North America and Europe with lighting industry leaders. LED adoption for certain general lighting applications is happening now, driving MOCVD opportunity significantly larger than backlighting, says Veeco.

Veeco currently plans to increase shipments to about 100 MOCVD reactors in third-quarter 2010 and to reach a production capacity of 120 or more by the fourth quarter. "As a result of our variable-cost, outsourced manufacturing strategy, we have dramatically increased our production capacity, with the ability to flex our actual MOCVD shipments up or down each quarter depending upon specific customer demand and delivery requirements," Peeler adds. In addition, next-generation product development in MOCVD is continuing on an accelerated timeline, he adds.

For Q3, Veeco expects revenue to grow 15-25% to \$290-315m and gross margin to rise to 46-47%.

"Based upon Veeco's strong backlog and current order visibility, the company is currently forecasting that 2010 revenues will be over \$1bn, with strong year-over-year growth from 2009 in revenue and profitability in all three business segments," concludes Peeler.

www.veeco.com

Neo-Neon orders its first Veeco K465i

In Q2/2010 Neo-Neon Holdings Ltd, a vertically integrated LED lighting maker listed on the Hong Kong stock exchange, ordered its first Veeco TurboDisc K465i MOCVD system to support the LED manufacturing capacity ramp at its plant in JiangMen, China.

"Neo-Neon is a recognized LED industry leader with a diversified product range and broad customer base," comments Bill Miller Ph.D., senior VP, general manager of Veeco's MOCVD Operations.

Founded in Taiwan in 1978 as Neo-Neon International Ltd, the firm is one of the world's largest seasonal decorative lighting manufacturers. In 1989 it moved its production to He Shan, Guangdong province on the Chinese mainland and in 2006 it made an initial public offering on the Hong Kong stock exchange.

Neo-Neon recently raised NT\$2.1bn (US\$64m) through a share issue in Taiwan to fund expansion of its LED chip plant in mainland China, supplementing its integrated manufacturing capability for LED lighting (which is already supported by the firm's in-house LED packaging, encapsulation and lighting fixture lines).

"Neo-Neon plans to expand our LED wafer output seven-fold over the next three years," says chief technology officer Dr Jurgen Yeh. "We have decided to include Veeco's K465i MOCVD system in our plans due to its proven high productivity as well as the recent uniformity and repeatability advances that Veeco has achieved," he adds. "We intend to move quickly to expand our position in the general illumination market, and require supplier partners that can keep pace with our plans."

www.neo-neon.com

Reactors shipped for Invenlux's China LED factory ramp

Veeco has shipped multiple Turbo-Disc K-Series GaN MOCVD systems to US-based LED maker Invenlux Corp to support the capacity ramp-up at its plant in Haiyan City, China.

"Invenlux has a history of producing reliable and efficient blue and green LEDs for LCD backlighting, traffic lights, full-color displays, and general illumination," Invenlux's CEO Chris Yan. "We continue to select Veeco as our supplier of choice for our LED capacity ramp because we believe their MOCVD tools provide a proven advantage in productivity, and a lower cost of ownership when compared to competitive systems," he adds.

"We are pleased to be Invenlux's chosen MOCVD supplier as they expand production of LEDs, and look forward to supporting their growth strategy," says Bill Miller, senior VP, general manager of Veeco's MOCVD operations.

www.invenlux.com

Epilight orders reactors for Shanghai LED fab ramp-up

In Q2/2010 Shanghai Epilight Technology Co Ltd placed a multi-tool order for Veeco TurboDisc K465i MOCVD reactors for the capacity expansion at its HB-LED chip fab.

"We selected Veeco's K465i MOCVD system because of its excellent system design and the good performance in the field," comments president Wendi Liu. "Given the increased demand for LEDs in such applications as general illumination, TV backlight and outdoor displays, we intend to ramp our production quickly. With a business partner like Veeco, we are confident we can meet the market demand."

"The China market will drive significant advancement of the LED industry, and Veeco, as the market-leading equipment provider in China, is well positioned to benefit from this growth," reckons Bill Miller, executive VP, general manager of Veeco's MOCVD operations.

www.epilight.com.cn/en

IN BRIEF

Arima buys Veeco MOCVD systems for production ramp

In Q2/2010 Taiwan-based LED epiwafer and chips maker Arima Optoelectronics Corp (AOC) bought multiple Veeco TurboDisc K465i GaN and E475 As/P MOCVD systems.

"We have selected Veeco's MOCVD systems because of our experience with their production-proven reliability and high productivity, which results in higher capital efficiency," says Arima Optoelectronics' president Marco Kuo. "Most of the systems will be installed in Shanxi Province, northern China, where we have entered into an agreement with the local government to form a new joint venture company to manufacture LEDs for backlight applications," he adds.

According to a report in Digitimes last December, AOC is investing US\$17.6m for a 40% stake in the joint venture plant but will receive US\$39.6m for providing technical know-how and services in the establishment of production lines and subsequent production.

"We are pleased to expand our long-standing relationship with Arima, and to be chosen to support their production ramp," says Bill Miller, general manager of Veeco's MOCVD operations.

With what is said to be superior wavelength uniformity and run-to-run repeatability, Veeco says that the production-proven K465i extends its capital efficiency (the number of good wafers per day for each capital dollar) for high-volume LED makers, and provides ease-of-tuning for fast process optimization on wafer sizes up to 8 inches and fast tool recovery time after maintenance. The E475 is engineered for high-volume production of red, orange and yellow HB-LEDs, the firm adds.

www.aocapi.com.tw

Aixtron grows 24% in Q2, as order backlog hits €250m 2010 revenue guidance raised again, from €650–700m to €750m

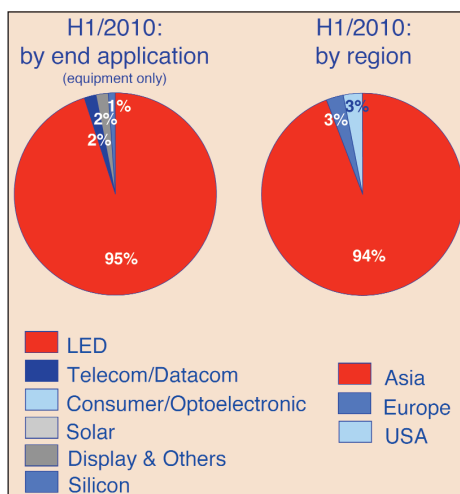
For second-quarter 2010, deposition equipment maker Aixtron AG of Aachen-Herzogenrath, Germany has reported revenue of €191.8m (up 24% on Q1's €154.5m and 238% on just €56.7m a year ago). Growth is supported by ongoing high system demand, fueled mainly by high-brightness LED backlighting and lighting applications, as well as being positively influenced by the stronger US dollar. This boosted first-half 2010 revenue to €346.3m (up 237% on €102.9m in H1/2009).

"We are unquestionably enjoying a very healthy period of growth, mainly driven by the current and anticipated demand coming from higher LED penetration and emerging LED applications," comments president & CEO Paul Hyland.

Quarterly gross margin continues to rise significantly, from 41% a year ago and 50% in Q1 to 55% in Q2. This boosted margin for H1/2010 to 53%, up from 43% in H1/2009.

Earnings before interest and taxes (EBIT) operating profit has risen from €4.7m (8% margin) a year ago and €46.4m (30% margin) in Q1 to €60.6m (32% margin) in Q2 (the fourth sequential rise in EBIT). This has driven first-half EBIT operating profit from just €12.3m (12% margin) in H1/2009 to €106.9m (31% margin) in H1/2010.

Quarterly net income has risen from just €3.3m a year ago and €31.8m in Q1/2010 to €42.3m in Q2. Half-year



Revenue by application and region.

net income has risen from €8.8m in H1/2009 to €74.1m in H1/2010.

"A combination of the positive volume and performance effect the backlighting applications have had on LED industry yields and efficiencies and the sustained government subsidies we are now seeing are creating tangible momentum in the development of solid-state lighting," Hyland says. "This is an early and very encouraging development."

Quarterly equipment orders continued to rise, to €175.4m in Q2 (up 4% on €168.5m in Q1/2010 and tripling from €57.8m a year ago), continuing the strong demand trend predicted previously. First-half orders have risen 286% from €89.1m in H1/2009 to €343.9m in H1/2010. Of this, about 8% of LED system orders were for new-generation tools

(e.g. the 56x2"-wafer capacity AIX G5 and 55x2"-wafer capacity CRIUS II), launched in Q1/2010.

Order backlog has risen to €250m (up 9% on €229.9m at the end of Q1/2010 and up 129% on €109.4m at the end of H1/2009).

Reflecting the healthy climate and recent positive USD/EUR exchange rate development, Aixtron's executive board has again raised its full-year 2010 guidance for revenue to €750m (up on April's guidance of €650–700m and March's guidance of €600–650m) and for EBIT margin to 33% (up on April's guidance of 30% and March's guidance of 25%).

"The macro perspective is that the industry is clearly moving from a technical niche market to a more sustainable and larger commodity market, and this development is already having a corresponding effect on the expectations of customers who are demanding better-performing products with better cost of ownership, which in turn is driving shorter product cycles and, for us, increased R&D investments," says Hyland. "We are, I believe, fully prepared and ready at Aixtron for the type of exciting opportunities we will see emerging over the next 3 to 5 years," he concludes.

To meet rising demand, Aixtron is currently increasing its manufacturing capacity, on target for 150 systems per quarter by the end of 2010.

www.aixtron.com

Aixtron moves into new South Taiwan Office in Tainan

Aixtron has moved its South Taiwan Office into its new facilities in Tainan Tree Valley, next to the Tainan Science Based Industrial Park.

With the MOCVD system installation base in Southern Taiwan expanding continuously, the firm's team in Tainan has been growing since it was established in 2005. The new office is part of Hsinchu-based Aixtron Taiwan Co Ltd, pro-

viding facilities for engineers, with permanent access to the Aixtron infrastructure, as well as conferencing facilities for internal and customer meetings. Aixtron says that the proximity of the new office to customers ensures responsive local process and engineering support in South Taiwan.

"We have established a very knowledgeable and experienced

team of service and process engineers in Tainan headed by our customer support supervisor Kevin Hsiao," says Dr Christian Geng, Aixtron's VP of Greater China & general manager of Aixtron Taiwan. "Our new facilities in Tainan however, mark an important step. This will allow us to further enhance managing our service to our South Taiwan based customers."

China's Sanan orders multiple CRIUS II and AIX G5 MOCVD reactors

Aixtron is to supply a double-digit number of CRIUS II and AIX G5 MOCVD reactors to Sanan Optoelectronics Co Ltd of Xiamen, China, for delivery between Q4/2010 and Q1/2011 at Sanan's new plant in Wuhu, Anhui province.

Earlier this year Sanan announced plans to invest in China's largest LED manufacturing and research center, capable of operating up to 200 MOCVD systems. Sanan is one of the largest manufacturers of full-color LEDs in China. The firm makes ultra-high-brightness (UHB) LEDs, epitaxial wafers, photodiode detectors, and compound solar cells.

Previously, in July Aixtron said that at the end of 2009 Sanan placed an order for multiple CRIUS MOCVD tools (in 31x2"-wafer configuration) commissioned by Aixtron's local support team in first-half 2010 for GaN HB-LED production at Sanan's new facility in Tianjin.

"We have begun a major expansion with our new facility in Tianjin," says Sanan's CEO Simon Lin. "Working closely with Aixtron's support team, we will be able to quickly ramp up HB GaN LED epiwafer production in response to strong market demand."

"Ever since the foundation of Sanan Optoelectronics we have been cooperating successfully with Aixtron, using both their CCS and Planetary Reactor technologies in our facilities in Xiamen and Tianjin," says Lin. "The new technology advantages on both product platforms [CRIUS II and AIX G5 HT] are focusing on our needs with respect to tool productivity and cost of ownership. Aixtron's technology roadmap is directly supporting our roadmap for being competitive in the ever-tighter LED market," he adds. "Sanan is currently setting the pace within the China LED market," comments Aixtron's VP sales Dr Bastian Marheineke.

"Both the AIX G5 Planetary Reactor and the CRIUS II CCS system represent a quantum leap in MOCVD technology, with drastically improved productivity, reduced maintenance requirements and significantly reduced overall cost of ownership," adds Marheineke. "Since our official launch mid-February this year, many customers worldwide have placed multiple orders for both platforms."

<http://sanan-e.com/en/index.aspx>

Yangzhou Longyao ramps GaN HB-LED epi production with CRIUS systems

Aixtron says that at the end of 2009 it received an order for multiple additional CRIUS MOCVD reactors from LED maker Yangzhou Longyao of Yangzhou, China (a subsidiary of long-time Aixtron customer Rainbow Optoelectronics Material Shanghai Co Ltd). The systems are being delivered in 31x2"-wafer configuration and commissioned in second-half 2010.

Aixtron has been chosen as the exclusive supplier for Rainbow's large-scale plan to meet the challenges of improved LED performance via its ongoing project 'Deo Light' which, in collaboration

with professor Shuji Nakamura's lab at University of California Santa Barbara, focuses on further technical development of blue, green and white LEDs and blue lasers.

"The order was placed with Aixtron as they will be continuing to help with our forthcoming capacity increase," says Longyao's general manager Dr Alan Li. "In only a couple of years we have seen great acceptance for our range of GaN HB-LED epiwafer products, so now we quickly have to ramp up more production in order to meet demand," adds Li.

www.rainbowled.cn/enindex.asp

Silan ramps GaN UHB-LED wafer production with six Aixtron CRIUS II systems

Deposition equipment maker Aixtron AG of Aachen-Herzogenrath, Germany says that in Q2/2010 Hangzhou Silan Microelectronics Co Ltd of Hangzhou, China ordered six CRIUS II MOCVD systems (in 55x2"-wafer configuration), for delivery in Q4/2010 and Q1/2011 for volume production of GaN ultra-high brightness (UHB) blue/green LEDs.

Silan plans a major capacity increase for nitride LED wafers, says Jiang Zhongyong, general manager Silan Azure. "[Aixtron's] new-generation CRIUS II systems have demonstrated major improvements such as higher growth rates, high-pressure growth and the more than doubling of productivity," he adds.

The local AIXTRON support team will commission the new reactors. "Aixtron's next-generation CRIUS II Close Coupled Showerhead (CCS) system offers customers fastest time to production and minimized maintenance based on proven technology," claims Tony Pearce, managing director of Aixtron Ltd. "The CRIUS II will be delivered with the ARGUS multi-channel pyrometer, allowing real-time surface temperature measurement and analysis that enables it to monitor the thermometric distribution across the whole of the MOCVD growth surface in the CCS system."

Silan Microelectronics is engaged primarily in the development and manufacture of ICs, LED products, and other electronic components. Its main products are digital audio and video ICs, power management ICs, LED drivers, and DC motor drivers. The firm distributes its products principally in Zhejiang province, China.

www.silan.com.cn

IN BRIEF

MOCVD equipment maker EMF enters receivership: business and assets offered for sale

The business and assets of metal-organic chemical vapor deposition (MOCVD) equipment maker EMF Semiconductor Systems Ltd of Mitchelstown, County Cork, Ireland are being offered for sale after the firm entered receivership.

Assets include: a leasehold facility covering about 23,000 square feet (including a 2000 square-foot cleanroom), with excellent links to Cork, Dublin and Limerick; an extensive IP portfolio of MOCVD tool design, including patented Vectored-Flow Epitaxy (VFE) technology, ammonia pre-cracker, metallorganic vapor rate monitor and ammonia catalytic waste-treatment system; a production tool under development; and gas cabinets, vacuum pumps, wet stations and various industry standard spares available.

Originally founded in 1991 as EMF Ltd in Cambridge, UK, EMF has a history stretching back about 20 years in manufacturing custom, R&D and production MOCVD reactors for a wide range of compound semiconductors including III-nitrides, zinc oxide (ZnO), silicon carbide (SiC) and narrow-bandgap materials.

Expressions of interest were requested by 13 August to receiver and manager Barry Forrest of UHY Farrelly Dawe White Corporate Recovery Specialists, 3C Dunshaughlin Business Park, Dunshaughlin, County Meath, Ireland.

Tel: +353 1 8024217,
Fax: +353 1 8024216,
E-mail barry@forrestco.ie.

www.emfsemi.com

Plasma-Therm deposition systems for Stanford Nanofabrication Facility

Plasma process equipment maker Plasma-Therm LLC of St Petersburg, FL, USA says Stanford University has recently placed an order for two deposition tools (a VERSALINE HDPCVD system and a Shuttlelock PECVD system) to be installed at Stanford's Nanofabrication Facility.

With its high-density ICP plasma and temperature-controlled environment, the VERSALINE HDPCVD system expands research capabilities by providing critical technology to deposit high-quality dielectric films at low temperatures, says Plasma-Therm. The Shuttlelock PECVD system uses a more traditional configuration of parallel-plate electrodes that contributes fundamental and important deposition processes such as controllable low-stress silicon nitride. Together, the systems will be used to assist the Nanofabrication Facility's research efforts in areas such as nanoelectronic devices, MEMS/NEMS and photonics.

"Deposition processes from industry-proven systems like VERSALINE and Shuttlelock will give researchers at the Nanofabrication Facility the tools necessary to make advances

in nanoscience applications," states Plasma-Therm's executive VP of sales & marketing Ed Ostan.

"Plasma-Therm's worldwide presence at nanofabrication facilities with processing equipment that spans decades is a reflection of equipment durability, reliability and technological relevance," he says. "Our continuous involvement and collaboration with these advanced laboratories is what stimulates process and equipment development."

Stanford Nanofabrication Facility (SNF) serves academic, industrial and governmental researchers across the USA in areas ranging from optics, MEMS, biology, and chemistry, to traditional electronics device fabrication and process characterization. The SNF is a 10,000ft² class 100 cleanroom facility that provides researchers with access to nanofabrication equipment and expertise. The SNF is one of 14 universities comprising the US National Science Foundation's National Nanotechnology Infrastructure Network (NNIN), which is dedicated to providing nanofabrication resources to researchers across the country in both industry and academia.

Plasma-Therm sells VERSALINE PECVD system to wireless component maker

Plasma-Therm says that a leading US wireless component maker is to add a VERSALINE PECVD/HDPCVD system to its manufacturing assembly as it enhances its fab in preparation for the projected ramp up in the wireless industry.

This VERSALINE system is a multi-chamber configuration with a high-density plasma deposition source module and a standard PECVD module. The versatile system is built to handle two independent cassette chambers and up to four process modules. VERSALINE's platform has a foundation that is built to easily manage

composition and stress control and monitor film thickness as well as other characteristics of quality, accurately with repeatable results.

"The flexible configuration options of VERSALINE's platform allow equipment users to find the custom results they demand at a low cost of ownership," says Ed Ostan, executive VP of sales & marketing. "From research laboratories to high-volume production environments, Plasma-Therm stands by our tools and our ability to provide custom solutions to specialty market challenges."

www.plasmatherm.com

Meijo orders Aixtron CCS reactor for GaN-based UV and white LEDs

Aixtron says that earlier this year it received a new order for a Close Coupled Showerhead GaN-based LED MOCVD system from established customer Meijo University in Nagoya, Japan. The system will be delivered in Q4/2010 in 3x2"-wafer configuration and commissioned by the local Aixtron support team.

The order includes both EpiCurveTT and Aixtron ARGUS in-situ tools. The latter is a new multi-channel pyrometer that allows real-time surface temperature measurement and analysis and is the only thermal profiling device available for complete susceptor temperature mapping.

"Meijo University plans to establish the LED Cooperative Research Center to develop white LEDs and UV-LEDs for lighting and bactericidal light sources with super energy-saving, high-color-rendering properties, long life-time and low-cost," says associate professor Dr Motoaki Iwaya. The center has been selected as an advanced research institute, and funded by

Ministry of Economy, Trade and Industry (METI). It will be shared with partner companies for collaboration, including EL-SEED Corp, a start-up venture company from Meijo University, which will conduct a research project at the center for next-generation white LEDs supported by the New Energy and Industrial Technology Development Organization (NEDO).

"We have been very happy with our current system, an AIX 200/4 RF-S," says Iwaya. "Furthermore, Aixtron's proven R&D showerhead systems have demonstrated in the past their great scalability and easy process transfer to showerhead production systems," he adds. "The 3x2" system enables us to easily switch between 2", 3" and 4" wafers, without any major adaption of the process conditions... we are confident that the Aixtron MOCVD system is the best for the challenging task of GaN based LED development."

www.aixtron.com

Aixtron receives first order from Bulgaria

In Q1/2010 Aixtron received an order from the INCOTEX Group (a new customer in Bulgaria) for three mass-production MOCVD systems, for delivery from Q3/2010 onwards for GaN high-brightness LEDs. The local Aixtron Europe support team will commission the reactors at INCOTEX's purpose-built facility.

"The technological leadership of Aixtron comes with a comprehensive Europe-wide service and support network," says INCOTEX Group VP Dr Plamen Dochev. "There is so much interest in LEDs for general lighting, displays, and other markets, thus we are looking forward to receiving the very best process equipment and service," he adds. "This will be of great help to us as we set up the first-of-a-kind manufacturing facility in Bulgaria."

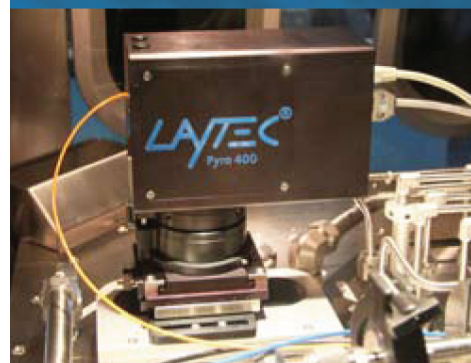
The INCOTEX Holding Company combines a group of firms focused on the development, production and servicing of a wide range of consumer-related electronic products. INCOTEX Ltd was founded in 1992 to produce electronic cash registers, but INCOTEX has since become a multi-disciplinary holding with production in Russia.

"We are pleased to contribute to the expansion of HB-LED technologies in Bulgaria and Russia and are committed to provide full support for INCOTEX growth and expansion," says Dr Frank Schulte, VP of Aixtron Europe. "INCOTEX has the potential to play a leading role in Eastern Europe for LED technology. We are looking forward to a long-lasting cooperation."

www.incotex.com

Real GaN surface temperature

LayTec's groundbreaking new product Pyro 400 finally makes real wafer surface temperature measurements of GaN possible. It offers deep insight into surface temperature changes caused by carrier gas, rotation speed and reactor pressure variations as well as wafer bowing effects. This quantum leap in GaN temperature measurement provides immediate access to emission wavelength variations and thereby provides huge benefit for yield enhancement in future GaN-based LED production.



The Pyro 400 in-situ system can be used in combination with the EpiCurve® TT for simultaneous bowing control.

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SPP Process Technology Systems triples first-half revenue, focusing on emerging micro device sector

SPP Process Technology Systems Ltd (SPTS) has celebrated its first 9 months of positive growth after being formed last October by Japan's Sumitomo Precision Products Co Ltd (SPP) through the merger of plasma etch & deposition equipment subsidiary Surface Technology Systems plc (STS) of Newport, Wales UK with assets acquired from Aviza Technology Inc, including Newport-based Single-Wafer process equipment subsidiary Aviza Technology Ltd (ATL) and Aviza's Scotts Valley-based Thermal Products business.

SPTS says that it has since experienced soaring orders and application wins, with 200% growth in revenue in first-half 2010 compared with the combined results of the separate companies in first-half 2009. More than 80%

of orders were from customers in the high-speed electronics, LED, MEMS, power semiconductor and advanced packaging markets.

"Last October, we set what seemed an ambitious target to double revenue in our first full year of operation," says SPTS' president & CEO William Johnson. Susumu Kaminaga, SPTS chairman & president of SPP, has had long ties to the MEMS industry as well as to the history and origin of STS and ATL. "We are well ahead of our target after a strong first half, thereby revalidating his and SPP's vision and commitment to the micro device industry," Johnson adds.

"SPTS was formed by the merger of two long-time members of the semiconductor community," says Dan Hutcheson, CEO of market

analyst firm VLSI Research. "SPTS is led by a new management that has a clear vision of combining production readiness with leading-edge processes," he comments.

"While a part of the upturn we are seeing relates to the overall rebound in the semiconductor market, we also conclude from market data that SPTS is growing at a rate that outpaces our peers in the capital equipment sector," notes Kevin Crofton, managing director of the UK Division and executive VP of SPTS.

At July's SEMICON West event, SPTS showcased its range of PVD, CVD and etch single-wafer products, and its thermal products support and systems, including vertical furnaces and APCVD systems.

www.spp-pts.com

University of Southampton and Oxford Instruments sign collaboration agreement

UK-based equipment maker Oxford Instruments and the School of Electronics and Computer Science (ECS) at the University of Southampton says they have signed a research-based collaboration agreement.

The university's Southampton Nanofabrication Centre (SNC), operated by the ECS Nano Research Group, has 10 Oxford Instruments systems, including the FlexAL ALD tool, Ionfab300Plus ion beam tool, Plasmalab System400 sputtering tool, Plasmalab System80Plus RIE plasma etch tool, Nanofab1000 nanoscale growth tool, System100 PECVD plasma deposition and System100 ICP380 plasma etch tools. The firm's process engineers will have use of this and selected other equipment at the SNC, which opened last year. Oxford Instruments says that this will in effect expand its research capabilities, and increase the process offering it is able to make to its customers.

In addition, Oxford Instruments is funding a post-doctoral position to work on a collaborative project with the SNC (and other partners) that will build on work funded by the UK Engineering and Physical Sciences Research Council (EPSRC) at the SNC as part of the Nanotechnology Grand Challenges for Healthcare research program. The project will research novel materials and technologies for use as nanowire biosensors. The ultimate aim of both the Oxford Instruments and EPSRC projects is to build a system that can be used as a diagnostic tool for point-of-care applications.

"We are certain the relationship between our two organisations will be mutually beneficial, and our aim is that it will result in a commercial product for use in the life science and healthcare markets," says SNC director professor Peter Ashburn.

"Oxford Instruments has an established relationship with the

University of Southampton, with a substantial range of its equipment already installed in the SNC," says Frazer Anderson, business development director at Oxford Instruments Plasma Technology. "One of Oxford Instruments' key objectives is to pursue responsible development and deeper understanding of the world through science and technology, and this collaboration with such a prestigious research university is just the type of activity that will achieve this end."

Dr Alec Reader, director of the Nanotechnology Knowledge Transfer Network (NanoKTN), was instrumental in facilitating initial discussions between Oxford Instruments and SNC and has strongly encouraged industry-university collaborations of this type. Oxford Instruments is currently involved in discussions with the NanoKTN on ideas for taking this research forward to the next stage.

www.ecs.soton.ac.uk

OEM Group adds AlN film foundry services

OEM Group Inc of Gilbert, AZ, USA, which provides equipment to silicon, MEMS, LED, RFID, power device and photovoltaic device makers, has added foundry services to its offerings. Specifically, it is offering high-quality aluminum nitride (AlN) foundry, performed in its applications lab.

Included in the firm's acquisition in March of the Thin Films and PVD product lines from Tegal Corp of Petaluma, CA, USA, the foundry services use the SFI Endeavor AT PVD (physical vapor deposition) platform to produce piezoelectric AlN films on a variety of wafers from 4-inches to 6-inches in diameter used in surface acoustic wave (SAW), bulk acoustic wave (BAW), FBAR (film bulk acoustic resonator), and micro-electro-mechanical system (MEMS) devices. Equipped with a dual-cathode AC power S-Gun magnetron, the Endeavor AT PVD cluster tool has proven sputter technology that can produce supe-

rior film crystallinity, uniformity, and precise stress adjustment, it is claimed.

OEM Group says that it also participates in customer R&D projects by assisting the optimization of devices and technology as well as developing deposition processes suited for specific customer requirements.

"Performance of AlN-based electro-acoustic devices such as BAW and FBAR filters, oscillators, and resonating sensors is substantially tied to thin-film technology," says PVD process development manager Valeriy Felmetzger. "Reactive magnetron sputtering is a method of choice enabling formation of AlN films with a high degree of c-axis texture and thus a strong piezoelectric response. In mass production, the most important criteria of advanced reactive sputtering are process stability and repeatability of the film properties from run to run, and independent control of the

film properties such as crystal orientation, thickness, uniformity, and stress." The SFI Endeavor AT PVD system suits the deposition of film stack, two-step deposition, or deposition of single AlN films, it is added.

"We have widened our breadth of products and services to move beyond tool manufacturing," says OEM Group president Wayne Jeveli. "Our foundry services are a logical next step given our infrastructure, equipment, and expertise," he adds. "Our foundry service's success is based on the reliable well developed technology we possess and we know customers can trust; careful analysis by our experts of all technical requirements and precise process adjustments to satisfy these requirements; and our professional reputation based on comprehensive hands-on experience in sputtered films technology."






www.oemgroupinc.com

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Veeco launches patterned sapphire substrate surface profiler for automated HB-LED production QA/QC

At the SEMICON West trade show in San Francisco, CA (13–15 July), epitaxial deposition, process, and metrology equipment maker Veeco Instruments Inc of Plainview, NY, USA launched a new ContourGT optical surface profiler configuration optimized for characterizing high-brightness light-emitting diode (HB-LED) patterned sapphire substrates (PSS).

The ContourGT-X8 PSS is a special configuration of Veeco's ContourGT-X8, the flagship of the ContourGT family (which includes a range of profilers designed to meet the requirements and budgets for production and R&D precision surface metrology applications). Specifically, the ContourGT-X8 PSS combines non-contact 3D measurement capabilities with Veeco PSS metrology hardware and software technology, and a wafer automation system developer's kit (SDK) that provides a tailored solution for PSS quality assurance and quality control (QA/QC) applications where high-throughput and repeatability

capabilities are essential.

Sold in conjunction with the ContourGT-X8 Wafer Automation SDK, the ContourGT-X8 PSS features patent-pending PSS metrology hardware and software and TCP/IP-based remote control capabilities. These features, combined with the ContourGT-X8's patented dual HB-LED illumination and continuous calibration, enable the system to be readily integrated with automated wafer handlers to provide optimum PSS measurement precision, throughput and gauge repeatability and reproducibility.

"With the rapid growth of PSS as a vital technology for enhancing efficiency and ensuring color consistency in HB-LEDs, measuring their feature size and consistency on sapphire wafers is becoming a critical step in HB-LED manufacturing," says Mark R. Munch Ph.D., executive VP, Veeco Metrology & Instrumentation. "Now, the ContourGT-X8 PSS gives wafer suppliers and HB-LED device manufacturers an affordable way to obtain

high-throughput, 3D surface metrology to enhance productivity, while assuring the quality of their end products," he adds.

"We have worked closely with PSS wafer suppliers and HB-LED manufacturers to develop the ContourGT-X8 PSS, ensuring that it has the full breadth of capabilities necessary to deliver the required measurements," says Ross Q. Smith, VP & general manager, Veeco Optical Industrial Metrology. In addition, Veeco has teamed with wafer automation providers such as CHAD Industries to develop a flexible automation solution for HB-LED makers. "We expect the ContourGT-X8 PSS to become the industry standard as a simple-to-operate, 7/24, high-performance PSS surface metrology solution," he adds.

At SEMICON West, CHAD Industries and Veeco conducted technology demonstrations of the ContourGT-X8 PSS integrated with a CHAD WaferMate200-2 Workcell.

www.veeco.com/ContourGT

Tiger Optics claims first ammonia analyzer exclusively for high-brightness LED applications

To keep pace with what it describes as explosive growth in the market for high-brightness light-emitting diode (HB-LEDs), at the Semicon West trade show in San Francisco (13–15 July) Tiger Optics LLC of Warrington, PA, USA has launched ALOHA, which it claims is the first ammonia analyzer designed and manufactured exclusively for HB-LED-related applications.

Tiger, which makes laser-based trace gas analyzers, already sells devices to HB-LED makers, tool manufacturers and the gas companies that supply ammonia as a source of nitrogen for the production of gallium nitride (GaN)-based HB-LEDs.

"Since 2004, we've sold almost 100 units in ammonia service around the world," says founder & chief executive Lisa Bergson. "With the surge in demand for HB-LEDs, we realized that we could help our customers by designing an instrument tailored to their specific needs," she adds. "We know that the purer the gas, the brighter the LEDs, and the bigger the margins for LED makers."

Widely used in mobile appliances such as cell phones, cameras, and the Apple iPad, HB-LEDs are quickly gaining favor in larger devices, says Tiger Optics. Demand is surging for the use of HB-LEDs as sources to backlight the LCD units of TV screens and computer monitors.

Indeed, backlight applications are projected to account for 56% of the HB-LED market this year, according to Robert Steele, director of the Optoelectronics Program with market research firm Strategies Unlimited. Steele projects worldwide HB-LED sales to rise 52% from 2009 to \$8.2bn this year.

With its Q1/2010 sales, Tiger Optics surpassed its goals for HB-LEDs by 250%. Spurred by such demand, it has developed the ALOHA analyzer to deliver the compact footprint, sensitivity, robustness, low cost of maintenance, speed of response, and uninterrupted throughput that the HB-LED market demands, it adds.

www.tigeroptics.com

EVG launches first fully automated wafer bonding system for HB-LED manufacturing

Wafer bonding and lithography equipment maker EV Group (EVG) of St. Florian, Austria has introduced the EVG560HBL wafer bonder, which it claims is the industry's first fully automated wafer bonding system for high-brightness light-emitting diode (HB-LED) manufacturing.

The system features a new design for multi-substrate bonding and is capable of throughput rates of what is claimed to be an unprecedented 160 bonds per hour. Based on the EVG500 wafer bonding series, the EVG560HBL is optimized to meet the unique requirements of HB-LED makers, with automation capabilities needed to increase production capacity and yields.

The HB-LED market continues to grow rapidly due to the rising number of applications that can take advantage of the lower energy consumption and other benefits of LEDs, says EVG. According to market research firm Strategies Unlimited, the HB-LED market will grow from \$8.2bn in 2010 to \$20.2bn by 2014, driven mainly by the market for LCD display backlights and lighting applications. To meet this increased demand, HB-LED makers must quickly ramp up to higher production capacity, as well as optimize their manufacturing processes to ensure high yields, both of which drive the need for automated manufacturing solutions says EVG. This is especially critical for wafer bonding, which is needed to transfer the active LED layer from epitaxial substrates onto carrier wafers with thermal properties better suited for HB-LED devices.

"Leveraging our 30 years of experience in developing wafer bonding solutions for advanced micro-electronics manufacturing, the EVG560HBL is the latest result in our ongoing efforts aimed at

helping HB-LED manufacturers develop more efficient, cost-effective and higher-yielding devices," says EVG's executive technology director Paul Lindner.

The EVG560HBL multi-substrate wafer bonder offers capabilities enabling high-volume HB-LED manufacturing that include:

- high-force capability, in-situ low-force wedge compensation and proprietary compliant layer technologies, ensuring bond uniformity across the entire wafer (essential for high-quality, multi-substrate bonding);
- integrated pre-processing modules for low-temperature metal wafer bonding, enabling higher throughput and providing less thermal stress on the wafer stack (which in turn increases yield);
- warped/bowed wafer handling capability for maneuvering thin and fragile substrates, which minimizes tool downtime and eliminates wafer breakage issues;
- unique bond chamber design, enabling change-out of substrate sizes in less than 30 minutes (increasing tool flexibility and lifetime while enabling easy maintenance and maximized tool uptime);
- cassette-to-cassette operation;
- mechanical wafer-to-wafer alignment;
- SECS II/GEM interface; and
- wafer ID tracking for advanced process control.

* At the SEMICON West event in San Francisco (13–15 July), business development manager Dr Thomas Uhrmann presented 'Wafer-level Packaging for Cost Reduction of High-brightness LEDs' during the Extreme Electronics' Solid-state Lighting session 'More Lumens per Dollar: The Road to More Efficient HB-LED Manufacturing — Progress and Next Challenges in Back-end Manufacturing'.

www.evgroup.com

Mask & bond aligner for R&D

EVG has launched the EVG610 mask and bond aligner, designed for university and research demands for a lower-cost system with greater process versatility.

The EVG610 provides wider access to EVG's core alignment technology platform used throughout its latest mask and bond aligner systems. Designed to offer the flexibility of the EVG620 automated mask and bond aligner, which is targeted for volume production, the EVG610 eliminates costly features, such as automation, which may not be needed in a research facility.

"EV Group has been working with research facilities for 30 years, giving us insight into the unique requirements of smaller-scale university research and production facilities," says EVG's executive technology director Paul Lindner. "We continue to roll out products like the EVG610 to make sure that students and first-time users have access to affordable systems with superior technology features that may not otherwise be available in lower-cost models," he says. "This latest addition is an integral part of our mask aligner and bond aligner product families, and completes our portfolio spanning the entire manufacturing chain — from R&D all the way to full-scale, high-volume production environments."

The new system provides mask alignment technology with the highest overlay accuracy enabling the best possible exposure, while its bond alignment capability offers alignment accuracy that maximizes process windows, both ensuring higher yields. The EVG610 also enables researchers to migrate their processes to volume production.

The EVG610 is a flexible R&D system that can process substrates up to 200mm. It is designed to support a variety of processes such as UV-nanoimprint lithography and fine patterning, wafer bumping and chip-scale packaging for MEMS, IC and compound semiconductor devices.

Metryx sees growth in MEMS, LED and 3D IC applications

Metrology equipment maker Metryx Ltd of Bristol, UK says that over the past six months it has seen a sharp recovery in business, including receiving multiple orders for Mentor mass metrology systems worldwide (both new and repeat business) representing customers expanding the use of Metryx's mass metrology systems in their production lines as well as initial implementations in new applications.

"Recent business successes clearly demonstrate that Metryx is emerging from the global recession in a strong position," says president & CEO Dr Adrian Kiermasz. "We are now seeing established customers starting to invest in additional capacity, with new and potential customers willing to drive their internal capital justification process based on our tools' demonstrated strong return on investment," he adds.

The Mentor can measure any mass change resulting from a process change, with atomic level accuracy suiting both material characterization

and device manufacture process control. The tool monitors the mass of any wafer following a process step to determine — using passive data collection (PDC) and normal distribution analysis — whether it is operating consistently. The ability to quickly and accurately identify any process drift allows the process to be corrected or stopped immediately, saving scrap or preventing yield loss.

Together with customers focused on 300mm front-end of line (FEOL) and back-end of line (BEOL) metallization due to the Mentor's ability to measure thin metals and stacked layers, Metryx says that the tool is also seeing strong interest from emerging markets such as micro-electrical mechanical systems (MEMS), solar, LEDs and 3D interconnect (IC), including through-silicon via (TSV) and wafer bonding applications. In 3D IC, additional processing steps are being added, but with a focus on keeping their cost low, so Mentor's multiple process capability and strong return on investment

(ROI) serves this growing market well, claims the firm.

Other recent activities include implementing mass metrology across process steps in bulk acoustic wave (BAW) device manufacturing. Metryx says that BAW manufacturers can benefit directly from mass metrology because density is an important parameter, and knowledge of the material density shortens the cycle between device design and manufacture.

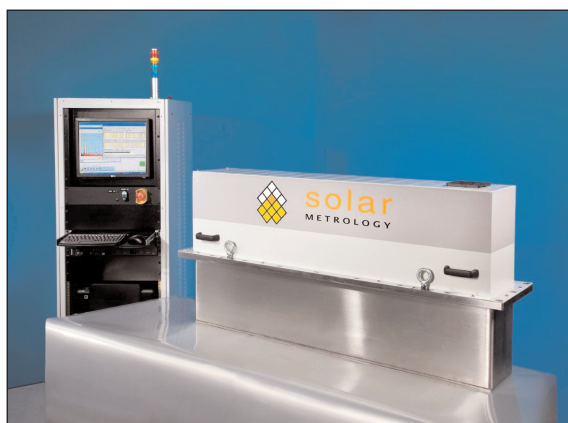
Metryx's DF3 Mentor offers a 300mm configuration that allows maximum benefit from the 60wph (wafer per hour) throughput, providing higher measurement coverage and less risk for a given process. The firm says that the open-cassette OC23 tool is also gaining traction in emerging markets due to its ability to accommodate multiple wafer sizes and thus more potential applications to maximize ROI without compromising measurement capability.

www.metryx.net

Solar Metrology extends in-situ XRF tool portfolio for CIGS PV composition and thickness measurement

X-ray fluorescence (XRF) analysis system maker Solar Metrology of Hollbrook, NY, USA has expanded its SMX XRF tool portfolio for film composition and thickness measurement of copper indium gallium diselenide (CIGS) photovoltaic (PV) deposition with the addition of the System SMX LINEAR ISI.

Solar Metrology says that its SMX metrology tool platform provides a production-ready suite of film thickness and composition measurement tools for research and process development, in-process monitoring and post-process quality control. The firm adds that XRF is an enabling technology for CIGS manufacture, delivering yield management and improvement by allowing in-situ process control.



Solar Metrology's System SMX LINEAR ISI.

The SMX LINEAR ISI in particular provides in-situ cross-web or cross-panel gradient measurement of CIGS composition and thickness for thin-film solar PV metal film stacks on flexible roll-to-roll substrates such as stainless steel,

aluminum and polyimide or rigid substrates such as float glass. Typical measurement applications include molybdenum (Mo) thickness and all CIGS combinations (including all CIG alloys and/or film combinations and final CIGS formulations).

Solar Metrology says that the SMX LINEAR ISI is fast, flexible and can be integrated easily into any vacuum deposition tool or vacuum process station or point of a vacuum process line.

Despite this, the SMX LINEAR ISI platform does not affect the deposition process, since all SMX LINEAR ISI tool components reside outside vacuum, providing optimum performance and serviceability.

www.solarmetrology.com

Nanometrics' record revenue of \$50.8m in Q2/2010 aided by growth in high-brightness LEDs

For second-quarter 2010, Nanometrics Inc of Milpitas, CA, USA (a supplier of process control metrology systems primarily for manufacturing semiconductors, high-brightness LEDs, data storage devices and solar photovoltaics) has reported record revenue of \$50.8m, up 37% on Q1 and 250% on a year ago (and exceeding the prior record by more than 30%).

Service revenue of \$7.4m is down 14% on Q1 but up 12% on a year ago. Product revenue of \$43.4m is up 52% on Q1 and 450% on a year ago.

"The level of revenues reflects our strong position with numerous customers, across several geographic regions and all device types, including logic, DRAM, Flash and high-brightness LEDs," says president & CEO Dr Timothy J. Stultz. In particular, growth accelerated for overlay, integrated metrology and high-brightness LED products, with the latter contributing about two-thirds of the revenue of the materials characterization business (which grew more than 50% in Q2).

Significantly, in Q2, Nanometrics added three countries (Japan, Taiwan and China) as regions that each generated at least 10% of revenue (joining North America and South Korea, which are dominated by Nanometrics' 10%-customers Intel, Samsung and, since Q2, Hynix). This reflects "growing adoption of our products by a broader customer base over expanded geographic regions, and a healthy reduction in revenue concentration".

Gross margin of 55.1% was roughly flat on Q1's 55.3% but up on 41.4% a year ago, due mainly to improved product gross margin, the higher overall sales volume and improved factory absorption.

Compared with a net loss of \$7m a year ago, net income has almost doubled from Q1's \$5.9m to \$11.6m. Cash and equivalents rose by \$9.1m to \$54.9m.

"Our second quarter results are testimony to the progress we have made against the operational and performance objectives we are consistently driving toward, namely:

strengthening the competitiveness of our products to drive key customer wins and strong gross margin performance; improving our predictability by managing to a robust and sustainable business model; and demonstrating the operational leverage, profitability and cash flow ensuing from our greater scale and improved cost structure," says Stultz.

"Our position with leading logic and memory companies, which have been sizeable customers for us since mid-2009, will enable us to continue to benefit from planned capacity expansions, ramping of the next technology nodes and fan-outs of our tool-of-record designations," adds Stultz.

"Our business pipeline is also benefiting from increased spending by other major semiconductor customers as well as contributions from our newer product offerings, which address rapidly-growing segments such as high-brightness LEDs and advanced wafer-scale packaging."

www.nanometrics.com

Jordan Valley and Nikon win 'Best of West' Awards

X-ray metrology tool maker Jordan Valley Semiconductors Ltd (JVS) of Migdal Ha'emek, Israel and Nikon Corp of Tokyo, Japan (whose Nikon Precision subsidiary provides photolithography systems) were the winners of the 'SEMICON Best of West' award at July's SEMICON West 2010 exhibition in San Francisco, based on the products' financial impact on the industry, engineering or scientific achievement, and/or societal impact.

Jordan Valley Semiconductors' winning product is the JVX7200 SiGe metrology tool, which combines high-resolution x-ray diffraction (HRXRD) and x-ray reflectivity (XRR) channels to provide composition, thickness, strain, relaxation charac-

terization and metrology for epitaxial layers such as silicon germanium (SiGe) and silicon carbide (SiC), which are required for strained silicon processes. Also, the XRR channel can provide information on other thin-films, such as those found in high-k gate stacks. The tool is capable of providing rapid, in-line measurements and analysis on both blanket and product wafers.

"Long ago, we had the vision to see the importance of the strained silicon process," says CEO Isaac Mazor. "Our engineers were able to bridge the metrology gap for this process by building the most advanced platform for the most advanced technology available today."

Nikon's award-winning product is the NSR-S620D ultra-high-productivity immersion scanner, which incorporates the Streamlign platform and a 1.35 numerical aperture lens to meet the aggressive demands of double-patterned lithography at 32nm, with extendibility to 22nm applications. The S620D targets 200 wafers per hour, maximizes yield with 2nm overlay and superior CDU (critical dimension uniformity), and enables rapid installation.

The selection of finalists was made by a panel of judges representing a broad spectrum of the microelectronics industry.

www.semiconwest.org/bestofwest

www.jvsemi.com

www.nikonprecision.com

Rubicon's sales grow 37% in Q2 to record \$15.8m

Major LED chip maker signs \$71m deal for 6" substrates

For second-quarter 2010, Rubicon Technology Inc of Franklin Park, IL, USA, which makes monocrystalline sapphire substrates and products for the LED, RFIC, semiconductor and optical industries, has reported record revenue of \$15.8m (far exceeding the forecast \$14m). This is up 37% on Q1's \$11.5m (driven by strong demand from the LED market) and up on just \$3.2m a year ago (which followed the low of \$2.3m in Q1/2009).

In particular, revenue from the LED market rose 46% from Q1's \$9.6m to \$14m, as the adoption of LED back-lighting for medium to large displays (such as LED LCD TVs, desktop monitors and notebook and netbook computers) continues at a rapid pace and general lighting applications for LEDs continue to advance, comments president & CEO Raja Parvez.

The trend among the major LED chip makers towards using larger-diameter substrates continues: only 28% of substrate revenue came from 2-inch material, with 72% coming from greater than 2-inch material (up from 64% in Q1).

"We reduced the volume of 2-inch core sold in order to sell more large-diameter material, particularly 6-inch polished wafers," says chief financial officer Bill Weissman. Revenue from 6-inch polished wafers rose 140% (from \$1.8m in Q1 to \$4.4m), due entirely to the LED market, as several customers make progress on development efforts using 6-inch substrates.

Given that Rubicon has been operating at full capacity in its crystal-growth operation, overall revenue growth came mainly from the shift in product mix and increased average selling prices (ASPs). The firm says the imbalance between sapphire supply and demand for the LED market led to it raising ASP on its substrates (across all diameters) by 16% over Q1 (on top of Q1's 20% rise over Q4/2009).

"We have been ramping our polishing operation in Illinois in response to the demand for 6-inch wafers, and that operation is now close to full utilization," says Weissman.

"We continued to dramatically increase gross margin and earnings per share in the quarter through increased pricing, improved product mix, and operational efficiency," says Parvez. Gross margin has risen from 36% last quarter to 46%. Diluted earnings per share has risen from \$0.07 last quarter to a record \$0.18 (far exceeding the forecast \$0.14).

Cash generated from operations was \$5.6m. However, capital expenditure was \$15.8m (due to purchase of a building in Batavia, IL to house new crystal growth operations plus payment of a significant portion of the construction cost of Rubicon's new Malaysia factory).

"We see an even stronger pricing environment in the third quarter and expect our substrate prices to increase by at least 20% on average sequentially," says Weissman. Together with a continued shift in product mix to large diameters, for Q3/2010 Rubicon hence expects revenue to grow 23% to \$19.5m, gross margin to reach the low 50% range, and diluted earnings per share to rise to \$0.28.

Also, an existing customer (one of the world's leading LED chip makers, it is claimed) is now moving into production using 6-inch substrates (which Rubicon has been supplying to them in significant quantities from its Chicago facility since January). Rubicon has hence now entered into an agreement (worth about \$71m) to supply 6-inch polished substrates from November 2010 (after Rubicon's current purchase order with the firm completes in October) through to the end of 2011. "This is the first LED chip manufacturer to move into volume production on this size material," reckons Parvez. "This continued

migration to larger-diameter substrates by the world's leading chip makers is an important trend for Rubicon, because our high-volume capabilities in both larger-diameter crystal growth and large-diameter wafer polishing uniquely positions us to serve this growing segment of the market," he adds.

"We expect continued strong growth in LED backlighting for the next several years, with LED backlighting for TVs and large displays achieving at least 75% penetration by the end of year 2012," says Parvez. "In addition, LEDs used in general lighting applications continue to develop, with industry reports indicating that LED sales in this market are expected to be up 30% in 2010 over the previous year, with continued strong growth over the next several years," he adds.

"Existing LED chipmakers continue to add significant capacity and there are many new entrants into LED chip manufacturing, particularly in China where local governments are providing subsidies for the purchase of MOCVD reactors."

"We also see significant opportunity in the two other markets we serve, the RFIC market and the optical market. Demand is strong in both," says Parvez. "However, we have limited sapphire to sell into this market at the moment. Margins are higher in LED sales and it is strategically important for us to provide as much material as possible to those LED customers that are leading the effort to move to larger-diameter substrates," he adds. Due to allocation of materials to the LED market, revenues from the optical market and from sapphire-on-silicon (SoS) for the RFIC market in Q2 were hence down slightly on Q1: from \$900,000 to \$800,000 and from \$1m to \$900,000, respectively. "Once our additional capacity begins to come online, we'll be in a better position to take advantage of this growing market as well." ➤

► “Central to our ability to capitalize on these exceptional market opportunities is the successful completion of our expansion plans,” notes Parvez. Rubicon is currently adding two new high-volume manufacturing facilities to expand both crystal-growth and post-crystal-growth capacity. “Our new crystal growth facility in Illinois will house larger furnaces, giving us even greater ability to serve the growing demand for large-diameter substrates,” says Parvez. “Our Asia

facility will significantly expand our capacity to process large-diameter wafers and reduce our current crystal-growth costs.” Both facilities continue to be on schedule to open by year-end, with capacity starting to coming online in Q4/2010 and fully operational by the end of 2011.

In June, Rubicon completed a follow-on share offering that raised \$61.5m (boosting cash and short-term investments to \$94m). The funding will help to finance the remainder of the expansion project

and allow “a smooth transition into the next phase of expansion, when the time comes”, the firm says. “Based on the continued growth of the LED industry and different sectors in it, the supply-demand imbalance will continue for quite some time,” reckons Parvez. “There is such a strong demand from our customer from all regions, from all applications and all diameter sizes that I don’t see any change, at least in the short term.”

www.rubicon-es2.com

Silicon growth equipment maker GT Solar acquires sapphire substrate maker Crystal Systems

GT Solar International Inc of Merrimack, NH, USA, which provides polysilicon production technology, multicrystalline ingot growth furnaces and related photovoltaic manufacturing services, has acquired Crystal Systems Inc of Salem, MA, a crystal growth technology firm that makes large-area sapphire substrates for the LED, defense, medical and aerospace industries.

The deal consists of about \$24m in cash, 5.4 million shares of GT Solar common stock, and a \$21m cash earn-out (based on attaining certain financial and technical targets). Crystal Systems is profitable and expects revenue of \$16m for 2010. The firm should contribute positively to GT Solar’s operating income over the next 18 months, and is expected to be accretive on an EPS basis by fiscal year-end 2012.

“Crystal Systems’ sapphire process knowledge complements our expertise in silicon growth technologies, and we believe this combination will allow us to quickly deliver products that leapfrog sapphire crystallization technology available from other suppliers,” says GT Solar’s president & CEO Tom Gutierrez. “We expect to capitalize on the attractive opportunities we have identified in equipment, LED, and high-tech specialty markets that require high-

quality, low-cost crystalline substrates,” he adds. “Crystal Systems has a rich history of innovation and we believe the combination of their technical expertise supported by our proven global operating experience and available capital resources will accelerate the adoption of new low-cost, high-quality crystalline sapphire solutions.”

Founded in 1971, Crystal Systems specializes in crystal growth technology and supplies sapphire and Ti:sapphire material. The firm leverages its proprietary and complementary crystal growth and process expertise to produce large-sized sapphire products. Founder Fred Schmid, who invented the heat exchanger method (HEM) process, will be joining GT Solar in a senior technical capacity to further accelerate commercialization of the technology.

Industry analysts project that the LED market could grow at a compound annual growth rate (CAGR) of up to 40% over the next several years, driven by rapidly growing sales of products adopting the use of LEDs, such as flat-panel TV and commercial and residential lighting (for which sapphire is the most widely used substrate).

www.gtsolar.com

www.crystalsystems.com

IN BRIEF

Die attach adhesive for LED making

Dow Corning’s Electronics group of Midland, MI, USA has introduced OE-8001 Die Attach Adhesive, a one-part heat-curable methyl silicone resin adhesive for LED manufacturing.

OE-8001 is said to offer better adhesion strength than conventional silicone DA and better thermal stability than conventional epoxy DA. The new adhesive is formulated for good pin transfer, enabling better application process workability and low viscosity change at room temperature for improved handling.

“Dow Corning brand silicone LED materials are designed to meet the challenges of the LED industry, including high adhesion, high purity, moisture resistance, thermal and light stability and optical transmittance,” says Dow Corning Electronics’ global market manager Kaz Maruyama. “Silicones retain optical clarity at elevated temperatures relative to organic materials.”

LEDs made using OE-8001 offer good light transmission due to its translucent appearance, and are durable due to its high modulus retention over a wide range of temperatures, the firm adds.

www.dowcorning.com/led

UCSB optimizes semipolar blue LED active region and p-doping to reach 39.5% external quantum efficiency

University of California Santa Barbara (UCSB) researchers have used semipolar ($10\bar{1}\bar{1}$) nitride semiconductor material to create blue ($\sim 450\text{nm}$ wavelength) LEDs with external quantum efficiencies (EQEs) of 39.5% at a drive current of 20mA [Yuji Zhao et al, Jpn. J. Appl. Phys., vol49 p070206, 2010]. This beats a previous highest EQE of 29% for a comparable blue semipolar ($10\bar{1}\bar{1}$) device.

The use of devices grown in non-polar and semipolar directions reduces or eliminates internal electric polarization fields, and it has been hoped that improved light emission could result when compared with c-plane (0001) devices. These hopes have not been realized due to the difficulty of growing high-quality nitride semiconductor material in these directions. The leading c-plane devices have maximum EQEs of the order of 60%. Nonpolar and semipolar devices have suffered from high densities of threading dislocations and basal plane stacking faults that tend to kill performance.

Improvements in material quality have recently been enabled for these materials by the use of new low-defect-density free-standing gallium nitride bulk substrates. UCSB used free-standing ($10\bar{1}\bar{1}$) GaN substrates from Japan's Mitsubishi Chemical Corp.

The UCSB result was based on an optimization of the MOCVD and of the device structure (Figure 1) in terms of the well width and barrier thicknesses, including the last barrier (LB) of the three-period multi-quantum-well (MQW) active region. The optimum indium gallium nitride (InGaN) well width (undoped) was found to be about 3nm. The optimum for undoped GaN barriers was 17.5nm. The effect of LB thickness was less important

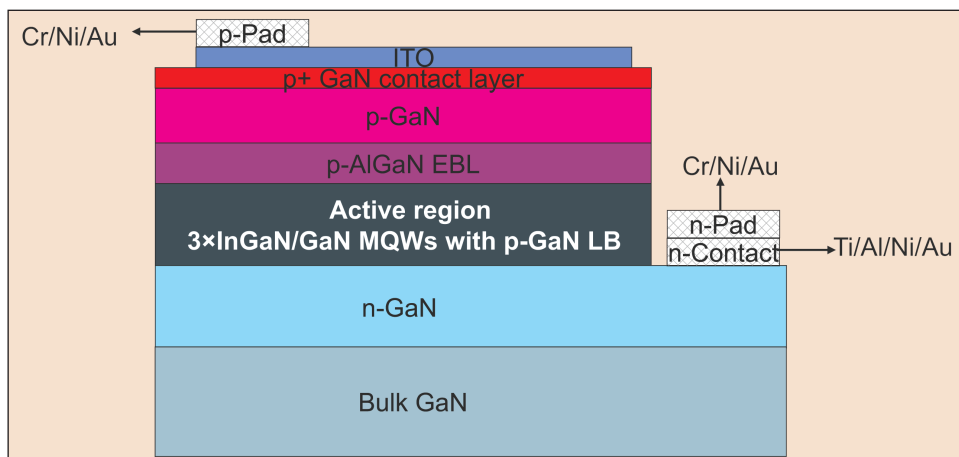


Figure 1. Schematic view of UCSB's semipolar ($10\bar{1}\bar{1}$) LED device structure.

as long as it was between 8nm and 16nm. Increasing the LB to 20nm impacted performance, possibly due to the thicker LBs hindering hole injection into the active region.

Also, the magnesium (Mg) doping used to create the p-contact layer and the last barrier was optimized. The last barrier before the p-contact layers was doped, presumably to ensure that more holes entered the MQW than is usual with undoped last barriers. In some LED structures, it has been found that the holes can be confined to the p-end of the active region, reducing the expected light output from electron-hole recombination. However, it was found that performance was relatively insensitive

to LB doping. The doping of the p^+ -contact layer was more important, with a step-increase in device performance with a flow of about $0.05\mu\text{mole}/\text{min}$ for the bis(cyclopentadienyl)magnesium (Cp_2Mg) Mg source. The researchers report that a systematic study for doping on device performance is under investigation.

The n-GaN contact layer was $1\mu\text{m}$ thick. Silicon was used for n-type doping. A 16nm aluminum gallium nitride (AlGaIn) electron-blocking layer (EBL) was also used to reduce electron overshoot into the p-contact where non-radiative and/or parasitic non-blue emitting recombination occurs.

The optimized UCSB devices did not include any special light extraction techniques, although a new LED structure with improved light extraction efficiency is under investigation with a view to future publication.

The final devices were tested under pulsed operation (1% duty cycle), and the light output power (L) and EQE were determined (Figure 2). The value of L was 22.75mW at 20mA and 110.50mW at 100mA. The EQE at 100mA (38.4%) was slightly down on the 20mA value. Compared with results from previous studies, this is a rather small 'efficiency droop'.

<http://jjap.ipap.jp/link?JJAP/49/070206>
Author: Mike Cooke

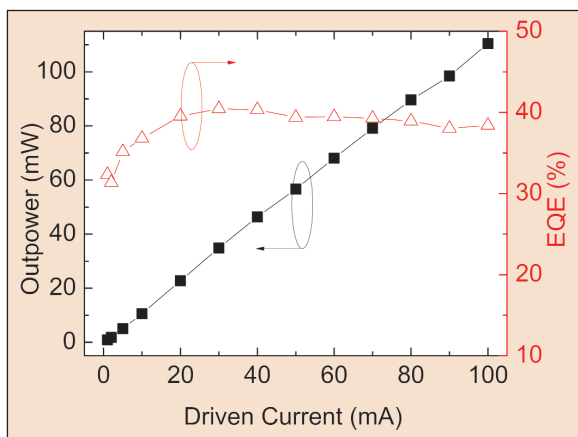


Figure 2. Light output power vs current (L-I) and external quantum efficiency vs current (EQE-I) curves for typical UCSB optimized ($10\bar{1}\bar{1}$) LED under pulsed conditions.

Crystal IS and Asahi Kasei to jointly develop large-diameter AlN substrate

Japanese industrial group makes \$2m strategic investment in UV-LED firm

Crystal IS Inc of Green Island, NY, USA, which makes ultraviolet (UVC) LEDs on aluminum nitride substrates, and Asahi Kasei Corp, the parent company of one of Japan's largest diversified industrial groups (whose electronics business includes semiconductor manufacturer Asahi Kasei Microdevices Corp), have signed a joint development agreement to create a manufacturing process for large-diameter AlN substrates based on Crystal IS' proprietary IP.

Development will take place at the Crystal IS facility, running in parallel with its UVC LED activities.

"AlN substrates are a critical component in the fabrication of UVC LEDs for energy-efficient water and air sterilization applications," says Crystal IS' CEO Dr Steven Berger.

"Building on our intellectual property to develop manufacturable large-diameter substrates is an important step towards high-volume production and long-term growth," he adds.

"After a comprehensive study, we found Crystal IS wafer technology the most advanced and suitable for commercialization," says Masafumi Nakao, who heads Asahi Kasei's development of new business in compound semiconductors. "To reinforce our commitment to Crystal IS and the technology, we are happy to make a \$2m investment in the company as we assess the long-term market potential of these substrates for LEDs and a number of other high-power applications."

www.crystal-is.com

www.asahi-kasei.co.jp/asahi/en/emd

BluGlass commissions fifth-gen tool

BluGlass Ltd of Sydney, Australia has completed design, installation and commissioning of its fifth-generation remote plasma chemical vapor deposition (RPCVD) system, combining features of its prototype third- and fourth-generation tools.

Spun out of Macquarie University's III-nitride department in 2005, BluGlass has developed a low-temperature process using RPCVD to grow materials including GaN and InGaN on glass substrates for the production of LEDs, with what is reckoned to be significant low-cost potential and inherent scalability.

Also, in May 2009, BluGlass said it intended to develop high-efficiency group III-nitride solar cells as another market for its RPCVD technology. Construction of the new tool was enabled as part of the \$4.95m grant awarded in June 2009 under the Commonwealth Government's Climate Ready program for its 'High Efficiency Thin Film Solar Cell Project'.

"Not only is this the most advanced and flexible deposition platform that the company has installed to date, but importantly this new-breed RPCVD machine will enable our technology team to deliver optimal process control and, we believe, high-quality single-crystal material," says chief technology officer Ian Mann.

BluGlass' plant in Silverwater now has an additional 50% nitride deposition capacity onsite, with three RPCVD tools running concurrent programs aimed at optimizing the technology. "This will accelerate the development of RPCVD for commercial applications, in both the company's market streams — LED and photovoltaic (solar)," says Mann.

BluGlass reckons that demonstration of the new system should accelerate its technology roadmap and advance its discussions with potential strategic partners.

www.bluglass.com.au

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IN BRIEF

Digi-Key distributing Bridgelux's LED products worldwide

LED lighting and chip making firm Bridgelux Inc of Livermore, CA, USA has entered into an agreement in which electronic components distributor Digi-Key Corp of Thief River Falls, MN, USA will distribute its products to customers worldwide (available now via Digi-Key's global websites, and to be featured in future print and online catalogs).

The agreement gives Digi-Key's customers access to Bridgelux's entire portfolio of LED array products, including neutral-white color temperature (4100K) LED arrays (launched last month).

Bridgelux offers solid-state light sources delivering 240 to 4500 'hot' lumens across a broad range of color temperatures. The portfolio of UL-recognized arrays provides wide-ranging options for developing replacement lamps and luminaires for a market rapidly transitioning to energy-efficient lighting, the firm adds.

"The demands of an emerging customer base vary greatly between discrete HB-LEDs, arrays to fully turn-key solutions," says Dave Doherty, Digi-Key's VP of semiconductor product.

"Digi-Key's exceptionally broad range of products and its world-class customer service have made it an industry leader," comments Bridgelux's VP of worldwide sales Dave Barnby. "We are impressed with Digi-Key's Lighting Solutions Technology Zone approach, consolidating solid-state lighting products on their website, simplifying component selection for lamp and luminaire design engineers."

www.digikey.com
www.bridgelux.com

Yields critical for LED chipmakers as material shortages persist Focus shifting to more profitable high-power LED chips

With continuing supply shortages, prices for metalorganic gases have doubled in third-quarter 2010, putting pressure on LED chipmakers to improve yield rates to maintain gross margins, according to a report by Taiwan-based publication Digitimes.

Some LED chipmakers are reportedly planning to shut down older equipment producing low-brightness LED chips in order to use the limited materials on more advanced equipment that is manufacturing more profitable high-power LED chips.

According to Taiwan-based LED chipmaker Tekcore, manufacturers

with yields less than 60% are likely to incur losses, with both metal-organic gases and sapphire substrates in tight supply. Companies that focus on producing less profitable LEDs with luminous intensities of less than 2000mcd (the minimum for most LED-backlit LCD TVs) will also have a tough time in the near future, Tekcore adds.

Metalorganic gases and sapphire substrates account for about 20% of LED chip production costs, and the percentage is likely to rise during second-half 2010, according to the report.

www.digitimes.com

Praxair to supply Bridgelux with ammonia and high-purity hydrogen

Praxair Electronics (a division of gas company Praxair Inc of Danbury, CT, USA) has been selected by solid-state lighting firm Bridgelux Inc to supply its LED design and manufacturing center in Livermore, CA with ammonia and high-purity hydrogen.

Praxair has installed its ammonia-delivery system, equipped with SureFlow control technology and a patented heat-control design, at Bridgelux's Livermore facility. Bridgelux chose Praxair's 10-metric-ton ISO container, configured for vapor-phase delivery of the ammonia, which is inherently safer to operate than liquid draw systems, says Praxair. The high-capacity bulk system can deliver sustained ammonia flow rates of more than 2000 standard liters per minute, with a peak flow capacity over 3000slm.

Praxair says that its system features full equipment monitoring to ensure reliable process control and

eliminates the need for a large number of cylinder change-outs, reducing costs and improving safety and reliability.

"Praxair has been an important partner in the expansion of Bridgelux's manufacturing operations," says Bridgelux VP of manufacturing Mike Peanasky. "As Bridgelux continues to drive product performance and technical innovation in solid-state lighting, the high-quality Praxair products are instrumental to those efforts," he adds.

"Repeat selection by Bridgelux of our high-purity ammonia and gas delivery technologies [after ordering a 600slm system last December], and Bridgelux's adoption of our high-purity hydrogen system, underscores Praxair's position as a premier supplier to the LED and electronics market," comments Praxair Electronics' president Mark Murphy.

www.praxair.com

FerroTec

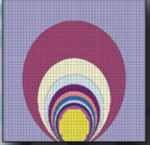
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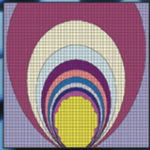
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Pt

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Temescal

SemiLEDs files for \$172.5m IPO

Proceeds to fund production capacity expansion and 6"-wafer test line

High-brightness LED chip maker SemiLEDs Corp of Boise, ID, USA (which has chip fabrication facilities in Hsinchu Science Park, Taiwan) has filed plans with the US Securities and Exchange Commission (SEC) to raise up to \$172.5m in an initial public offering (IPO) of stock on NASDAQ under the symbol 'LEDS'. Bank of America, Merrill Lynch, Barclays Capital, and Jefferies & Co are the lead underwriters of the offering.

Founded in 2005, SemiLEDs' proprietary blue (white), green and UV 'metal vertical photon' (Mvp) LED chip design features a vertical LED structure on a patented copper alloy base (after removal of the sapphire substrate) that provides what is claimed to be the best thermal resistance on the market (0.4°C/W) — allowing better heat removal than for LEDs that retain the sapphire substrate — as well as electrical and optical advantages such as greater luminous efficacy

(more than 120lm/W) and longer lumen maintenance. Reclamation of the sapphire substrate also allow reductions in both the manufacturing cost and the dependence on sapphire (for which the current short supply is increasing cost). The firm also believes that its technology will aid its migration to larger (6-inch) wafer sizes.

SemiLEDs fabricates LED chips for sale (mainly to chip-packaging customers in China, Taiwan and other parts of Asia, or to distributors who sell to packagers). It also packages some of its chips into LED components for sale to distributors and end-customers in selected markets (mainly for general lighting applications, including street lights and commercial, industrial and residential lighting). The firm's revenue was \$29m for the 12 months to end-May 2010.

To meet demand for its LED products, SemiLEDs intends to use net proceeds to expand its production

capacity in Taiwan, build a test line for R&D related to LED chip production based on 6-inch wafers, and for general corporate purposes (including working capital and capital expenditure).

SemiLEDs is already building additional capacity through an LED chip-making joint-venture China SemiLEDs (Xurui Guangdian Co Ltd) formed in January in Foshan, Guangdong Province (paying \$14.7m for a 49% stake). China SemiLEDs is currently constructing manufacturing facilities (to be operational after January).

SemiLEDs may also use some of the proceeds of its IPO to acquire or invest in complementary technologies, solutions or businesses or to obtain rights to such complementary technologies, solutions or businesses.

www.semileds.com

www.sec.gov/Archives/edgar/data/1333822/000104746910007161/a2199642zs-1.htm

FOREPI raising capital to expand LED capacity

Taiwanese firm to add 38 MOCVD systems this year, then 40 next year

According to a report in Digitimes, to expand its production capacity Taiwanese LED chipmaker Formosa Epitaxy Inc (FOREPI) plans to raise additional capital of about NT\$6.4bn (US\$162.6m) by issuing up to 150 million new shares.

A shareholders' meeting was due to be held to discuss whether this will be via either a public offering or private placement in Taiwan or through the issue of global depositary receipts (GDRs) and convertible bonds.

FOREPI plans to expand production capacity from 43 MOCVD reactors to 81 by the end of 2010. Of the 38 new systems, 13 will be in Taiwan and 25 in China (at its affiliate Jiangsu Canyang Corp, which

started production in July). Another 40 systems will be added during 2011 (including Canyang adding another 25).

FOREPI began shipping to LED lighting device clients in Japan in second-quarter 2010, with initial monthly shipments of a few thousand units, but volumes are expected to increase substantially in second-half 2010, reports Digitimes, noting that shipments include 3W and 7W LED light bulbs and light strips.

For South Korea's LED lighting market, FOREPI is shipping high-brightness LED chips to chip packaging and module manufacturing partners in the country. The firm also plans to enter the

US and Europe markets by fourth-quarter 2011.

With the China government rumored to be modifying its LED street lamp policies from direct subsidization to reimbursing companies at a later date (based on the amount of money saved annually from implementing LEDs), FOREPI reportedly plans to retreat from such projects in Yangzhou, China.

FOREPI points out that, despite uncertainties surrounding subsidies, the LED street lamp market still presents a good opportunity so, as long as it is beneficial to the firm, it will continue to consider future developments.

www.forepi.com.tw

www.digitimes.com

POWERFUL IDEAS IN THIN-FILM TECHNOLOGY

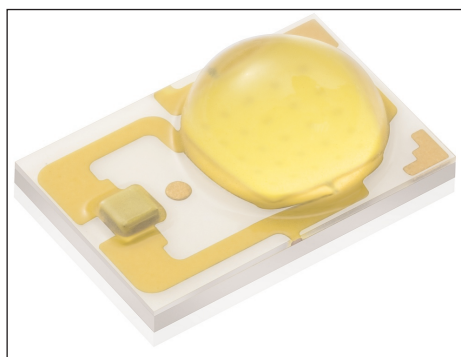


From high speed trains to wind turbines, hybrid vehicles to solar devices, Evatec's thin film technology powers the manufacture of IGBTs, GTOs and MOSFETs that make our world run faster, cleaner or more efficiently.

LUXEON Rebel ES LED performance extended to 300 lumen output and 125lm/W efficacy to meet outdoor lighting standards worldwide

LED maker Philips Lumileds of San Jose, CA, USA has announced advances in its LUXEON Rebel ES product line that, it is claimed, enable new outdoor lighting solutions to deliver higher efficacy and more light output, shortening pay-back periods, lowering the total cost of ownership, and enabling LED systems to meet new efficiency standards being implemented around the world.

At 1000mA, the new LUXEON Rebel ES delivers more than 300 lumens and efficacy of 100 lumens per Watt. When optimizing for system efficiency, current can be lowered and efficacy can exceed 125lm/W at 350mA. Either way or in combination, applications can be more easily designed to meet emerging outdoor lighting standards system cost targets, and cost of ownership requirements,



LUXEON Rebel ES, which can produce more than 300lm of light.

Lumileds reckons.

"We continue to listen to our customers and broaden our LUXEON portfolio in order to help them achieve their lighting solution objectives," says Steve Barlow, executive VP of sales & marketing. "System efficiency and costs are significant drivers of LED solution adoption. LUXEON Rebel ES directly

addresses these factors," he adds.

LUXEON Rebel ES is optimized for outdoor applications, including streets, roadways, tunnels, and high- and low-bay lighting, with correlated color temperatures (CCTs) centered at 4100K and 5650K. The combination of light output levels, efficacy and color temperature enable higher-performance lighting systems that meet end-market needs, it is claimed. Options include optimizing for light output (reducing the number of emitters required and potentially reducing upfront costs); optimizing for efficacy (which lowers operating expenses through energy savings); or designing for variable operation (based on the amount of light required at a particular time of day, or at a particular location).

www.philipslumileds.com

Lumileds' LUXEON Rebel LEDs illuminate bridge in Harbin, China

Future Lighting Solutions, which provides LED lighting components and support services for solid-state lighting products and installations (including engineering expertise, concept development, full system solutions and online tools), has completed a bridge lighting project in the Chinese city of Harbin using 1288 linear floodlights containing 12,000 LUXEON Rebel LEDs made by Philips Lumileds of San Jose, CA, USA.

Spanning the 1565m Songhua-jiang Bridge over the Songhua River, the new lighting was designed and manufactured by Roled Opto Electronics Shanghai Co Ltd, with LEDs and solution support supplied by Future Lighting Solutions.

Roled used LUXEON Rebel LEDs in the floodlights because of their proven long-term reliability,

including the ability to withstand extreme local temperatures ranging from 28°C to -24°C that have given Harbin the nickname of 'The Ice City'. Other key considerations included the ability to run at a drive current of 700mA, reducing the LED count and associated costs required to generate the necessary light output, and assured LED supply under Future's inventory management program.

The use of LED illumination in the project reduces energy consumption by as much as 80% and provides a lifetime of 50,000 hours that minimizes bulb replacement frequency in the difficult-to-reach bridge girders. Future Lighting Solutions assisted Roled with thermal and optical simulations as well as component recommendations, including the National Semiconductor driver used in the system

design.

"The Songhua-jiang Bridge is a showcase lighting project. It is in the 10th largest city in China, and the bridge lighting can be seen at night from at least 1.5km away," says Roled Opto Electronics' marketing manager Derkson Liu. "Reliability is therefore essential, and Future was able to demonstrate that LUXEON Rebel LEDs met all of our performance criteria," he adds.

"Roled's reputation as one of the top architectural solid-state lighting designers in China literally depends on the integrity of their luminaires," says Future Lighting Solutions' regional sales VP Winter Chan. "Their use of LUXEON technology in a demanding project like this clearly shows that LUXEON LEDs can withstand any installation environment."

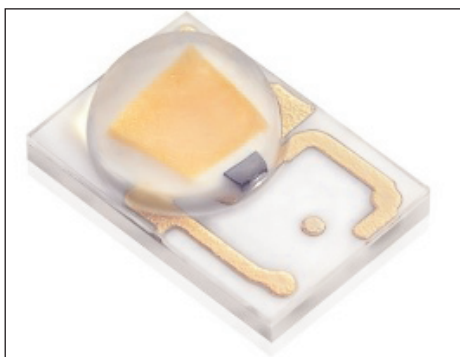
www.futurelightingsolutions.com

Lumileds improves hot/cold factor and light output with LUXEON Rebel

LED maker Philips Lumileds of San Jose, CA, USA claims that its indium gallium nitride (InGaN)-based phosphor-converted LUXEON Rebel PC Amber LED is setting new performance benchmarks that are proving important not only for automotive and specialty markets but also for the illumination market. Hot/Cold factor, which indicates how much light is delivered at operating conditions as opposed to test conditions, has risen 12% at 80°C. Lumens and lumens per watt (efficacy) performance exceed that of all other amber power LEDs, it is claimed.

Amber LEDs have been essential for automotive and construction/manufacturing lighting applications for some time, and in the lighting market they have been implemented in entertainment solutions. Now, says Lumileds, there is particular interest from the makers of retrofit bulbs designed to replace traditional incandescent lamps and replicate the color change from white to reddish-yellow as the light is dimmed.

Unlike conventional bulbs, white LEDs do not change color as they are dimmed, so the 'color' of the white light is always the same. Adding an amber LED to the system allows a retrofit bulb's light to change in a way that people expect. However, amber LEDs typically have poor light output and color stability at the high temperatures found in retrofit bulbs. Lumileds says that its LUXEON Rebel PC Amber combines the same blue thin-film flip chip used in its white LUXEON LEDs. By adding proprietary Lumiraminc phosphor technology, the firm is able to manufacture a highly stable, reliable amber LED that performs in high application temperatures, high humidity, and high drive currents, and still delivers the light output, efficacy, and quality of light that is required.



LUXEON Rebel PC Amber power LED.

"The InGaN-based LUXEON Rebel PC Amber with Lumiraminc phosphor simplifies system design," says VP of product marketing Frank Harder. "It gives 4-5 times the light output of AlInGaP amber products so fewer pieces can be used, and it is much more reliable and cost effective from a lumens/watt and lumens/dollar perspective," he adds.

www.philipslumileds.com

IN BRIEF

Lumileds ships billionth LUXEON

In second-quarter 2010 Lumileds shipped its billionth LUXEON power LED. The firm says that its capacity and infrastructure investments over the last several years have enabled it to meet demand for high volumes of products, delivering more than 750 million LUXEON power LEDs in just the past two years to automotive, illumination and consumer electronics customers alone.

"This isn't just a milestone for the company but for the entire industry," says CEO Michael Holt.

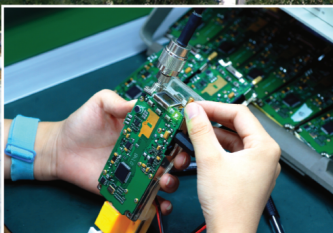
Lumileds says that, prior to its invention of the power LED (operating at a current of 350mA or more), LEDs typically produced only a lumen or two. Now, LUXEON power LEDs can generate hundreds of lumens.

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Cree reports annual revenue up 53% as LED lighting sales double year-on-year

First LEDs on 150mm substrates to be qualified by July 2011

For fiscal 2010 (ended 27 June), Cree Inc has reported record revenue of \$867.3m, up 53% on fiscal 2009's \$567.3m. In particular, fiscal fourth-quarter revenue was a record \$264.6m, up 13% on last quarter's \$234.1m and 79% on \$148.1m a year ago.

Of total Q4 revenue, LED product revenue was \$240.1m (up 13% on \$211.8m last quarter and 83% on \$131.3m a year ago) and power and RF product revenues were \$24.5m (up 10% on \$22.3m last quarter and 46% on \$16.8m a year ago). In particular, growth was driven mainly by: strong sales of XLamp LED components for outdoor lighting and LED bulb applications; LED lighting products for indoor commercial applications; and power devices for solar inverter applications.

Well over half of overall LED business is now for lighting applications. "Fiscal 2010 was a great year for Cree and the LED lighting revolution," says chairman & CEO Chuck Swoboda. "We made good progress building momentum in our business and delivering on our four key objectives for the fiscal year," he adds. "We grew the LED lighting components business more than 100% year-over-year, we further established our leadership in LED lighting and disrupted the market with customer wins like Wal-Mart, we turned power and RF into a profitable and growing product line, and we increased non-GAAP operating profit 244% [from \$68m for fiscal 2009 to \$234m]."

Non-GAAP gross margin has risen from 40.3% a year ago and 48.1% last quarter to 49.9% (above the targeted 48%), with components a little above the corporate average, followed by chips, then lighting systems a bit below average. The rise is driven by continued strong execution in the factory ramp-up

along with the benefit of higher volume scale, better-than-forecast cost reduction due to higher yields, and continued improvement in the power and RF product lines. This boosted full-year gross margin from 38.1% in fiscal 2009 to 47.8% in fiscal 2010.

Non-GAAP net income has risen from \$16.3m a year ago and \$51.3m last quarter to a record \$60.1m. This boosted full-year net income from \$59.2m in fiscal 2009 to \$179.2m in fiscal 2010.

In fiscal Q4, operating cash flow was \$94.9m (up on \$72.9m last quarter). After capital expenditure of \$40.8m, free cash flow was \$54.2m. Cash and investments rose by \$75.4m to \$1066.4m.

To further accelerate growth of the LED lighting market, during fiscal Q4 Cree signed a worldwide patent cross-license agreement with Philips (parent firm of LED maker Lumileds of San Jose, CA, USA). Cree also extended the warranty on its family of LED fixture products to five years. It also launched its LR6-DR1000 high-output 6-inch downlight (delivering 70% more light than the original LR6) and the LR24HE LED-based troffer (the first indoor fixture to deliver more than 100 lumens per watt efficacy), both featuring Cree's TrueWhite technology.

"Entering fiscal 2011, we are focused on extending our leadership position while we build the scale, cost structure and channels to win in the market," says Swoboda.

For fiscal first-quarter 2011 (ending 26 September 2010), Cree expects revenue to rise to \$270–280m. This should be driven by double-digit growth in LED components and lighting products (as Cree continues to invest in its factories to support the increased adoption of LED lighting), driven by the USA and Asia while European demand is seasonally slow.

However, this growth will be offset partially by lower LED chip sales for consumer backlighting application, particularly in Europe (a short-term supply/demand correction), as well as flat power & RF product sales (due to production constraints that will last until new capacity comes online, probably in fiscal Q3/2011).

Non-gross margin in fiscal Q1 should fall back a little to 48–49%, as Cree aims to operate its factory at a more sustainable level of utilization (i.e. down closer towards 90% for LED chips). Non-GAAP net income should rise to \$62–65m.

Cree's authorized capital expenditure for fiscal 2011 is about \$300m (up from \$168m in fiscal 2010), as the firm aims to: support targeted growth in LED lighting applications (by more than doubling XLamp LED capacity by the end of fiscal 2011); support initial capacity to develop and qualify LED products based on 150mm (6-inch) substrates; and position the factory to support additional growth in fiscal 2012.

As well as increasing manufacturing capacity (and adding new pilot production and testing capabilities to reduce time to market for LED component and lighting system products), Cree will transition LED chip production from 4-inch to 6-inch wafers. The plan is to ramp the 6-inch process into production on silicon carbide wafers (on which Cree produces most chips), but it also has a parallel program for 6-inch sapphire substrates, aiming to be able to run the process on both platforms. "We are putting in place the initial 150mm capacity to start to develop and qualify the process," says Swoboda. Cree targets the first 150mm products to be qualified by the end of fiscal 2011 (end-June 2011), followed by the first production volumes in early fiscal 2012.

www.cree.com

Cree claims most color-consistent LEDs via the smallest warm-white and neutral-white color bins

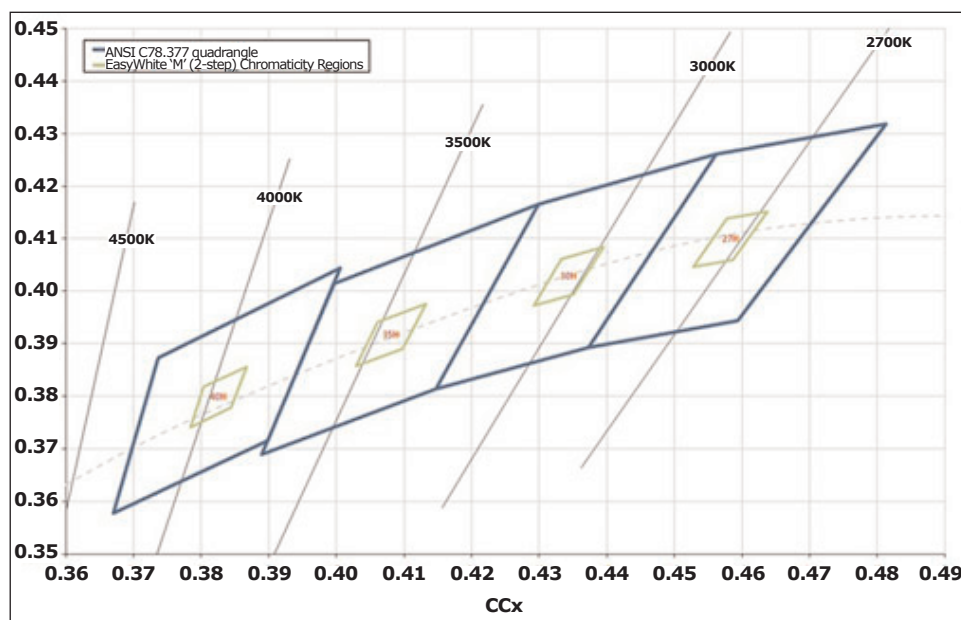
LED chip, lamp and lighting fixture maker Cree Inc of Durham, NC, USA has added what it claims are the industry's smallest warm-white and neutral-white color bins to its multi-chip XLamp MP-L and MC-E EasyWhite LEDs.

Cree says this offers a single two-step MacAdams ellipse bin per color temperature, optimized to achieve incandescent-like color consistency and eliminating the need to purchase multiple small bins and perform complex color mixing.

"This innovation gives the lighting community a simple solution to a previously challenging issue — combining lighting-class LED efficacy with traditional incandescent color consistency," says Paul Thieken, Cree's director of marketing, LED components.

"Providing our customers with Cree's EasyWhite technology in smaller, single bins can lower their cost and potentially speed time-to-market," he adds.

Cree says that EasyWhite binning is a unique feature of its lighting-class multi-chip LED components enabling



Two-step MacAdams bins, situated in the large ANSI standard bins, showing EasyWhite XLamp chromaticity regions for MP-L and MC-E LEDs.

the specification of a particular color temperature and lumen output, simplifying LED system design and improving LED-to-LED color consistency. Each bin, at the intersection of the black-body locus and standard warm/neutral correlated color temperature (CCT) points, is 94%

smaller than the respective ANSI C78.377 quadrangle and 75% smaller than current EasyWhite bins.

MP-L and MC-E LEDs with EasyWhite two-step bins are offered in 2700K, 3000K, 3500K and 4000K, available in sample and production quantities with standard lead times.

Cree extends EasyWhite technology to LED modules

Cree has expanded its LED Module LMR4 product line by incorporating its EasyWhite technology and introducing a broad range of available color temperatures.

Cree says that the expansion of its LMR4 portfolio demonstrates its commitment to accelerating the adoption of LED lighting by simplifying the design process and shortening time-to-market for new LED-based fixtures. Lighting manufacturers now have more options as they develop LED lighting products.

"The addition of EasyWhite options and additional color points gives us increased flexibility when designing fixtures," comments DMF Lighting's president & CEO Mark Danesh. "Since the LMR4 is

drop-in-ready, we can now address more applications within a limited development budget; from general illumination to our most demanding customers such as restaurants or museums, which benefit from the higher light quality of Cree's TrueWhite technology."

The LED Module LMR4 with EasyWhite technology uniquely integrates driver electronics, optics and primary thermal management, making the compact module easy to integrate and fast to market, claims Cree. Designed to last 35,000 hours while consuming just 12W of power, it offers 2700K, 3000K, 3500K and 4000K color temperatures at a color rendering index (CRI) of 80.

"LED Module customers now have access to EasyWhite technology, allowing them to expand their design possibilities while shortening the manufacturing cycle for new products," says Scott Schwab, Cree's LED Module product line manager. "This further broadens Cree's portfolio of application-optimized LED modules, specifically designed to meet the needs of our OEMs."

The LED Module LMR4 with EasyWhite technology is available in production quantities now with standard lead times. Also available are new module evaluation kits featuring four modules with a mix of Cree TrueWhite and EasyWhite options.

www.cree.com

Golden DRAGON oval Plus LEDs light Russian cities

Situated on the Trans-Siberian Railway, the Russian city of Kemerovo (which has 520,000 inhabitants) is converting to LED street lighting on a broad scale after installing 200 luminaires made by LLC TD Focus, equipped with Golden DRAGON oval Plus LEDs made by Osram Opto Semiconductors GmbH of Regensburg, Germany.

The USS-90 Magistral street luminaires have already been installed at various locations in Kemerovo. Another 200 will also be put up in the neighbouring village of Neftebazy and in Leninsk-Kusnetsky.

Each luminaire uses 90 Golden DRAGON oval Plus LEDs, which have been developed specifically for street lighting and meet the special requirements for energy-efficient lighting without light pollution. The Golden DRAGON oval Plus

has special directional characteristics based on an integrated, durable silicon lens. Emitted light is only aimed at parts of roads or squares that have to be lit.

Osram Opto says that the range of color temperatures and shades of white that the LEDs offer meet the various lighting requirements at individual locations. From cold white (5000–6500K) to neutral or warm white (2700–5000K), the right solution is available for every application, the firm claims. Light output on average has luminous efficiency of 65–95lm/W.

Osram Opto says that LED street lighting also suits adverse weather conditions with freezing temperatures, rain, ice and snow, since their operating life and radiant power increase as temperatures fall. Compared with conventional solutions

using 150W sodium high-pressure discharge lamps, the USS-90 Magistral streetlamp has total power consumption of just 105W, requiring far less energy. For the local authority this can save more than €20,000 annually (as well as more than 200kg in CO₂). The LEDs' durability can also reduce maintenance costs considerably.

Both the even illumination and good light quality improve perception of objects and therefore increase safety, says Osram Opto. The LEDs' small size also gives lighting manufacturers greater design opportunities.

"With their great efficiency, long life and low maintenance, lighting solutions based on LED soon pay for themselves," says Martin Wittmann, Osram Opto's marketing manager of solid-state lighting.

Osram's sensors complement LEDs in Arquiled street luminaire

Osram Opto Semiconductors says that, in addition to using its LEDs, new luminaires made by Arquiled are now also equipped with one of its ambient light sensors, providing intelligent light management and cutting energy costs as its brightness is automatically adjusted to any situation.

The SFH 5712 digital ambient light sensor regulates the LED's intensity depending on lighting conditions. Its spectral sensitivity matches that of the human eye, so lighting is regulated accordingly — the brighter the ambient light, the weaker the street luminaires shine.

Osram Opto's Golden DRAGON Plus LED, which has luminous efficacy of 100lm/W, has been designed specifically for street lighting and is available in various color temperatures. With a long lifetime of more than 50,000 hours and hence low maintenance, the robust LEDs are suited to lighting roads, pathways and squares, says the firm. Using the LED and ambient light sensor together, local govern-



Arquicity luminaire, which uses LEDs and ambient light sensors from Osram.

ments can achieve significant cost savings, says Osram Opto.

Another benefit of LEDs for street lighting is their directed light, shining precisely where it is required, so less light is scattered needlessly. Overall, less light needs to be produced to illuminate the road properly. By

also adjusting the luminaires with the aid of digital brightness sensors, electricity consumption is reduced further compared with conventional lighting solutions, while the LED's operating life is also increased.

The Arquicity street luminaire is characterized by the low amount of installation work needed, so conventional luminaires can be replaced easily, it is claimed. The compact luminaire head, in combination with the optimized directional characteristics of Osram Opto's LEDs, provides light distribution that meets street lighting requirements while also improving safety for road users, the firm adds.

"More than 4000 Arquicity lamps in various projects already provide proof of how efficient state-of-the-art street lighting can be," says Osram Opto's marketing director Rainer Friedrichs. "Intelligent light management is made possible by coordinating the interaction of light sources and sensors based on semiconductors," he adds.

www.osram-os.com

Osram boosts LED efficiency record to 44%

Increase by 30% raises luminous efficacy to 119lm/W at 350mA for red LED

Osram Opto Semiconductors GmbH of Regensburg, Germany has raised the efficiency of red thin-film LEDs by 30% to a new record. The firm says that its latest generation of thin-film chips benefits from an optimized chip platform that has potential for further improvements. The boost in efficiency opens up new LED applications in general illumination, projection and the industrial sector, claims the firm.

The record efficacy for an LED of 119lm/W at an operating current of 350mA (136lm/W at 70mA) has been achieved using the latest generation of a red 1mm² thin-film (InGaAlP) chip in a Golden Dragon Plus package, emitting at a wavelength of 615nm (λ dominant). At present there are no LEDs with higher efficacy at this wavelength, claims Osram Opto. Efficiency has been measured at 44% (49% at 70mA) at 615nm, and even exceeds 50% for a wavelength of 642nm.

Higher efficiency means greater output for the same current and lower power consumption in the relevant applications. This also enables new design options, requiring fewer chips and therefore less space to produce the same bright-

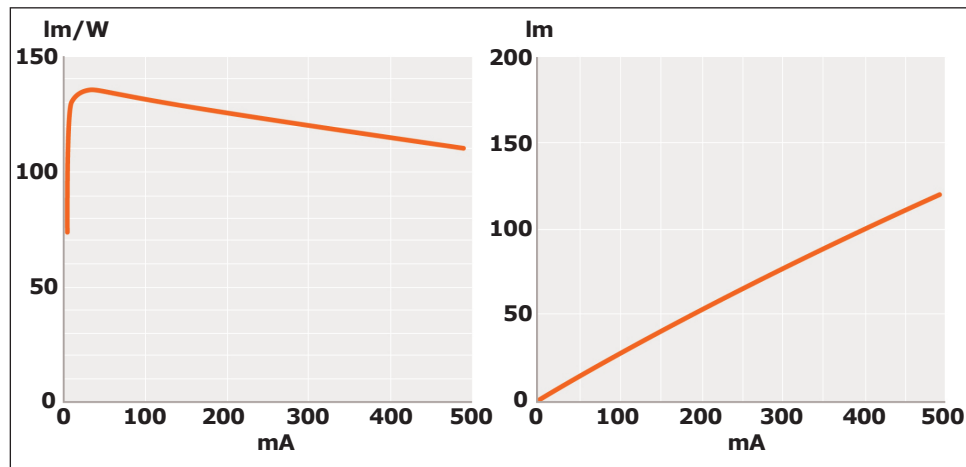
ness. In addition, almost 50% less waste heat needs to be removed, which in turn reduces the need for cooling. As brightness increases, the light sources can be made smaller, the firm adds.

The LED's improved performance expands the possible applications, e.g. high efficiency means that warm-white LED solutions can be produced with better light quality and energy balance through color mixing than through the usual conversion of blue light.

"This will benefit all applications that use high-efficiency red, particularly projection applications," says Dr Wolfgang Schmid, who is responsible for developing the chip technology at Osram Opto Semiconductors. "We expect to start equipping LED products with the new thin-film chips in about a year's time," he adds.

Efficiency has been measured at 44% (49% at 70mA) at 615nm, and even exceeds 50% for a wavelength of 642nm

www.osram-os.com



Prototype red (615nm) Golden Dragon Plus LED achieves record luminous efficacy of 119lm/W at 350mA, and output of 100lm at 400mA.



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www.EVGGroup.com



Epistar invests in LED planar light source maker Oree Funding to enable high-volume production early next year

Taiwan's biggest LED epiwafer and chipmaker Epistar Corp of Hsin-chu Science-based Industrial Park has invested in Oree Inc of Ramat Gan, Israel, which owns patented technology enabling the conversion of LED point sources to a planar, thin and uniform illuminating surface.

Founded in 2006, Oree has developed 'LightCell' LED-based planar light sources which — with a modular design — suit the illumination of areas of varying size (e.g. general lighting, decorative and architectural lighting, and backlighting for LCD panels). The technology is said to be able to significantly boost LED lighting system efficiency and dramatically reduce system cost and energy consumption.

Up to now, Oree had raised \$16m from Genesis Partners and GIMV,

as well as obtaining loans from Silicon Valley Bank and Kreos Capital. According to Israeli publication www.globes-online.com, Epistar's strategic investment in Oree amounts to \$2–3m, forming the first part of a planned financing round of about \$15m involving the existing investors.

Epistar says that it is dedicated to partnering with firms that present novel and promising technologies. It has been making chips for Oree since 2007, and the continued collaboration aims to strengthen market penetration in Asia, Europe and the USA for both companies.

Epistar's strategic investment in Oree amounts to \$2–3m

"Oree has introduced a game-changing LED technology and brought some great talent to the market," believes Epistar's chairman BJ Lee.

"By investing in Oree, Epistar has demonstrated confidence in the significant market potential of our technology," says Oree's founder, president & CEO Eran Fine. Oree is currently working with select customers in Asia and Europe, and expects to begin high-volume production early next year. "This funding will help us meet our high-volume production goals, as well as expand our global reach," Fine adds.

www.oree-inc.com

www.epistar.com.tw

www.globes.co.il/serveen/globes/docview.asp?did=1000581592&fid=1725

Luminus appoints Comex as Asia distributor

Luminus Devices Inc of Billerica, MA, USA, which makes PhlatLight (photonic lattice) LED solid-state light sources for illumination applications, has appointed Comex Technology Ltd of Hong Kong to distribute its LEDs in Asia. Comex Technology will also provide supply-chain optimization and technical support to Luminus' customers to accelerate product development for general illumina-

tion and specialty lighting applications.

"The Asian market is a cornerstone to our growth strategy," says president & CEO Keith T.S. Ward. "Comex's reputation, reach and experience in Asia as a specialist in LED technology is first-rate," he comments.

"Our priority is to expand the PhlatLight LED brand in China and Hong Kong through our extensive

customer channels of companies adopting solid-state lighting solutions," says Comex's general manager Steve Ho. "As traditional lighting solutions are phased out and energy-efficient, long-lasting PhlatLight LEDs are built into tomorrow's lighting applications, Comex will help Luminus become the light engine in next-generation LED-based products."

www.luminus.com

Luminus adds sales directors for Northeastern & Eastern/Southeast

Luminus Devices has appointed William Wholley as director of sales - Eastern/Southeast Region and Warren Forman as director of Sales - Northeastern Region, responsible for developing and managing direct-customer as well as distributor accounts.

"Bill's and Warren's deep lighting market knowledge, strong senior level sales leadership experience delivering technical solutions, and

established customer relationships will contribute to driving our aggressive growth targets and accelerate our market penetration," says president & CEO Keith T.S. Ward.

Prior to joining Luminus, Wholley was East Region sales director for Iwasaki/EYE Lighting, a manufacturer of lamps and lighting products based in Cleveland. He has senior level management experi-

ence with GE Lighting and Panduit and holds a BS in Business Administration from Northeastern University.

Forman has held several senior sales management and product development engineering positions with Texas Instruments in the US and abroad. He holds a BS in Optical Engineering from the University of Rochester, and an MBA from the University of Dallas.

DoD awards ASU \$2.34m to research antimonide-based superlattices for IR photodetectors and lasers

ASU collaborating with University of Illinois, Georgia Tech and University of North Carolina in \$6.25m project

A team of researchers at Arizona State University (ASU) is to receive support from the US Department of Defense (DoD) to aid development of the next generation of lasers and infrared photodetectors (for use in sensing and imaging for defense and commercial applications).

The work will be funded by an Army Research Office grant through the DoD's Multidisciplinary University Research Initiative (MURI) program, which supports science and engineering involving research and technology development considered vital to national interests. In mid-July, as a result of the fiscal 2010 competition conducted under the MURI program (which drew more than 150 full proposals), the DoD announced plans to make 32 awards (totaling \$227m over five years) to a total of 67 academic institutions.

As part of the only project selected this year in the area of laser and photodetector materials research, ASU researchers have been awarded \$2.34m (out of a total grant of \$6.25m over five years) involving collaborating with colleagues at University of Illinois

at Urbana-Champaign, the Georgia Institute of Technology and the University of North Carolina. This is the third MURI program grant awarded to ASU researchers in the past several years in semiconductor optoelectronics and photonics.

ASU's Yong-Hang Zhang, David J. Smith and Shane Johnson will combine expertise in electrical engineering, materials science and physics. Zhang is a professor and Johnson is a senior research scientist in the School of Electrical, Computer and Energy Engineering (one of ASU's Ira A. Fulton Schools of Engineering). Smith is an ASU Regents' Professor in the Department of Physics in ASU's College of Liberal Arts and Sciences.

The researchers will focus on deepening knowledge of the basic properties of materials used to construct lasers and infrared photodetectors, studying the origins of defects in the materials and exploring ways to reduce them. Understanding how defects form at the nanometer scale should enable improvements in the materials, opening the path to advances in semiconductors,

infrared photodetectors and imaging systems, Johnson says.

Zhang, Smith and Johnson aim to strive to better understand and improve the physical and structural properties of antimonide-based compound semiconductor materials, which have the potential to produce very high-performance infrared photodetectors and lasers.

Specifically, they will study superlattice systems, consisting of two or more semiconductor materials in alternating layers several nanometers thick which — combined with an antimonide material system — can give "additional degrees of freedom when selecting for color and performance in infrared photodetectors and lasers," says Johnson.

Zhang has previously (while at Hughes Research Laboratories) performed pioneering work on superlattices for infrared laser applications. He has collaborated with Johnson and Smith on this research since joining ASU in 1996. Smith also has decades of experience studying structural properties of semiconductor superlattices.

<http://engineer.asu.edu>

NIH awards Vixar Phase II SBIR grant for red VCSEL laser scanning in computed radiography

Vixar of Plymouth, MN, USA, which designs and manufactures vertical-cavity surface-emitting laser (VCSEL) products operating at wavelength of 650–900nm, has been awarded a Phase II Small Business Innovative Research (SBIR) grant 'Novel Laser Scanning Technology for Computed Radiography' by the National Institutes of Health (NIH) to develop a large red VCSEL array assembly for the readout of images in computed radiography systems. Vixar will collaborate with

manufacturers of computed radiography systems to evaluate the potential of the technology.

"Reducing the size, increasing the resolution and reliability of computer radiography have been key drivers for potential customers interested in the technology," comments Bill Hogan, Vixar's director product development.

Vixar is also pursuing wafer-scale packaging approaches for combining laser arrays with cost-effective packaging and lensing solutions.

VCSEL-based components and subassemblies are increasingly being used for sensor and device applications in the biomedical, industrial, office product, military, automotive and consumer industries, says Vixar.

Benefits include miniaturized cost-effective platforms, performance equal or better to edge-emitting lasers, and the lowest available power consumption, the firm adds.

www.vixarinc.com

Horizontal Ge pin diode yields first WDM-compatible silicon photonics detector operating at 32GHz

Kotura Inc of Monterey Park, CA, USA, which makes application-specific silicon photonics components for the communications, computing, sensing and detection markets, has demonstrated a high-speed horizontal p-i-n germanium photo-detector integrated with silicon waveguides on a single chip. The device has been developed as part of the US Defense Advanced Research Project Agency's Ultra-performance Nanophotonic Intrachip Communications (UNIC) program in conjunction with Oracle America Inc (under the leadership of DARPA program manager Dr Jagdeep Shah).

"Previous research has focused on vertical detectors within sub-micron-scale waveguides to achieve high-speed operation," says chief technical officer Mehdi Asghari. "These typically exhibit high loss and are hard to integrate with waveguide geometries needed for other functionalities such as WDM

(wavelength division multiplexing) multiplexer and de-multiplexer devices," he adds. "Our invention of a horizontal junction detector does away with conventional designs and creates a new structure that supports high-speed operation and yet is compatible with a variety of waveguide heights including the larger waveguides needed for high-performance WDM operation," Asghari continues. "These structures allow standard silicon processing techniques to be used to couple waveguides and photo-detectors on the same chip with extremely low loss and high performance." The Kotura-led team has demonstrated devices with more than 32GHz optical bandwidth at 1V bias, a responsivity of 1.1A/W, dark current of less than 300nA, and fiber coupling loss of less than 1.2dB.

"A low-loss, high-speed, easy-to-manufacture detector is a key component for optical interconnects,"

comments Dr Ashok Krishnamoorthy, principal investigator on the project at Sun Labs, Oracle America Inc.

"This horizontal junction detector is a huge improvement for several reasons, not the least among which is that it can be readily coupled to single-mode fiber. This opens the door for wavelength-multiplexed silicon-based optical interconnects that will reduce the complexity of connectors and cabling in high-performance systems," he adds.

"Now we can easily integrate WDM and detection functionality into one chip," adds Asghari. "A single silicon photonics device can take a single input stream of light with 100 WDM channels, demultiplex the wavelengths and route each wavelength to its own detector," he adds.

"We can envision integrating 100 receiver channels, each operating at 40Gb/s, on a single chip."

www.darpa.mil/mto/programs/unic
www.kotura.com

Euro silicon photonics research consortia form cluster

Ten European R&D project consortia focusing on silicon photonics are to coordinate their efforts to facilitate knowledge and technology transfer.

Under the umbrella of the European Silicon Photonics Cluster, the projects will coordinate efforts to:

- raise awareness of the potential of silicon photonics among chip foundries, end-users, start-ups etc;
- broadly disseminate the results of their projects; and
- train young scientists, engineers and researchers.

Cluster members aim to organize a silicon photonics workshop in 2011 and cooperate on training programs.

The cluster represents more than €30m (\$36m) in investment by the European Union and European countries. In forming the cluster, members agree that it is of strategic importance to maintain photonic chip-design and chip-integration

functions in Europe to improve its ability to compete globally. Silicon photonics also provides new opportunities and opens new markets for European microelectronics firms.

The research project consortia and their focuses are:

- 'Boom', terabit-on-chip: micro- and nano-scale silicon photonic integrated components and sub-systems enabling Tb/s capacity, scalable and fully integrated photonic routers (www.ict-boom.eu);
- 'Historic', heterogeneous InP on silicon technology for optical routing and logic (www.ict-historic.eu);
- 'Helios', photonics electronics functional integration on CMOS (www.helios-project.eu);
- 'Intopsens', a highly integrated optical sensor for point-of-care, label-free identification of pathogenic bacteria strains and their antibiotic resistance (www.intopsens.eu);

● 'PhotonFAB': lowering the barriers for access to silicon photonics IC technology by enhancing the silicon photonics platform ePIXfab (www.photonfab.eu, www.epixfab.eu);

● 'Platon', Tb/s optical-routing fabrics for optical interconnects adopting plasmonics (www.ict-platon.eu);

● 'SOFI', new low-cost active optical waveguides and ultra-low-power integrated optoelectronics circuits based on novel silicon-organic hybrid technology (www.sofi-ict.eu);

● 'UK Silicon Photonics' (www.uksiliconphotonics.co.uk);

● 'Wadimos', wavelength division multiplexed photonic layer on CMOS (<http://wadimos.intec.ugent.be>);

● 'Sabio', a completed project on ultra-high-sensitivity slot-waveguide biosensors on a highly integrated chip for simultaneous diagnosis of multiple diseases (<http://ist-sabio.org>).

www.siliconphotonics.eu

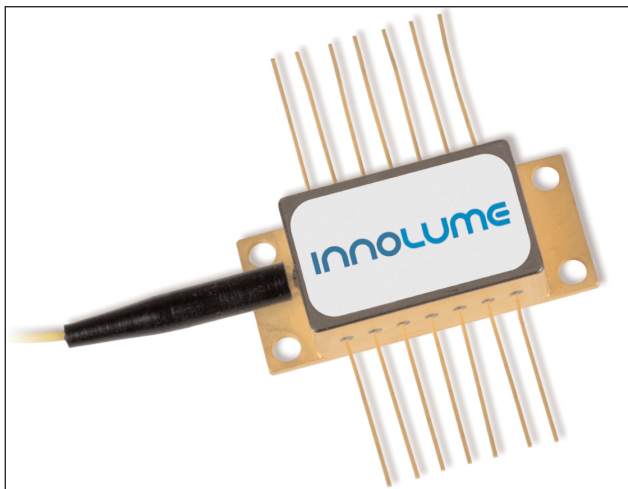
Innolume debuts QD pump laser to extend low-cost GPON reach

Innolume of Dortmund, Germany, which manufactures quantum-dot (QD) diode lasers covering the 1064–1320nm spectrum, has begun sampling its LD-12xx-series laser platform, a new generation of pump lasers based on the firm's proprietary quantum dot epitaxial technology.

Designed as a pump source for O-band Raman amplification, the LD-12xx-series features a single-mode output of 300mW at 1100mA, centered at 1240nm or 1260nm. Packaged in a 14-pin butterfly, the laser is optionally equipped with a polarization-maintaining fiber (PMF) as well as a fiber Bragg grating (FBG) to achieve high stability of output power and spectrum.

Large-scale fiber deployments of access networks are underway worldwide, comments Innolume. Passive optical network (PON) technologies play an important part in meeting subscribers' increasing demand for high-bandwidth services. The existing G.984.2 Amd1 GPON standard (with 28dB loss budget) limits 1:32 split GPON deployments to about 20km reach. Compared to electrically powered extender boxes, a full passive solution is an attractive technology, as discussed at March's Optical Fiber Communication Conference & Exposition (OFC 2010) in San Diego (see 'Economic Study Comparing Raman Extended GPON and Mid-span GPON Reach Extender', D. Nessel et al).

"Pilot customers have demonstrated a 13.3dB increase in the upstream loss budget of a commercial GPON system operating over >50km of fiber with a 1:32 PON split," says VP of business development Guido Vogel.



Innolume's LD-12xx-series laser platform.

"O-band Raman amplification is an excellent example of how the unique features of quantum dot lasers enable new commercial applications. It has been discussed for a long time but never commercially realized due to the absence of low-cost pump lasers in the 12xx nm range," he adds.

"Deployment of distributed Raman-amplified GPON technology based on our LD-12xx-series lasers will offer network operators the option to extend network reach while saving on CapEx and OpEx. Installing the amplifier unit at the central office significantly reduces maintenance costs versus powered extender boxes in the field, which are generally impractical, particularly for rural deployments," Vogel says.

"Our epitaxial growth technology enables high-efficiency GaAs-based pump lasers at any desired wavelength in the previously uncovered 12xx nm window," says VP of technology Dr Daniil Livshits. "But our excellent accelerated lifetime test results, conducted internally and at our customers' facilities, demonstrate an even more outstanding feature of these pumps, making them a compelling component for access network and PON-type applications."

www.innolume.com

Advanced Photonix returns to underlying profit after 22% quarterly growth

For its fiscal first-quarter 2011 (to 2 July 2010), Advanced Photonix Inc of Ann Arbor, MI, USA (which designs and makes silicon, InP- and GaAs-based photodetectors, subsystems, and terahertz instrumentation) has reported revenue of \$6.3m, up 22% on \$5.1m last quarter (above the guidance of 15–20%) and up 5% on \$5.9m a year ago (as the firm returned to year-on-year growth).

Gross margin rose further, from 46% last quarter to 47% (though still down on 51% a year ago).

On a non-GAAP basis, compared with a net loss of \$324,000 last quarter, Advanced Photonix has returned to net profit, of \$97,000 (though still down on \$315,000 a year ago). However, on a GAAP basis, the firm still made a net loss, although this has been cut further, from \$846,000 last quarter to \$273,000 (back to below \$296,000 a year ago). Consequently, during the quarter cash reserves shrank slightly again, from \$1.8m to \$1.4m.

"As we stated in our year-end conference call [at the end of June], this year would be one of getting us back on a growth path," says chairman & CEO Richard Kurtz. "If we annualize the first quarter of \$6.3m, that would give us \$24.8m for fiscal year 2011, or a projected growth rate of 18% over last year [\$21.1m]," he points out.

"Our second quarter is also strong and we are continuing to see an increase in demand for our HSOR [high-speed optical receiver] products, a rebounding of our Optosolutions product platform and strong interest with our terahertz product platform, as demonstrated by our recent sale of a system into the art conservation world of the Louvre," he adds. "We are optimistic about meeting our growth goals and would narrow our guidance range to the high end or 20% for the year."

www.advancedphotonix.com

GigOptix grows 19% sequentially to record revenue of \$6.3m for Q2

40–100G product revenue rises 200% as adoption drives ramp-up

For second-quarter 2010, GigOptix Inc of Palo Alto, CA, USA, which designs modulator and laser drivers and transimpedance amplifier (TIA) ICs based on III-V materials as well as polymer electro-optic modulators, has reported record revenue of \$6.3m. This is up 41% on \$4.5m a year ago and up 19% on \$5.3m last quarter (exceeding guidance of 10%). It is also the third consecutive quarter of sequential revenue growth that has exceeded \$1m per quarter.

Of total revenue, \$0.8m came from government contracts (up from just \$0.1m last quarter), while \$5.5m came from product revenue (up from \$5.2m), driven by a significant increase in volume shipments across all high-speed optical markets. Specifically, revenue from 40G and 100G products rose more than 200% sequentially.

GigOptix reached volume shipments of its high-performance 100G DP-QPSK driver for DWDM, a market that Ovum forecasts to rise at a CAGR of 140% to more than 16,000 systems by 2015. Also, GigOptix recently received more than \$2m in orders to supply 100G modulator drivers in 2010 to an existing leading systems customer. "We are unique in the marketplace in that we provide a 100G quad driver solution for use in next-generation 100G DWDM networking systems, and we continue to believe this market will be a strong growth driver for GigOptix," says chairman & CEO Dr Avi Katz.

Also, in early May, GigOptix entered mass production and volume shipments of its GX3240 high-performance 40G RZDQPSK receiver amplifier (developed under collaboration with a tier-1 strategic telecom partner). More recently, the firm began high-volume production of its portfolio of

transimpedance amplifiers (TIA) designed to address varied requirements of Fiber Channel, telecom and Ethernet 10G, 40G and 100G applications.

Gross margin of 56% is down on 60% a year ago due to the contribution from lower-margin CX products, which have been addressed aggressively (since last November's acquisition of analog and mixed-signal custom ASIC supplier ChipX Inc of Santa Clara, CA) in an effort to return the business segment to its 60% target (reflected by the improvement from GigOptix's gross margin of 49% last quarter).

Though up from \$0.1m a year ago, non-GAAP net loss has been cut from \$1.1m last quarter to \$0.4m. GigOptix has consequently achieved its first ever quarterly positive adjusted EBITDA (more than \$0.2m), versus a loss of \$0.1m a year ago and \$0.4m last quarter.

Despite this, due mainly to using cash to complete payments relating to the ChipX acquisition and for investments in working capital in order to support the rapid revenue growth, cash and investments fell during Q2 from \$1.7m to \$0.8m.

However, on 8 July, GigOptix closed a public offering to institutional investors of 2.46 million shares at \$1.75 per share to raise \$4.3m. This enabled the firm to strengthen its balance sheet, satisfy certain covenants under its line of credit with Silicon Valley Bank, and maintain lock-ups beginning 1 July for an additional 6 months associated with the 3.5 million shares issued in the ChipX acquisition.

During Q2, GigOptix began the first commercial sampling of a thin polymer on silicon (TFPS) modulator in a telecom application (its LX8400, for 40G). This underscores the benefits of the manufacturing partnership with electronics

manufacturing services (EMS) firm Sanmina-SCI Corp of San Jose, CA, USA as the firms jointly ramp-up the production line in Shenzhen, China, says Katz. GigOptix remains on track to be fully qualified for production of its 40G modulators in fourth-quarter 2010.

GigOptix also received further financing of \$4.5m in government contracts to develop an On-chip Optical Interconnect, which combines GigOptix's driver technology with its TFPS optical technology to realize an integrated 100G driver/modulator solution for next-generation optical data communication applications up to 200G. "This development activity, earmarked for an additional \$5m in government contracts expected to be received through 2011, will enable the company's new family of products for next-generation 100G and beyond integrated driver-TFPS modulators," says Katz.

For third-quarter 2010, Hittite expects revenue to grow a further 5–8% sequentially, driven by continued demand for its 10G product line combined with ramping shipments of products for the 40G and 100G markets as major network providers accelerate the conversion of their existing systems. "We also expect to further improve our adjusted EBITDA and profitability metrics as we go forward," comments chief financial officer Ron Shelton.

● On 28 July, Roth Capital Partners (the sole manager of GigOptix's public offering) fully exercised its over-allotment option and bought 300,000 additional shares at \$1.75 each. The total of 2.76 million shares raised gross proceeds to \$4.83m (to be used for working capital, strategic growth and other general corporate purposes).

www.GigOptix.com

GigOptix's 40G DQPSK driver enters mass production

GigOptix says that its GX6261 40G driver for differential quadrature phase-shift keying (DQPSK) systems, has entered mass production and is now shipping in volume (together with GigOptix's previously announced portfolio of GX3240 and GX3220 DQPSK receiver amplifiers) to tier-1 telecom customers.

"The GX6261 ramp to production confirms industry analysts' predictions of strong demands for high-speed 40G and 100G systems," says VP of marketing Pdraig O'Mathuna. "40G DQPSK is now one of the fastest-growing segments in the optical communications space. It is being deployed within metropolitan networks to economically address the bandwidth bottlenecks caused by the exponential growth in enterprise and consumer traffic generated by increased usage of smartphones and IPTV," he adds.

"We developed the GX6261 in close cooperation with our tier-1 customer to address their DQPSK

application and we are now their platform's sole driver solution," continues O'Mathuna. "GigOptix is now very well positioned to benefit from the clear market demand for more bandwidth based on not only our broad portfolio of production-ready 40G solutions (including not only the GX6261 driver but also our GX3440 40G DPSK receiver amplifier and GX3240 and GX3220 40G DQPSK receiver amplifiers), but also our product portfolio for 100G applications," he adds. "We expect the GX6261 to be a significant contributor to our future growth."

The GX6261 is a high-voltage differential driver for 40G DQSPK Mach-Zehnder modulators used in long-haul and metro optical transponders. Key features include: excellent electrical eye performance; small footprint in a compact 6mm x 6mm surface-mounted device with simpler system manufacturability due to in-package integrated high-frequency coils;

and low power dissipation (typically 1W lower than comparable competition), for a total saving of 2W per transponder (since two drivers are used per DQPSK transponder).

"40G DWDM is one of the fastest-growing segments in optical communications," notes Daryl Inniss, VP & practice leader at market research firm Ovum. "We expect to see the demand continue to expand as operators transition from 10G to 40G to address the increased demand by consumers and enterprises for more bandwidth," he adds. "We especially see major DQPSK technology deployments happening in Asia."

In its most recent report on 40G components, Ovum forecasted that the 40G DWDM market for DQPSK drivers would grow at a compound annual growth rate (CAGR) of 44% from \$14m in 2010 to more than \$34m in 2015.

www.GigOptix.com

Infinera enters underlying profit as revenue grows 62% year-on-year to record \$111.4m in Q2

For second-quarter 2010, Infinera Corp of Sunnyvale, CA, USA, a vertically integrated manufacturer of digital optical network systems incorporating its own indium phosphide-based photonic integrated circuits (PICs), has reported record revenue of \$111.4m, up 16% on \$95.8m last quarter and up 62% on \$68.9m a year ago. The four greater-than-10% customers included: one of the world's leading Internet content providers as the top customer; two wholesale carriers (Level 3 and Global Crossing); and one of the largest cable companies in North America.

This represents the fifth consecutive quarter of improving revenue, the third of increased bookings, and the fourth of improving gross margins.

On a non-GAAP basis (excluding restructuring and other related

costs and non-cash stock-based compensation), gross margin has risen from 31% a year ago and 41% last quarter to 44%.

The quarter was one of the strongest in the firm's history, says president & CEO Tom Fallon. "We achieved new records for over-all quarterly revenue and bookings, including increased shipments of tributary adapter modules [to 2400 TAMs], and we posted higher gross margins, achieved positive cash flow, and earned a profit on a non-GAAP basis," he adds.

Compared to net loss of \$18.2m a year ago and \$7m last quarter, non-GAAP net income was \$3m.

"Demand remains robust for our PIC-based networks, which we believe provide the most efficient, flexible and cost-effective way to manage Internet bandwidth growth,"

says Fallon. "Furthermore, we have been pleased with the broad-based positive customer reception that we have received to our recently announced plans to accelerate our PIC-based, 100G transmission system development with planned volume production in 2012," he adds.

"Our financial results and industry data provide clear evidence that Infinera is gaining share in both North America and on a worldwide basis and doing so in a rapidly growing market for long-haul DWDM networks," Fallon concludes. On the basis of market data from Dell'Oro Group, as of the end of Q1/2010 Infinera had strengthened its DWDM market share positions both in North America (number 1, at 39%) and worldwide (number 2, at 15%).

www.infinera.com

Opnext's growth limited by supply constraints

10G products & 40G modules compensate for drop in 40G subsystem

For its fiscal first-quarter 2011 (to end-June 2010), optical module and component maker Opnext Inc of Fremont, NJ, USA has reported revenue of \$78.9m (below the forecast \$80–85m). This is down 7.5% on \$85.3m a year ago but up 2.7% on \$76.8m last quarter, despite continuing supply constraints.

Of total revenue, 10% or more came from each of Cisco Systems, Alcatel-Lucent and (for the first time) China's Huawei Technologies Co Ltd (51% combined, up from 44% last quarter). North America represented 44% of total revenue, Europe 22%, Japan 13%, and the rest of Asia 21%.

Revenue from sales of industrial and commercial products grew for a fourth consecutive quarter to \$6.7m, up 9.8% on \$6.1m last quarter and up 191% on the record low of \$2.3m a year ago (and well above pre-downturn levels).

Revenue from sales of 10Gbps-and-below products was \$55.8m, rebounding 14% from last quarter's dip of \$48.9m (after increased sales of 300-pin tunables, XFP and SFP+ modules, offset by decreased sales of Xenpak modules).

Revenue from sales of 40Gbps-and-above products was \$16.3m, down 25.2% on \$21.8m last quarter (due to a 60% drop in 40Gbps subsystems sales and lower R&D contract revenue, offset by a 31% rise in 40Gbps module sales).

"Demand for 40Gbps subsystems was weaker than expected and was the primary reason total revenue came in under plan," says president & CEO Gilles Bouchard. Excluding 40G subsystems (which have fallen to just 5% of total revenue), all other revenues collectively grew by \$21.6m (40%) year-on-year.

Non-GAAP gross margin of 20.9% is down on 23.2% a year ago and flat on last quarter. This was favorably impacted by lower average per-unit material and outsourcing costs, and lower excess and

obsolete inventory charges, but unfavorably impacted by a lower mix of 40Gbps-and-above revenue and lower average per-unit selling prices.

Though up from \$8.5m a year ago, non-GAAP operating loss has been reduced from \$14.7m last quarter to \$12m. This is due to higher

Opnext expects sales of 10Gbps and below products to show solid growth (as supply constraints gradually improve), sales of 40Gbps and above products to remain flat (during new product ramp-up and an inflection point on subsystems), and sales of industrial and commercial products to grow modestly

gross margin dollars and lower R&D expenses, offset by higher selling, general & administrative expenses. R&D expenses fell by \$2.5m (from last quarter's \$18.4m to \$15.8m, below the targeted \$16–18m per quarter), due mainly to lower material and outsourcing costs for advanced product development programs. SG&A expenses rose \$300,000 to \$12.7m.

Though still down on negative \$3.4m a year ago, adjusted EBITDA (earnings before interest, taxes, depreciation and amortization) improved from negative \$9m last quarter to negative \$6.1m. Cash and cash equivalents fell by \$25.8m from \$132.6m to \$106.9m (after \$19.7m of cash used in operations, \$3.1m of capital expenditure and \$2.6m of capital lease payments), as Opnext continues investment in new capacity to support growth and new products.

For fiscal second-quarter 2011 (to end-September 2010), Opnext expects sales of 10Gbps-and-below products to show solid growth (as supply constraints gradually improve), sales of 40Gbps-and-above products to remain flat (during new product ramp-up and an inflection point on subsystems), and sales of industrial & commercial products to grow modestly. Total revenue should rise 1.4–7.7% to \$80–85m. Gross margin should improve slightly due to a more favorable product mix and improved volumes. CapEx and capital lease requirements should remain relatively constant as Opnext completes capacity expansions.

"Based on recent order activity, we expect [40G] subsystem sales to be slightly down in Q2 and then show some growth in the second half [as excess inventory is worked through at one particular customer]," says Bouchard. "We are at an inflection point where this off-setting effect is either minimal or turns positive."

In fiscal second-half 2011, gross margin should improve as a result of favorable product mix and cost reductions in several internally developed components. Also, R&D spending should taper off to about \$14m per quarter as several advanced development programs transition to product introduction efforts. Opnext hence expects to achieve breakeven EBITDA when revenue reaches \$90m per quarter (an improvement on the previous goal of \$95m). These factors, together with continued working capital management, should also reduce cash utilization.

www.opnext.com

Oplink's profit margins dip as it expands manufacturing to meet growing demand

Increased R&D spending targets 40G and 100G products

For its fiscal 2010 (to end-June), optical networking component, module and subsystem maker Oplink Communications Inc of Fremont, CA, USA has reported revenue of \$138.8m, down 3.4% on \$143.7m. However, fourth-quarter revenue of \$38.9m was up 16% on Q3's \$33.6m and up 20% on \$32.4m a year ago (as well as exceeding the forecast \$35–38m), although this included \$2.1m from Taiwan-based AMIT Technology (acquired last quarter).

The three 10% customers were Tellabs, Alcatel-Lucent, and Huawei (accounting for 41% of revenue collectively), although there were also strong contributions from Sienna, Fujitsu and Cisco. Of total revenue, 33% was from North America, 22% from Europe, and 45% from Asia.

"It was a strong quarter across all lines and geographies," says president & CEO Joe Liu. "World-wide carriers are spending more on next-generation optical tools to increase bandwidth and service to many new applications," he adds. "Business is strong in both access and metro markets, FTTx is growing, and so is the metro core and the metro edge," continues Liu. "We have experienced these demand trends for several quarters now, and we were able to ramp up our production capacity as a result of our ongoing expansion efforts... We expect these demand trends to continue."

Non-GAAP gross margin rose from just 27.4% in fiscal 2009 to 33.7% in fiscal 2010. In particular, Q4 was 33.5% (up on 30.6% a year ago). However, this was down slightly on Q3's 34.5%.

This was due to Oplink increasing R&D and manufacturing headcount substantially (from 3446 to 3821) in order to expand production capacity. As Oplink continued to invest in R&D and new product initiatives, non-GAAP operating expenses have risen from \$6.3m a year ago and \$6.6m last quarter to \$7.4m, partly due to R&D expenditure rising by \$456,000 (although OpEx also included a full quarter of expenses from AMIT).

Net income has risen from just \$249,000 a year ago and \$2.6m last quarter to \$3.6m. This took fiscal 2010 net income to \$11.1m, compared with a net loss of \$13.8m in fiscal 2009.

Gross margin will remain flat, due to product mix and increased labor costs in China manufacturing facilities... Operating expenses should continue to rise

During the quarter, cash, cash equivalents and investments fell by \$24.4m to \$160.3m. However, this was due mainly to repurchasing 1.5 million shares of common stock for \$22m (of which \$20.8m was paid during the quarter, and the remainder after quarter end).

"The outlook for the current quarter is good; however, long-term visibility is still limited," says Liu. "Hence, we remain cautiously optimistic about the growth trends we are experiencing," he adds. "The environment for our products is picking up, and we are planning for sequential increases in revenue," comments chief financial officer Shirley Yin.

For first-quarter 2011 (to end-September 2010), Oplink expects revenue to grow 21–29% to \$47–50m (including \$2m of sales unable to be shipped in fiscal Q4 due to capacity and supply constraints, plus \$3m from AMIT). Despite this, gross margin will remain flat, due to product mix and increased labor costs in China manufacturing facilities (although Oplink's headcount addition will probably be limited to no more than 200 during the quarter, says Liu). Also, operating expenses should continue to rise as the firm continues to increase spending on R&D, targeting 40G and 100G products.

Oplink launches further stock repurchase program of up to \$40m

On 1 June, Oplink announced that its board of directors had approved a program authorizing the repurchase of up to \$40m in the firm's common stock. At the time, Oplink had mostly completed the prior \$20m stock repurchase program that it announced in August 2008.

"This share repurchase program communicates continued confidence in our long-term prospects

as well as our commitment to shareholder value," commented CEO Joe Liu.

Oplink says that repurchases under the program will be made in open market or privately negotiated transactions in compliance with US Securities and Exchange Commission (SEC) Rule 10b-18, subject to market conditions, applicable legal requirements and other factors.

The repurchase program does not require the firm to acquire a specific number of shares, and may be suspended from time to time or discontinued. The share repurchases will be funded from available working capital.

There is also no fixed termination date for the repurchase program, says Oplink.

www.oplink.com

Oclaro reports record profitability on 44% revenue growth year-on-year

Gross margin target brought forward from June 2011 to December quarter; target operating margin raised from 10–12% to 12–15%

For its fiscal fourth-quarter 2010 (ended 3 July), optical component, module and subsystem maker Oclaro Inc of San Jose, CA, USA has reported revenue of \$112.7m. This is up 11.4% on \$101.2m last quarter and up 44% on revenue of \$78.1m a year ago on a pro forma basis (including \$6.1m of revenue of Avanex Corp of Fremont, CA prior to its 27 April 2009 merger with Bookham Inc to form Oclaro). This took fiscal 2010 revenue to \$392.5m, up 86% on fiscal 2009's \$210.9m (excluding \$24.8m from the Advanced Photonics Solutions division's New Focus unit, swapped in July 2009 for Newport Spectra Physics' high-power laser diode unit).

Of total fiscal Q4 revenue, Alcatel-Lucent was 14%, Huawei was 13%, and CNI-Nortel was just under 10%.

Telecom revenue was \$98.5m, up more than 13% on \$87m last quarter. Advanced Photonics Solutions (APS) revenue was \$14.3m, relatively flat on last quarter's \$14.1m (although fiscal second-half 2010 revenue for APS was up more than 40% on fiscal first-half 2010). Much higher-than-expected demand for APS meant that, like fiscal Q3, sales were capacity constrained again by \$5–6m in fiscal Q4. "Customers have very short visibility on their orders," says president & CEO Alain Couder. "We get very short-term orders, and we do not necessarily have all the materials and components needed." In the meantime, Oclaro is concentrating on supporting its established customer base while qualifying and ramping new lines.

On a non-GAAP basis, gross margin has risen from 23% a year ago and 27.7% last quarter to 30.7% (exceeding the 30% target set during the April 2009 merger of Bookham and Avanex). The rise is due to increased scale in revenue growth, from realizing cost savings

from the shutdown of the former Newport Spectra-Physics fab in Tucson, AZ (after transferring APS production to Oclaro's facilities in Europe), and from moving beyond March-quarter price reduction (the largest percentage of customer price reductions for the year). This boosted fiscal 2010 gross margin to 28%, from 23.5% in fiscal 2009.

Compared with a \$2m operating loss a year ago, operating income has tripled from \$3.2m (operating margin of 3.2% of revenue) last quarter to \$9.6m (8.5% of revenue, exceeding the 5% target set a year ago). This has contributed to operating income of \$15.7m for fiscal 2010, compared to fiscal 2009's operating loss of \$12.4m.

Adjusted EBITDA has continued to rise, from just \$0.7m a year ago and \$5.8m last quarter to \$12.3m. This has boosted adjusted EBITDA for fiscal 2010 to \$26.5m, compared to -\$1m for fiscal 2009.

Compared with a net loss of \$6.7m a year ago, net income has more than tripled from \$3.4m last quarter to a record \$11.5m. This has contributed to net income of \$16.5m for fiscal 2010, compared with fiscal 2009's net loss of \$3.3m.

"We are proud to have been profitable on a non-GAAP operating income basis for our first year as Oclaro; our adjusted EBITDA has increased each quarter, and our operating margins continue to trend upwards," says Couder.

During the quarter, cash, cash equivalents, restricted cash and short-term investments doubled from \$55.7m to \$111.6m. However,

this includes \$77.1m received in the May follow-on public offering of common stock, partly offset by \$7.5m paid in late May for the firm's investment in ClariPhy Communications Inc of Irvine, CA, USA (a privately held fabless semiconductor company developing mixed-signal digital signal processing ICs for 10, 40 and 100Gb/s optical networks in enterprise backbone, enterprise data center and telecom environments). Capital expenditure was \$6.2m (up from \$3.7m last quarter), reflecting Oclaro's continuing investment towards executing on the strong demand it sees, says chief financial officer Jerry Turin.

Also, on 21 July, Oclaro spent \$12m in cash to acquire Mintera Corp of Acton, MA, USA, which makes high-bit-rate optical transport subsystems. Mintera's quarterly revenue has fallen from \$7–8m a year ago to \$2–3m due to several customers worrying about its financial stability before acquisition. But the 40G market is "working again", says Couder. "We feel reasonably confident in the ability to ramp given their relatively mature organization and delivery to those revenues before."

For fiscal first-quarter 2011 (ending 2 October 2010), Oclaro expects revenue to be up 9% to \$120–126m (including \$3–4m from Mintera) and adjusted EBITDA to rise to \$12.5–15.5m. Non-GAAP gross margin should rise to 31–33%, but it will be constrained by higher-margin APS sales growth continuing to be limited by production capacity still being unable to fulfill demand.

"Our technology differentiation and product breadth are creating new opportunities for Oclaro; and so we believe our growth will continue through 2010 and that calendar 2011 is shaping up to be a strong growth year," says Couder.

Oclaro expects Mintera's operating

"We have a plan to scale the company quickly and reach the \$1bn revenue rate in 2–3 years," says Couder

► loss to be \$2.5m in the September quarter, but to improve to \$1.5m in the December quarter and break-even in the March 2011 quarter (considering transitioning products, aligning operations, in-feeding products, as well as scale from revenue growth). Initially, margin should be "quite a bit below the low-30s range". However, Oclaro's target model for Mintera is gross margin of 40–45% and non-GAAP operating margin of 20–25%.

Oclaro targets reaching overall gross margin of 35% by fiscal Q4/2011 (to end June). "But, with solid revenue demand, we could

achieve target as early as this December," reckons Turin.

Oclaro is hence increasing its target non-GAAP operating margin from 10–12% to 12–15%. "When we first achieve 35% gross margins, we would initially expect non-GAAP operating margin to be about 12%. With continued revenue growth at 35% margin, non-GAAP operating margins should continue to have leverage and scale towards 15%," he adds. "We continue to have a longer-term goal of driving our model towards 40% gross margin or even higher towards the end of next year (with operating margin scaling

accordingly), scaling revenue growth and moving manufacturing to low-cost countries [e.g. from Texas to Asia for the 40G DPSK module]."

Couder's forecast for annual revenue growth was 20–30%, but it is now 30–40%. "We are more bullish than before. We have a plan to scale the company quickly and reach the \$1bn revenue rate in 2–3 years," he says. "We have a significant organic momentum... We may also supplement this with strategic acquisitions," Couder adds. "We have more than 10 small companies on our radar screen."

www.oclaro.com

Oclaro buys optical transport sub-system maker Mintera to broaden 40Gbps portfolio & speed 100Gbps coherent development

Oclaro has acquired privately held Mintera Corp of Acton, MA, USA, which makes high-bit-rate optical transport sub-systems. Oclaro says the acquisition broadens its product portfolio for high-speed telecoms. It will hence offer components and sub-systems covering all major modulation technologies necessary for 40Gbps data transmission in regional, metro, long-haul (LH) and ultra-long-haul (ULH) networks.

"Oclaro's acquisition of Mintera is the latest in a series of strategic moves to increase our addressable market," says president & CEO Alain Couder, who reckons it is another step in building a position in 40Gbps regional and metro networks by broadening Oclaro's product portfolio and systems expertise to expand into 40Gbps LH and 100Gbps coherent markets.

Infonetics Research forecasts that the 40Gbps long-haul optical component market will reach \$150m in 2011, divided almost equally between DPSK and DQPSK technologies. Mintera has achieved market acceptance of its 40Gbps Adaptive DPSK transmission module, which enables ULH transmission compatible with 50GHz channel spacing. By adding Mintera's DPSK technology and products to its existing portfolio of DQPSK com-

ponents and modules, Oclaro can now offer a complete line of solutions for the full range of 40Gbps networks, maximizing the internal use of its discrete optical engines.

Oclaro reckons that, beyond 2011, the 40Gbps DPSK market will begin to migrate to coherent technologies, enabling lower line costs and simpler deployment. Mintera's 40Gbps PM-QPSK (coherent) module is due for production by second-half 2011. Its 40Gbps coherent technology development is expected to further enhance Oclaro's competitiveness in developing 100Gbps components and modules.

Due to an existing partnership between Mintera and ClariPhy Communications Inc of Irvine, CA, USA, a fabless semiconductor firm providing mixed-signal ICs for 10, 40 and 100Gb/s optical networks (and an Oclaro strategic partner), the 40Gbps Coherent module is expected to be the first such product on the market.

Mintera's team includes technical experts with knowledge of high-performance optical systems, who are expected to augment Oclaro's own systems-level capabilities. President & CEO Dr Terry Unter is to remain with Oclaro for a transitional period and lead the new 40/100Gbps module & subsystem

division, reporting to Couder. A longer-term role for Unter will be explored in Oclaro's executive management. Unter has over 20 years' experience in the optical communications industry, involving executive, engineering, management and operations roles at firms including Corvis Corp, AMP, Alcatel, and Northern Telecom.

"Oclaro's products and technologies are highly complementary to Mintera. We serve different but complementary segments of the telecommunications supply chain," says Unter. "Mintera can leverage Oclaro's strong customer relationships and recognized brand to accelerate sales of our products and technologies," he adds. "In addition, the Mintera team will contribute significantly to helping Oclaro create a leadership position in 40Gbps and 100Gbps LH and ULH telecommunications markets," he believes.

Mintera's revenue was about \$20m for the 12 months to end-June. The acquisition's terms call for a cash payment of \$12m upon close, plus a revenue-based earn-out (payable in cash or stock, at Oclaro's option) ranging from \$0 to \$20m on achieving cumulative revenue of \$70m over the next 18 months.

www.mintera.com

International Trade Commission bans import of Emcore parallel fiber optics products infringing Avago patent Limited exclusion order and cease & desist order issued

The International Trade Commission (ITC) has concluded its investigation in response to a complaint filed by Avago Technologies in February 2009 against fiber-optic component maker Emcore Corp of Albuquerque, NM.

The complaint alleged that certain optoelectronic devices, components, and products containing them infringed Avago's US Patent Nos. 5,359,447 ('Optical Communication With Vertical-Cavity Surface-Emitting Laser Operating In Multiple Transverse Modes') and 5,761,229 ('Integrated Controlled Intensity Laser-Based Light Source'). The patents were issued originally to Hewlett-Packard in October 1994

and June 1998, respectively. The products are Emcore's 12-channel parallel optical transmitter and receiver modules, 4-channel parallel transceiver modules, VCSEL TOSAs and ROSAs, 1x12 and 1x4 VCSEL arrays and photodiode arrays, singlet VCSELs and pin photodiodes, and VCSELs in TO cans, made by contract manufacturer Fabrinet in Thailand.

On 12 March 2010, the presiding administrative law judge (ALJ) issued his initial determination (ID), finding no infringement of claim 8 of patent 5,761,229 and claim 6 of patent 5,359,447 but finding infringement of one or more of the claims 1, 2, 3 and 5 of patent 5,359,447 (Avago

withdrew claim 4 from the investigation in its post-hearing brief).

The ITC has now issued Emcore with a limited exclusion order (LEO) and a cease and desist order (CDO). The LEO prohibits the unlicensed importation into the US of the infringing optoelectronic devices, components, and products containing them. The CDO prohibits Emcore from importing, selling, marketing, advertising, distributing, offering for sale, transferring (except for exportation), and soliciting US agents or distributors for the infringing products.

www.emcore.com

www.usitc.gov

IN BRIEF

Avago joins large-cap Russell 1000 Index

Avago Technologies Ltd, which designs and supplies analog interface components (with a focus on III-V based products) for communications, industrial and consumer applications, has been added to the Russell 3000 Index as well as the large-cap Russell 1000 Index.

"Membership in the Russell 1000 Index represents another milestone for Avago," says Doug Bettinger, Avago's senior VP finance & chief financial officer. "Inclusion reflects Avago's place in the market after our IPO in August 2009," he adds.

Annual reconstitution of Russell's US indexes captures the 4000 largest US stocks as of the end of May, ranking them by total market capitalization. Russell determines membership for its equity indexes primarily by objective, market-capitalization rankings and style attributes.

www.russell.com

12kV fiber-optic short-link isolator for renewable energy and medical apps

Avago has launched the 10MBd HFBR-3810Z fiber-optic (FO) short-link transmitter/receiver for isolating frequency inverter and power converter applications common in renewable energy installations.

In power-generating wind and solar farms, fiber-optics technology is widely considered to be the preferred isolation technology to interface between low-voltage control logic or microprocessors and high-voltage power inverters and switching circuits, says Avago.

The FO short-link technology pin-to-pin distance of 24.96mm provides transient voltage suppression of 12kV according IEC 60664-1. Avago's 650nm-wavelength FO short-link technology allows galvanic isolation on one PCB where previously separate transmitter/receiver pairs on two PCBs were linked by plastic optical fiber for isolation. The HFBR-3810Z (which has a 13mm x 33.56mm PCB footprint of 4.36cm²) allows much more compact designs, Avago says. The extended temperature range is -40°C to +85°C.

FO short-link devices have creepage and clearance specifications greater than existing optocoupler devices and offer superior galvanic isolation than transformer-based technology, Avago claims.

Fiber technology also has excellent EMI resistance and EMC characteristics (with a HFBR-3810MSZ metal shield version also available). The HFBR-3810Z short-link transmitter/receiver operates reliably in high-noise environments common in high-voltage switching and motor control equipment and systems. The DC-coupled data link does not require data encoding or digitizing circuitry. The FO receiver has a CMOS/TTL output for easy interface design (with no data encoding or digitizing circuitry required).

Avago also offers a wide range of fiber-optic transmitters, receivers, and transceivers, and IGBT/power MOSFET gate drivers, and optocoupler isolation products for wind turbine, wind farm and solar electric power generation applications.

www.avagotech.com

Emcore and San'an to form JV for terrestrial CPVs

Emcore grants Suncore exclusive license to make receivers, modules and systems in China

Emcore Corp of Albuquerque, NM, USA, which makes components and subsystems for the broadband, fiber-optic, and solar power markets, and San'an Optoelectronics Co Ltd of Xiamen, China have agreed to form the joint venture Suncore Photovoltaics Co Ltd, for developing, manufacturing and distributing concentration photovoltaic (CPV) receivers, modules and systems for terrestrial solar power applications.

In conjunction, Emcore has agreed to grant Suncore an exclusive license to manufacture its current and future improved CPV receivers, modules and systems in China for terrestrial solar power applications.

San'an is the largest producer of LED epitaxial wafers and chips in China (with annual capacity of 650,000 wafers or 20 billion LED chips) as well as being involved in CPV manufacture and deployment. The firm is listed on the Shanghai Stock Exchange and has a market capitalization of more than \$3bn.

Owned 40% by Emcore and 60% by San'an Optoelectronics, Suncore's chairman will be San'an Optoelectronics' chairman Xiucheng Lin and the general manager will be Emcore senior VP Dr Charlie Wang. All operational activities and business for CPV receivers, modules, and systems currently residing at both San'an and Emcore's Langfang, China manufacturing facilities will eventually be transferred to Suncore, and its primary manufacturing operations will be in Wuhu city, Anhui province of China. The economic development organization of Wuhu city has agreed to provide significant economic incentives, including land, subsidies, grants and other incentives.

Suncore will serve as Emcore's primary low-cost/high-volume manufacturing base for CPV receivers incorporating its CPV solar cells, and for CPV modules and systems to support both

Emcore and San'an are pursuing multiple CPV project opportunities, including the 280MW solar energy plan in six western regions of China recently announced by the Chinese government

Also, Emcore and San'an are pursuing multiple CPV project opportunities, including the 280MW solar energy plan in six western regions of China recently announced by the Chinese government.

"The formation of this joint venture represents a significant step in Emcore's business strategy towards introducing CPV products for terrestrial solar power applications in one of the fastest-growing solar power markets," says Emcore's president & CEO Dr Hong Q. Hou. "By commercializing Emcore's terrestrial Gen-III CPV systems through this low-cost manufacturing base, we believe Emcore will be in position to gain significant advantages over competing terrestrial solar technologies," he adds.

Emcore's and San'an's worldwide sales efforts. Subsequent to the establishment of Suncore, it will start work on producing 12MW of CPV systems for San'an's current customers and 2MW of CPV components for projects sourced by Emcore.

"Furthermore, the joint venture provides an ideal platform to penetrate China's emerging renewable energy market."

San'an is a "well established Chinese company that shares the same vision and passion for the CPV market", says Hou. "Our joint venture with San'an will enable Emcore to leverage our existing resources, infrastructure and market presence to accelerate growth in the China and other global markets," he adds.

"China is accelerating development and deployment of solar energy resources," comments San'an's chairman Xiucheng Lin. "The potential for CPV terrestrial

San'an is a well established Chinese company... Our joint venture with San'an will enable Emcore to leverage our existing resources, infrastructure and market presence to accelerate growth in the China and other global markets

systems over the next several years is enormous. Combining the advantages provided by San'an and Emcore, the joint venture will have the capability of high-volume and low-cost manufacturing, the most advanced CPV technology and continued innovation," he adds. "Suncore will play a key role in accelerating

the market adoption and deployment of CPV solar power."

www.sanan-e.com

www.emcore.com

Sharp, Enel and ST form 3Sun for PV production in Italy Enel and Sharp form separate JV for power generation in EMEA

After authorization of a €49m subsidy by the Italian government's CIPE (Inter-ministerial Committee for Economic Planning), Japan's Sharp Corp, Rome-based Enel Green Power (EGP, a company of Italy's largest power firm Enel Group) and Europe-based semiconductor manufacturer STMicroelectronics (ST) have formed the equal-share joint venture 3Sun S.r.l. for the integrated production of thin-film photovoltaic cells and panels (in line with an agreement of 4 January). The partners have now signed a binding letter of commitment for a project financing agreement of €150m.

Each partner brings specialist knowledge and skills to the JV. EGP has expertise in developing renewable energy on an international scale and in project management. Sharp is contributing its exclusive III-V-based triple-junction thin-film PV technology, which entered production this March at its new GREEN FRONT SAKAI plant in Osaka Prefecture, Japan. ST has manufacturing know-how with trained specialists in technology sectors such as microelectronics.

By using an unfinished former 300mm silicon fab shell in Catania, Sicily owned by ST, 3Sun will begin producing thin-film solar panels in second-half 2011, with an annual capacity of 160MW initially making it Italy's biggest solar panel plant (expanding to 480MW in future).

Initial capacity is to be financed via a combination of self-financing, the €49m funding from the CIPE, and project financing provided by leading banks. Each JV partner has underwritten a third of the equity, with a commitment of €70m in cash or in tangible and intangible assets.

The panels will be marketed mainly in Europe and the Mediterranean area through the sales networks of Sharp and EGP. Enel.si, an EGP subsidiary that installs PV systems for the retail market, will also market the panels through its franchise network of over 500 approved installers throughout Italy.

Also, the joint venture Enel Green Power & Sharp Solar Energy S.r.l (ESSE) has been formed in Rome between EGP (50%), Sharp (40%) and Italian sales subsidiary Sharp Electronics (Italia) S.p.A. (10%).

Using thin-film solar panels produced by 3Sun, ESSE will be an independent power producer (IPP) developing, building and operating plants for generating photovoltaic power for sale to utilities and end-users in Europe, the Middle East and Africa (EMEA), with a particular focus on the Mediterranean area (where EGP and Sharp already have extensive sales networks).

Thin-film PV panels suit large-scale solar power generation (especially in Mediterranean areas including southern Europe) since, compared to silicon-type solar cells, they can maintain their conversion efficiency even in hot climates. ESSE aims to establish power generation plants with a total capacity of more than 500MW by the end of 2016.

Sharp adds that, through collaboration with a power generating firm, it aims to become a 'total solution' company in PVs, initiating what is claimed to be the first business model extending from thin-film solar cell production to IPP business.

www.st.com

www.enelgreenpower.it

www.sharp-world.com

OPEL closes \$7.55m private placement

OPEL International Inc of Shelton, CT, USA and Toronto, Ontario, Canada, which makes high-concentration photovoltaic (HCPV) panels (as well as both roof- and ground-based dual- and single-axis solar trackers for mounting them), has closed its private placement (announced on 10 June) of 25,164,665 units at a price of \$0.30 each for gross proceeds of \$7,549,400.

Each unit consists of one common share and one-half of a common share purchase warrant. Each whole warrant entitles the holder to purchase one additional share at \$0.50 each until 21 July 2012. The securities issued may not be traded before 22 November 2010.

IBK Capital Corp was lead agent. The agents received total commissions of \$668,556 and 2,476,134 compensation warrants (each entitling the holder to purchase one common share at \$0.30 each until 21 July 2014).

The offering exceeded the original \$7m target, despite the tough economic times, points out CEO Leon M. Pierhal. "This capital raise ensures the company's ability to build out the necessary inventory to timely supply its forecasted solar project backlog."

Net proceeds will be used to secure key components for solar products, for R&D, and for general working capital purposes. Much of the manufacturing of the products required

for upcoming solar projects will be performed in the USA and Canada. OPEL says that this should result not only in the achievement of its forecasted revenue, but also in the creation of jobs in the North American manufacturing sector.

"The OPEL team is enthusiastic to get underway to fulfill the requirements of the projects which our relationships with some of the largest EPC (engineering, procurement and construction) partners have yielded," says Pierhal. "The investors in OPEL have clearly affirmed their belief in our ability to deliver solar energy at the utility-scale level."

www.opelinc.com

Concentrix establishes US subsidiary following California Energy Commission listing

CPV system maker targets power plants in US southwest

Strengthening its presence in the US market for solar power plants, concentrated photovoltaic (CPV) system maker Concentrix Solar GmbH of Freiburg im Breisgau, Germany, a division of the Soitec Group, says that it has launched a US-based subsidiary, hired additional industry professionals, and won listing from the California Energy Commission. The firm says that its utility-scale power plant technology is proven and commercially ready for large-scale deployment with all the key capabilities in place for increasing business in the USA.

Concentrix was founded in 2005 as a privately held spin-off of the Fraunhofer Institute for Solar Energy Systems ISE. Last December, about 80% of its shares were acquired by the Soitec Group of Bernin, France, which manufactures engineered substrates including silicon-on-insulator (SOI) wafers (as well as III-V epiwafers through its Picogiga International division).

"With the development and growing importance of solar farms in the US, the time is right for us to form our US venture," says Concentrix Solar's CEO Hansjörg

Lerchenmüller. "Due to our CPV technology's extreme efficiency, modularity and flexibility, we are prepared to meet the needs and challenges of the US market," he adds.

The new US subsidiary Concentrix Solar Inc is based in San Diego, where Concentrix installed a CPV demonstration system in July 2009 to test its solar modules under California's climate conditions. Since its installation, the 6kW system has achieved 25% efficiency in generating electricity.

After evaluating the market potential for its CPV technology, Concentrix Solar decided to open the US office, which will be led by Clark Crawford, the firm's new general manager of business development. Previously, Crawford led sales & marketing efforts at CPV systems supplier Amonix Inc of Seal Beach, CA, USA, and has a track record of securing large-scale orders of CPV systems.

Also, after testing at TÜV Rheinland Photovoltaic Testing Laboratory LLC in Tempe, AZ, Concentrix's CX-75 multi-junction CPV module has achieved a listing with the California Energy Commission (CEC), which is

vital to doing business in California and a key step in financing commercial projects with customer companies and state energy utilities, says the firm.

Concentrix says that its CPV technology is designed for use by large-scale solar power plants in hot, arid regions. With characteristics such as low heat degradation and high durability, the system is suited to power plant installations in the American southwest. Performance benefits include a constant power-output curve to maintain the electricity supply needed to meet peak-load demands, the ability to operate without active cooling mechanisms, and almost no energy loss at high ambient temperatures.

Concentrix says that these attributes helped it to win a project with Chevron Technology Ventures to install the energy firm's first megawatt solar farm in the US, at a site in New Mexico (as announced in February). Construction has begun on the project, which will be one of the largest CPV power plants ever built in the USA. Completion is scheduled by the end of this year.

www.concentrix-solar.de

Concentrix to inaugurate its first power plant in South Africa

On 1 September, Concentrix Solar will inaugurate its first power facility in South Africa — a 60kW plant at the Aquila Private Game Reserve in Touwsrivier, Western Cape — as the initial step in developing large-scale solar power projects in the country.

"CPV systems are perfectly suited for use in South Africa, with its energy shortage, water scarcity and high temperatures," says Concentrix Solar's CEO Hansjörg Lerchenmüller, who adds that the systems can be implemented quickly and easily, do not need

cooling water and do not suffer from heat degradation at hot ambient temperatures. "In addition, this facility will initiate the transfer of know-how, and serves to develop local skills in South Africa with immediate effect."

With the new installation, the Aquila Private Game Reserve can cover all energy requirements during daylight hours as well as making a positive contribution to environmentally friendly tourism, Concentrix comments.

Concentrix is also actively pursuing the project development of a

50MW utility-scale power plant in the Western Cape. The firm has been present in South Africa since 2008 and has the ability to develop large-scale solar projects and deliver turnkey solutions under local conditions utilizing local content, it adds.

With a high amount of direct solar irradiation, South Africa is suited to the use of Concentrix's CPV systems which, due to their high efficiency and two-axis tracking, provide constant high power output throughout the day, the firm claims.

Amonix signs lease for CPV factory in North Las Vegas

Amonix Inc of Seal Beach, CA, USA, which makes concentrated photovoltaic (CPV) systems using III-V multi-junction cells, has signed a lease for a new 214,000ft² manufacturing facility in North Las Vegas, NV that should be up and running by the end of 2010 and create 278 private-sector jobs in Southern Nevada. The firm intends to hire local residents to fill management, technical, and production roles.

In May, while presiding over a ceremony to inaugurate a 308kW Amonix CPV power plant at the Southern Nevada Water Authority's (SNWA) River Mountains Water Treatment Facility, Senate Majority Leader Harry Reid applauded Amonix for taking advantage of an Advanced Energy Manufacturing Tax Credit in the 2009 American Recovery and Reinvestment Act. The plant is financed through a \$6m tax credit plus another \$12m in private capital. "Amonix offers the perfect example of how the Recovery

Act is helping Nevada businesses and the clean energy industry expand and thrive," says Reid. "Nearly 300 Nevadans will find work in this developing industry that is diversifying our state's economy so that we don't fall victim to another economic downturn," he adds.

"I'd like to thank all of our leaders in Congress who made the Recovery Act a reality," said mayor Shari L. Buck of the City of North Las Vegas. "This plant, made possible through public-private cooperation, will make a real difference to our community and families."

"The Amonix commitment to Nevada will help propel ongoing efforts to make the Silver State a world leader in solar production while also creating local jobs and promoting economic growth," adds Congresswoman Shelley Berkley.

Amonix CPV power systems have been installed at three locations in Nevada, including also the University of Nevada, Las Vegas campus and

Nevada Energy's Clark Generation Station. The firm will use its new North Las Vegas facility to manufacture solar power systems for additional installations in Nevada and for export to neighboring states. In addition, the new manufacturing facility will be powered by an Amonix 7700 CPV system as part of its electrical power source.

"Amonix chose this site because our CPV solar systems are ideal for sunny and dry climates like Nevada," says CEO Brian Robertson. "This plant puts additional capacity in close proximity to where many of our systems will be installed."

When at full capacity, the plant will operate 24 hours per day, seven days per week, manufacturing CPV equipment with a production capacity of 150MWs annually (equivalent, according to Robertson, of NV Energy's stake in the recently cancelled coal plant at the Mohave Generating Station).

www.amonix.com

NREL confirms that Soloptics' PV surface technology boosts efficiency by 10–12.5%

Soloptics, a division of Genie Lens Technologies LLC of Englewood, CO, USA (a specialist in applied optics and light ray management solutions that develops and patents intellectual property to then license or sell to industry commercialization partners) has announced results from recent performance testing at the US Department of Energy's National Renewable Energy Laboratory (NREL) for FUSION, its patent-pending photovoltaic enhancement technology.

FUSION is an optics-based surface technology that can boost the conversion efficiency of photovoltaic (PV) panels in an effort to lower the cost of electricity generated by solar photovoltaics, says the firm. The technology uses microstructures that can be embossed or cast into either a thin polymer film and then adhered to a PV panel (either in the

factory or in the field) or engineered directly into the protective glass layer used in most PV panels produced currently.

In tests performed by NREL at its research campus in Golden, CO, FUSION delivered conversion efficiency gains ranging from 10–12.5% (depending on testing conditions) for less than \$0.10/Watt (installed cost), regardless of the underlying PV material.

"The FUSION product shows significant improvement in the PV current over existing technology, particularly under various low-level lighting conditions," says Keith Emery, principal research supervisor at the Outdoor Test Facility, NREL's laboratory for characterizing the performance and reliability of PV cells, modules, and small systems.

FUSION's gains in efficiency are

amplified by its low cost, driven primarily by its integration into existing glass and plastic film manufacturing processes and its use of readily available and inexpensive materials.

FUSION is also claimed to be the only efficiency boosting technology whose application process can take place in the field (for the film version) or at the production facility, and installation does not require expensive specialized equipment or labor. It can also be customized on the basis of various factors such as higher/lower diffuse light conditions, specific panel manufacturers, or to filter out specific wavelengths of light.

"We look forward to ongoing testing and development," says Genie Lens' president Melissa Grossman.

www.soloptics.com

SRC forms The Energy Research Corp industry–university collaboration

University-research consortium Semiconductor Research Corp (SRC) of Research Triangle Park, NC, USA has established a \$5m industry–university partnership to bring clean, reliable and efficient energy systems and technologies to market. Founding industry members include ABB, Applied Materials, Bosch, First Solar (which makes solar modules based on cadmium telluride), IBM, Nexans and Tokyo Electron.

Managed by SRC subsidiary The Energy Research Corp (TERC), which was formed in 2009 to create opportunities between the semiconductor industry and the energy sector, the Energy Research Initiative (ERI) will team companies from the semiconductor sector and other energy-related sectors with university research centers in order to address the need for smart alternative energy sources and to prepare students with the technical skills required for the burgeoning industry.

Initial research will address the need for new modeling and simulation tools to support the development of improved photovoltaic devices and the development of systems and technologies to enable an efficient, reliable and secure smart-grid electricity infrastructure with integrated renewable energy resources.

“The pervasive use of simulation in semiconductor process development, device design and system analysis has been a critical factor in the success of the electronics industry. Similar capabilities do not exist for technologies in support of solar-powered systems,” says SRC executive VP Steven Hillenius. “Likewise, today’s smart-grid simulation capabilities are also limited, and new transformational approaches are required to enable significant integration of renewable energy resources into the grid,” he adds. “The development of these capabilities is beyond the scale of a single company or even industry, making the cooperation between

industry and academia critical to delivering the benefits of alternative energy on a global scale.”

The ERI will initially address two critical areas for efficient distribution of renewable energy resources: photovoltaics and systems and technologies to enable and optimize smart grids.

A Photovoltaic Research Center will be established at Purdue University to address the performance, cost, reliability and manufacturing challenges of PV technologies. The center will leverage Purdue’s modeling/simulation expertise and national Network for Computational Nanotechnology framework to provide enabling analytical models and simulation tools for photovoltaic manufacturers (much as Purdue has done for the semiconductor industry).

A Smart Grid Research Center will be established at Carnegie Mellon University to support the incorporation of renewable energy resources and provide modeling, simulation and control tools needed to manage, optimize and secure the power grid. The center will develop the dynamic monitoring and decision systems (DYMONDS) required to create a new paradigm for the electricity infrastructure. Also, personal energy systems will be enabled that provide individuals and organizations choices and flexibility in the use of energy.

The ERI will also train and educate students, providing them with expertise and skills needed to transition these new methods to market.

Research will be undertaken by a global network of universities consisting of several university centers, starting with Purdue and Carnegie Mellon. Each center will have its own research focus and area of expertise, with close coordination to complement the respective programs. ERI’s industry members will dedicate engineering and other resources and participate in the selection of appropriate research projects.

www.src.org

IN BRIEF

Proposals sought for PV Technology Incubator program

The US Department of Energy’s (DOE) National Renewable Energy Laboratory (NREL) is seeking project proposals as part of recently announced DOE funding to accelerate commercialization of solar energy technologies.

The Photovoltaic (PV) Technology Incubator project fosters collaboration between US small businesses and NREL and other DOE laboratories and facilities. Funding aims to focus attention on high-impact areas that are critical to scaling up PV technology and meeting aggressive DOE goals to reduce the cost of PV-generated electricity and expand installed PV capacity by 2015.

“The PV Technology Incubator helps companies quickly overcome R&D hurdles that are inhibiting the commercialization of their promising technologies,” says NREL senior program manager Martha Symko-Davies.

NREL will accept responses to the latest solicitation in two categories: Tier 1 and Tier 2. In previous rounds of the PV Incubator program, separate solicitations for Letters of Interest (LOI) have been issued under ‘Pre-Incubator’ and ‘Incubator’ programs. For this round, NREL is requesting LOI bringing the two under a single solicitation:

- Tier 1 projects will receive up to \$1m through 12-month subcontracts and focus on speeding the development of innovative PV module-related technologies to the prototype stage.

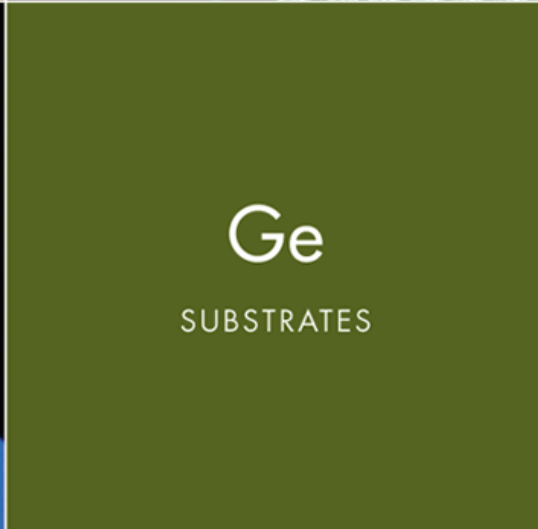
- Tier 2 projects will receive up to \$4m through 18-month phased subcontracts and focus on hastening firms transitioning innovative lab-scale and pre-commercial prototypes into pilot and then full-scale manufacture.

www.nrel.gov

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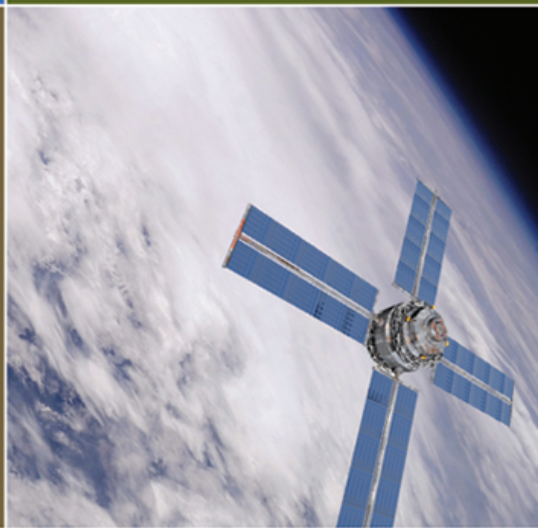
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SUBSTRATES



USA Headquarters

4281 Technology Drive
Fremont, CA, USA 94538
Tel: 510-438-4700
Fax: 510-353-0668
Email: sales@axt.com

China

Beijing Tongmei Xtal Technology
4 Eastern Second Street
Industrial Development Zone
Tongzhou District,
Beijing, China 101113
Tel: 86-10-6156-2241
Fax: 86-10-6156-2245
Email: sales@axt.com

Japan East

MO Sangyo Co. Ltd.
Soto-Kanda Nagashima Building
No.2, 7F, 3-2-3 Sotokanda
Chiyoda-ku, Tokyo
Japan 101-0021
Tel: 03-5298-1060
Fax: 03-5298-1070

Japan West

Mo Sangyo Co, LTD.
201 Ashiya-Farfalla, 6-16
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Fax: 886-2-2501-6279
Email: sale@conary.com.tw

Korea

Iantek Corporation
CheongMyung Towntel 607,
1021-4 YeongTong-Dong,
YeongTong-Gu
Suwon-Si, Kyunggi-Do 442-813
Korea
Email: iankim@iantek.co.kr

Europe

Geo Semiconductor Ltd.
POB 6262
CH 1211 Geneve 6
Switzerland
Tel: 33-1-45316284
Fax: 33-1-45333943
Mobile: 33-680-134-895
ralphhananel@gmail.com

United Kingdom

Geo Semiconductor (UK) Ltd
Newton Grange
Kingsley Green, Kingsley Road
Frodsham, Cheshire WA6 6YA
United Kingdom
Tel/Fax: 44-(0)-1928-735389
Mobile: 44-(0)-779-543-8189
Email: johnlockleyaxt@aol.com

First Solar revenue grows just 3.5% to \$587.9m in Q2 2010 revenue, cash flow generation and CapEx forecast cut

For second-quarter 2010, First Solar Inc of Tempe, AZ, USA, which makes thin-film photovoltaic modules based on cadmium telluride (CdTe) as well as providing engineering, procurement and construction (EPC) services, has reported net sales of \$587.9m. This is up 12% on \$525.9m a year ago, driven by increased production volumes and systems revenue, partially offset by a decline in pricing and lower euro exchange rates. It is also up 3.5% on \$568m last quarter, due mainly to increased turnkey system sales (EPC system sales rose from 7% of total sales to 15%).

Production shipments totaled 344MW, up 7% on last quarter due partly to annual capacity per line rising 6% (equating to adding two new production lines) to 59MW. This boosts current and announced capacity from 2.1GW to 2.2GW by 2012 (compared to 1.4GW current capacity). The Malaysian facility's Plants 5 and 6 are on track to start shipments in first-half 2011. The firm also recently announced the addition of a new four-line plant in Frankfurt (Oder), Germany, where shipments will begin in fourth-quarter 2011.

However, gross margin fell from 49.7% last quarter to 48.3%. This was due to the increased (lower-margin) EPC system mix, lower module ASPs and accrued module replacement costs, offset by module manufacturing cost per Watt being cut by 13% year-on-year and by 6% from Q1's \$0.81 to \$0.76 (benefiting from higher throughput rates, improvement in conversion

efficiency to 11.2%, lower material costs and the decline in the euro).

Net income has fallen from \$180.6m a year ago and \$172.3m last quarter to \$159m, due mainly to operating expenses rising \$12.8m. Capital expenditure was \$134m, including Plants 5 and 6 in Malaysia, the Frankfurt (Oder) Plant 2, and the new plant in France.

First Solar's 2.2GW of captive projects provides a buffer against potential demand fluctuations in the European market. "We continue to work with our partners to expand the business in Europe," says CEO Robert Gillette. In Q2 the USA became First Solar's number-2 market, but it was closely followed by continued growth in France and Italy as the firm diversifies its country mix. Germany's share of sales fell year-on-year from 71% to 50%, despite strong module demand ahead of the government lowering its feed-in tariff (FiT) on 1 July.

Module pricing has hence been set for Q3 to ensure sell-through at the new German FiT, and for Q4 to position channel partners for sales for 2011 in anticipation of further FiT declines. In Italy, the level of support will be cut by 23–27% over the next four quarters (depending on the type of installation) but should continue to enable investor returns and encourage demand growth in second-half 2010 and into 2011.

For full-year 2010, First Solar expects sales of \$2.5–2.6bn. This is up on 2009's \$2.07bn but a cut from late April's forecast of \$2.6–2.7bn. Because the firm expects to remain

capacity-constrained in second-half 2010, it has reallocated module capacity from its EPC & Systems business to meet stronger module demand from Europe.

Capital spending should be \$575–625m (more than double 2009's \$280m, but down on late April's forecast of \$625–650m). First Solar has also cut its forecast for plant start-up costs from \$27m to \$20m (mainly from Malaysia Plants 5 and 6 in second-half 2010).

The firm has also lowered its expectation for operating cash flow generation from \$725–775m to \$575–625m (down on 2009's \$675m) due to investments in the development of project assets from the NextLight Renewable Power LLC acquisition completed on 12 July (including 530MW of projects in North America). First Solar plans to increase Systems project construction from 175MW in 2010 to 500–700MW in 2011 as it looks to service its 2.2GW pipeline of projects stretching out to 2015.

Correspondingly, First Solar is currently adding a total of 14 new module production lines (capacity of 826MW at current annual run rates) in the coming years. In addition, through increasing efficiency to 14%, the goal is to raise the annual capacity per line from 59MW (in Q2/2010) to 80MW by 2014. This is critical to continuing the reduction of module manufacturing cost per Watt (which has halved from \$1.59 in 2005 to \$0.76 in Q2/2010) to the targeted \$0.52–0.63 in 2014.

www.firstsolar.com

First Solar completes acquisition of NextLight

First Solar has completed its \$297m acquisition of NextLight Renewable Power LLC of San Francisco, CA, a solar development firm formed by the inaugural fund of Energy Capital Partners (a private equity firm focused on investing in North America's energy infrastructure).

First Solar now has power purchase agreements for 2.2GW of utility-scale solar projects in North America.

The deal is another step in expanding into the US utility-scale power market, after acquiring Turner Renewable Energy in 2007 as well as the solar project

pipelines of OptiSolar in 2009 and Edison Mission Group in 2010.

The first project developed by NextLight that is expected to start construction by First Solar is the 290MW Agua Caliente Solar Project in Yuma County, AZ. Construction is expected to start this year.

AQT's first manufacturing plant starts production

Production line to fulfill first 20MW of orders

AQT Solar of Santa Clara, CA, USA has opened its new facility in Sunnyvale for manufacturing its copper indium gallium diselenide (CIGS) thin-film photovoltaic cells. The plant — in a new R&D and manufacturing facility (close to the firm's headquarters) — has already begun production on an initial manufacturing line with annual capacity of 15MW, in order to fulfill customer orders of 20MW (with substantial purchase orders in the pipeline).

Founded in 2007, AQT's rapid path from inception to production in two years is claimed to be unprecedented in the solar industry, demonstrating its technology and 'CIGS 2.0' business model.

AQT uses a proprietary process (allowing continuous in-line production) together with manufacturing platforms that have been field-proven in the hard-disk-drive industry. In early April, AQT announced a strategic partnership with Santa Clara-based Intevac, which designs and makes high-productivity sputtering-based manufacturing systems, to supply

its manufacturing equipment to AQT.

Also in early April, AQT closed a \$10m second round of venture funding (bringing the total raised to almost \$15m), which financed construction of the new facility.

As well as using 'off-the-shelf' manufacturing equipment from Intevac, the line's modular design also allowed for quick on-site deployment. The new site's preparation, build-out, line implementation and qualification, and production initiation was completed in less than eight weeks. AQT says that the small footprint of each highly automated machine provides efficient use of space within the 20,000ft² facility. The firm can hence scale up the plant to an annual production capacity of 60MW in an area many times smaller than its nearest competitors, it is claimed.

"Starting commercial production so early in our company's lifecycle is a confirmation of our business model, the leverage we receive from world-class partners like Intevac, and our breakthrough

CIGS production process," claims CEO Michael Bartholomeusz.

"We have set aggressive production goals for the remainder of 2010 and beyond."

AQT has also announced its first customer installation, at the large Sol Pacifico high-end property development, which has ordered a 2MW plant to power its gated community in Baja Mexico on the Pacific coast. Scheduled to break ground in 2011, the plant could potentially grow to 9MW. "This project represents a concerted effort at renewable and responsible resort development," says Sol Pacifico project manager Antonio Cordova. "Our vision was of a sustainable and eco-friendly project."

In August, AQT is moving its headquarters and R&D from its original location in Santa Clara to the new site in Sunnyvale. It expects to add 40 jobs over the next six months in Silicon Valley. AQT is also evaluating sites for a second high-volume facility, expecting to break ground on it early next year.

www.aqtsolar.com

SoloPower launches flexible CIGS PV module product

Displayed on the booths of Shoals Technologies Group and eIQ Energy, at InterSolar 2010 in San Francisco (13–15 July) SoloPower Inc of San Jose, CA, USA launched its debut copper indium gallium diselenide (CIGS)-based, thin-film, lightweight, flexible SFX1-i photovoltaic module.

The SFX1-i module (80Wp, 0.3m x 2.9m, 2.3kg/5lbs) represents the first of several products of SoloPower's flexible module product line, which includes the SFX1-i3 module (260Wp, 0.9m x 2.9m, 6kg/13lbs) and the SFX2 module (170Wp, 0.3m x 5.8m, 3.6kg/8lbs).

SoloPower claims that its proprietary roll-to-roll electroplating



SoloPower's CIGS PV modules.

manufacturing process offers unique cost advantages including low capital expenditure, high line throughput and excellent material utilization.

"The SFX1-i3 lightweight module is optimized for commercial and industrial roofs, allowing our customers to increase their profitability and to complete projects that would not have been possible with other technologies," says CEO Tim Harris.

Select customers are currently sampling the SFX1-i and SFX1-i3 modules off SoloPower's existing production line, with general availability scheduled for second-half 2010.

The company is also in the process of a significant capacity expansion to meet further market demand.

www.solopower.com

IN BRIEF

Brian Harrison joins Solyndra as president & CEO

Brian Harrison has joined Solyndra as president & CEO and will be appointed to the firm's board of directors. Prior CEO & founder Dr Chris Gronet will continue with the firm in an executive capacity and as chairman of the board.

From 2008, Harrison was president & CEO of flash memory company Numonyx B.V. and Numonyx Inc. Previously, he was VP & general manager of the Flash Memory Group of Intel Corp (managing all flash memory businesses). Other roles at Intel included VP & general manager of Intel Europe, Middle East, and Africa (responsible for regional product sales & marketing) and general manager of Fab/Sort Manufacturing (managing worldwide wafer production facilities).

"Brian's strong understanding of sophisticated manufacturing operations, history of achieving significant product and manufacturing cost reductions, and experience in building an international sales and marketing organization make him the right person to lead our growth," comments Gronet.

"Brian has proven he can ramp operations while aggressively driving down costs in a very competitive global industry," adds board member Steve Mitchell, managing director of investor Argonaut Private Equity.

"Solyndra's rooftop photovoltaic system is highly differentiated, and the market opportunity for the company is tremendous," reckons Harrison.

www.solyndra.com



Solyndra to provide 16.2MW of PV systems to Southern California Edison

Solyndra Inc of Fremont, CA, USA, which makes copper indium gallium diselenide (CIGS) photovoltaic (PV) systems consisting of panels and mounting hardware for commercial rooftops, has been awarded 20-year power purchase agreements to supply Southern California Edison (SCE) with renewable electricity from 16.2MW of solar systems on 18 rooftops. The agreements were awarded to Solyndra's subsidiary Photon Solar LLC.

"Southern California Edison is demonstrating tremendous leadership in the application of distributed solar electricity to serve its customers and address the state's renewable energy goals, and we are pleased to be selected as a part of this industry-leading utility-scale rooftop power generation program," says Corby Whitaker, VP of North America sales. "Rooftop solar takes advantage of unutilized space to generate energy right where it is needed, eliminating the need for costly transmission lines and extensive environmental impact testing and permitting," he adds.

"The Southern California Edison solar rooftop project will ultimately be held out as an example for the rest of the world, demonstrating the benefits of distributed rooftop power generation in achieving

broader renewable generation goals," believes Marc Ulrich, SCE's VP of Renewables and Alternative Power. "We are also pleased that Solyndra designs and manufactures their panels in California, which means this project is maintaining and creating jobs here in our State."

Unlike traditional flat-plate solar modules, Solyndra cylindrical panels are designed to suit large commercial and industrial rooftops. They can be cost-effectively installed on rooftops that require a distributed load of less than 3lbs/ft², which is typical of 'big box' retail, warehouse and other light-industrial roofs which are not designed to support significant additional rooftop weight.

A benefit is that Solyndra's system can be easily moved in the case of re-roofing, building retrofit or ownership change, which is particularly important to many real-estate owners wishing to receive the cash flow benefits of hosting a solar system without encumbering the sale of the property in the future.

Photon Solar intends to complete construction of the 18 rooftop systems comprising the 16.2MW project during 2011 (subject to California Public Utility Commission approval, financing of the project, certain permitting, and other customary closing conditions).

VP of North America sales appointed

Corby C. Whitaker has been hired as VP of North America sales.

From 2007, he was with Energy Conversion Devices subsidiary United Solar Ovonic, most recently as VP of North American sales.

"Corby brings strong solar and roofing sales and channel development experience to our team and, with his leadership, we will continue to rapidly expand sales in our target markets in North America," says CEO Chris Gronet. "He has a proven ability to develop new business and



enhance customer satisfaction."

Whitaker was previously director of sales and service for Berkshire Hathaway

company Johns Manville Corp from 2003-2007, where he managed sales of roofing systems and services. Before that, he served in executive and sales management roles for Suez Energy Services, Constellation NewEnergy Inc, and Ingersoll Dresser Pump.

DayStar in discussions with potential partners Offshore manufacturing targeted after lease terminated on premises

DayStar Technologies Inc of Newark, CA, USA, which is developing copper indium gallium diselenide (CIGS) thin-film photovoltaic products, says that it is pursuing a strategy for offshore manufacturing of its CIGS solar modules.

"While DayStar has accomplished significant innovations with our CIGS process and technology, we have encountered challenges in obtaining affordable capital for the build-out and operation of our facility in Newark," states CEO Magnus Ryde. "We are pursuing opportunities to manufacture our CIGS modules offshore and have begun discussions with several potential partners to implement this strategy," he adds. "They understand the commercial potential for our CIGS modules and they bring substantial manufacturing

and financial capabilities to the table. Those potential partnerships, if consummated, could include joint ventures, licensing agreements, contract manufacturing agreements, a reverse merger with or an acquisition of DayStar," he continues.

"We are confident in our core proprietary CIGS technology and believe that completing a transaction with a strategic partner and manufacturing our CIGS modules offshore would provide the best opportunity to bring our product to market and to manufacture the product in the most cost-effective manner."

On 3 May, DayStar disclosed that it had entered into an agreement for Dynamic Worldwide Solar Energy LLC to provide a series of loan commitments and at least one fully

funded 25MW solar energy project. Dynamic proposed to assign to DayStar its interest in a fully financed contract to fabricate, install and commence operation of a 25MW solar energy generation plant. "If consummated, these projects will add a new 'downstream' dimension to DayStar and allow us to become a fully integrated solar energy company," says Ryde. "DayStar's acceptance of the assignments is subject to applicable due diligence."

As disclosed in a Form 8-K filing with the US Securities and Exchange Commission (SEC) in late July, DayStar has been notified by landlord BMR-Gateway Boulevard LLC that its lease for premises at 7333-7373 Gateway Boulevard in Newark, CA has been terminated.

www.daystartech.com

Sulfurcell to supply 16MW of panels to China and India

Sulfurcell GmbH of Berlin, Germany, which designs and manufactures solar modules based on thin-film copper indium sulfide (CIS), has concluded supply agreements with new customers in India and China in excess of 16MW: more than 10MW of panels to be deployed in new large-scale construction projects and building-integrated photovoltaic (BIPV) applications in China; and more than 6MW by 2012 to New Delhi-based Prime Group (which has subsidiaries in Europe and the Far East) for mainly commercial rooftop projects.

"Sulfurcell's innovative solar energy solutions have been met with great interest in the Asian market," claims CEO & co-founder Dr Nikolaus Meyer. The new supply agreements mark an important stage for the firm as it expands into the global market, he adds.

Sulfurcell was founded in 2001 by Nikolaus Meyer and Ilka Luck as a spin-off of the Hahn-Meitner-Institut (now the Helmholtz Centre Berlin



An array of Sulfurcell copper indium sulfide solar modules.

for Materials and Energy), and in 2002 raised €9m from private investors, followed in 2003 by R&D grants of €7m from the Senate of Berlin. The firm subsequently set up pilot production, leading to market introduction in 2005. In July 2008, the firm raised €85m in an equity fundraising round led by Intel Capital, which was used to construct new production facilities and for R&D.

"We value not just the technological competitive edge offered by the Sulfurcell modules, which are particularly good at generating high yields in spite of the heat of this region, but also Sulfurcell's reputation for high

quality," says Prime Group's founder Surinder Mehta. "Our agreement with Sulfurcell marks the beginning of a what we hope will be a mutually beneficial collaboration," he adds.

"Sulfurcell's high-quality and powerful thin-film solar modules are uniquely well suited for BIPV," claims Meyer.

www.sulfurcell.de

Intel takes further step toward Terabit/s data transmission

III-V/silicon hybrid demonstrates 50Gb/s transmission over fiber.

Intel has combined developments over the past several years to create the first 50Gbps optical data link using silicon opto-electronic technology with hybrid indium phosphide (InP) infrared laser diodes. The 'concept vehicle' demonstrator system was on show at the Optical Society of America's 'Integrated Photonics Research, Silicon and Nano Photonics' conference (IPR 2010) in Monterey, CA, USA (25–28 July).

The system (Figure 1) consisted of four InP lasers of different emission wavelengths coupled to four silicon modulators capable of 12.5Gbps data speeds. The four signals are then combined to give the 50Gbps headline speed. After transmission, the signals are separated and detected in silicon-germanium (SiGe) photodetectors.

The company hopes that the technology will become even faster, aiming at the terabit/sec (1000Gbps) level (see Table 1). Higher speed is being sought through increasing the performance of the modulators and through increasing the number of lasers with different wavelengths. Intel believes that the technology will "allow computer makers to completely rethink traditional system design from netbooks to supercomputers" based on its low cost and high speed.

Server farms and datacenters would benefit from eliminated bottlenecks and savings from replacing

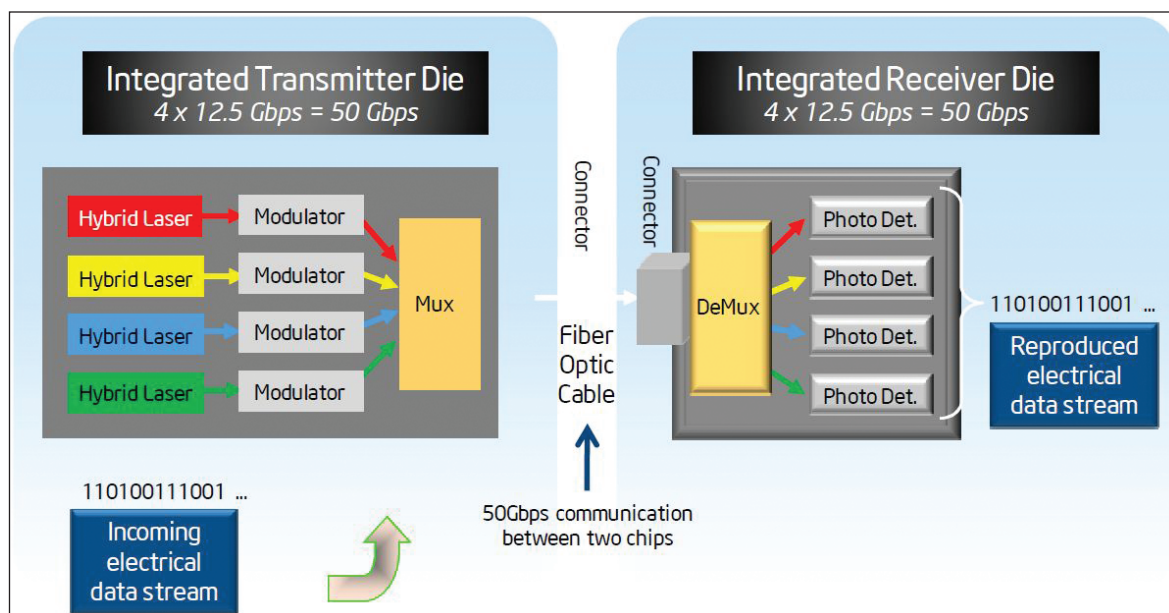


Figure 1. Optical 50Gbps interconnect system demonstrated by Intel.

many cables with one fiber, consuming less energy, Intel believes. Further application could come from the high-data-rate needs of new 3D television formats.

The 50Gbps transmission speed is the equivalent of one high-definition (HD) movie per second. The use of optical fiber enables higher-speed transmission over longer distances compared with what is available from

By integrating laser light emitters with silicon-based light-handling technologies, the company believes that it can produce precision devices at much lower cost at high volume compared with existing assembly technologies that are often built semi-automatically or even by hand

using traditional copper wiring. Today's electronics devices are limited to interconnections of at most a few inches of copper for the highest-speed data.

Intel has been working towards optical interconnects for some time. By integrating laser light emitters with silicon-based light-handling technologies, the company believes that it can produce precision devices at much lower cost at high volume compared with existing assembly technologies that are often built semi-automatically or even by hand. ▶

Table 1. Intel's proposed route to 1Tbit/sec.

Modulator speed	Channels	Data rate
12.5Gbps	x4	50Gbps
12.5Gbps	x8	100Gbps
25Gbps	x16	400Gbps
40Gbps	x25	1Tbps

► In 2006, the company announced that it had developed technology with University of California Santa Barbara (UCSB) to integrate indium phosphide lasers with silicon opto-electronic structures using plasma-enhanced bonding techniques. The individual lasers are then etched out of the hybrid material.

These laser devices were based on aluminum gallium indium arsenide (AlGaInAs) multi-quantum well active regions that emit light into silicon waveguides (Figure 2). In 2008, Intel developed gratings to vary the laser output wavelength (Figure 3).

To put signals into the laser light beams, the Intel system uses silicon modulators. Intel announced 1GHz silicon modulators in 2004, increasing this to 40Gbit/s in 2007. Modulators allow better signaling performance compared with direct modulation of the laser itself. The multiplexing is achieved passively, combining signals on different-wavelength laser beams.

The detection end of the system consists of a de-multiplex system followed by silicon-germanium photodiodes. Intel announced a p-i-n photodiode capable of 40Gbit/s in 2007 and an avalanche photodetector (in conjunction with US Defense Advanced Research Projects Agency) with a gain-bandwidth product of 340GHz in 2008.

Intel stresses that these results are separate from its 'Light Peak' project, which is targeting nearer-term applications connecting systems to high-speed optical networks. In January, Intel said it was preparing to ship Light Peak devices later this year.

www.intel.com

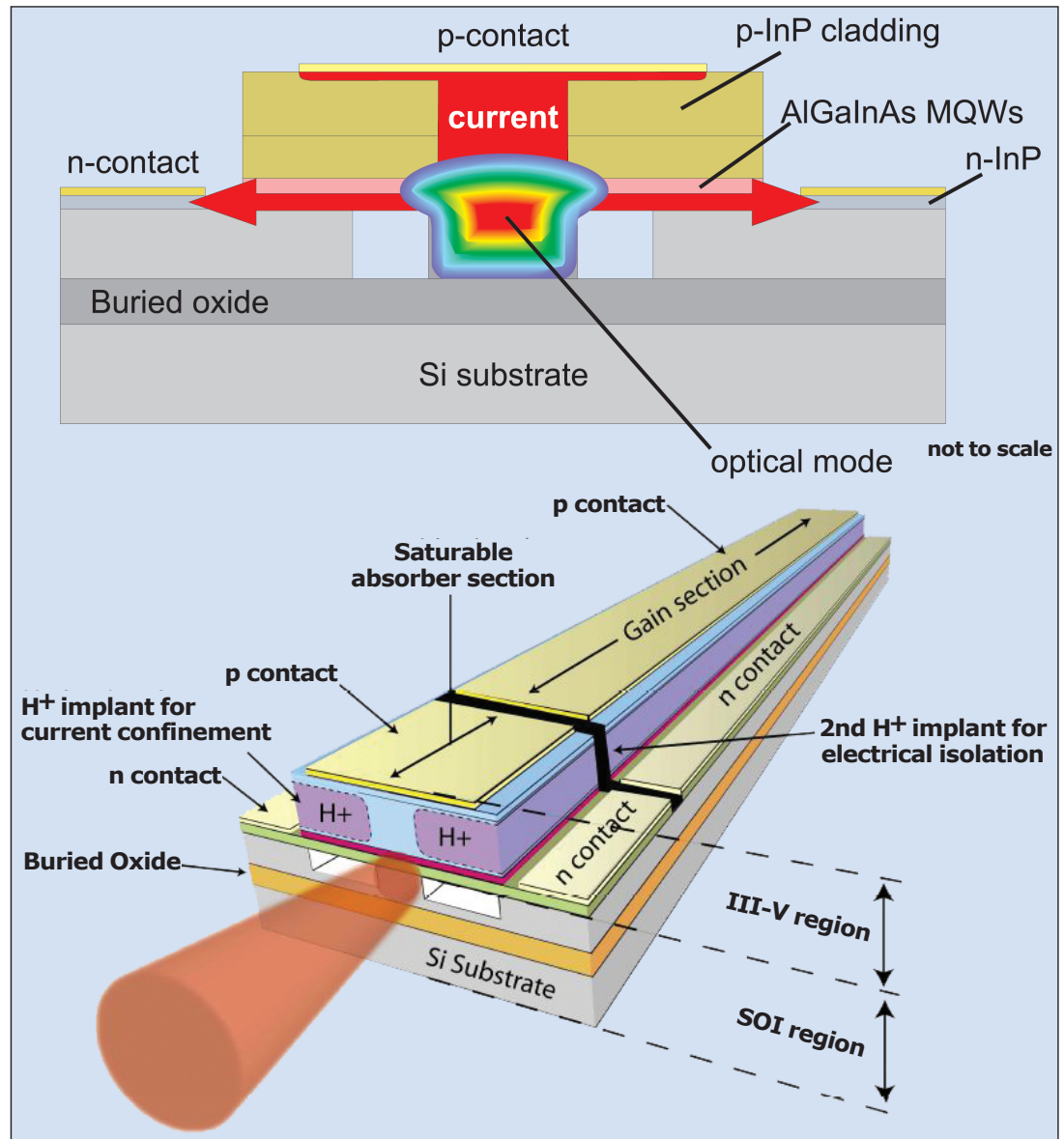


Figure 2. Hybrid InP/silicon laser schematics.

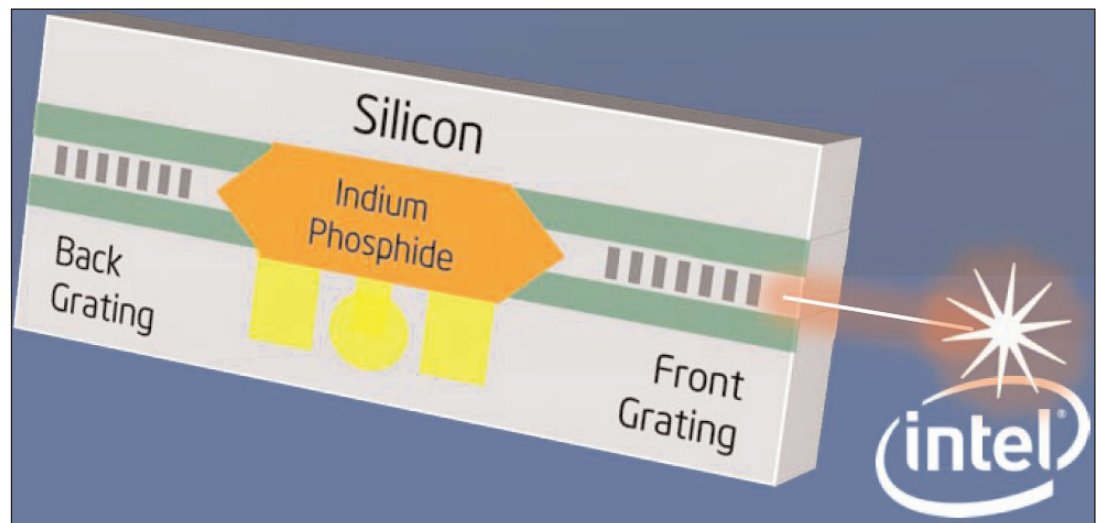


Figure 3. Etched gratings added to laser enable wavelength tuning.

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

Tohoku and Sony develop first 100W blue-violet ultra-fast pulsed semiconductor laser

High-capacity optical disc storage and nano-fabrication targeted.

Professor Hiroyuki Yokoyama of Tohoku University's New Industry Creation Hatchery Center (NICHe) and Sony Corp's Advanced Materials Laboratories in Japan have jointly developed a blue-violet indium gallium nitride (InGaN)-based ultra-fast pulsed semiconductor laser with peak output that is 100 times that of the highest output for existing conventional blue-violet pulse semiconductor lasers (Appl. Phys. Lett. vol 97, issue 2, 021101).

The new all-semiconductor-laser picosecond pulse light source has an emission wavelength of 405nm (in the blue-violet region of the spectrum), and can generate ultra-fast single-transverse-mode optical pulses as short as 3ps in duration, with a repetition frequency of 1GHz, without the use of any pulse compression. The generation of clean optical pulses without sub-pulse components from the proprietary mode-locked laser diode (MLLD) and the reduction in amplified spontaneous emission in the accompanying semiconductor optical amplifier (SOA) by incorporating a flare waveguide structure resulted in effective amplification of optical pulses to produce peak output power of more than 100W (see Figures 1 and 3).

Although there have previously been ultra-high-output laser devices combining solid-state lasers and a second-harmonic-generation unit for high functionality and high-value chemical research applications, the light source was bulky, and a specialist technician was required to ensure stable operation of the laser. It is expected that the new system, incorporating semiconductor laser diodes, can have a much wider range of applications through enabling the size of components such as the light source to be drastically reduced (see Figure 2).

The new high-output, ultra-fast pulsed semiconductor laser light source is capable of using the two-photon absorption (TPA) nonlinear optical process, which occurs only due to high-intensity optical pulses

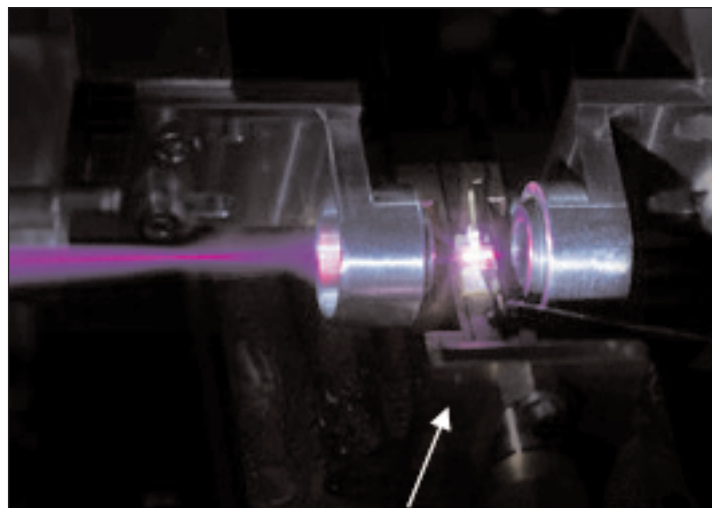


Figure 1. Beam emitted by blue-violet ultra-fast pulsed laser (arrow indicates SOA).

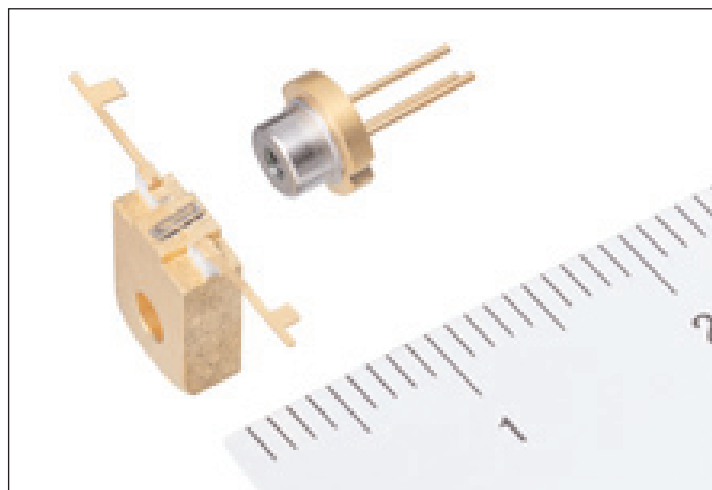


Figure 2. The new blue-violet laser (right) and SOA (left).

In addition, the new high-output, ultra-fast pulsed semiconductor laser light source is capable of using the two-photon absorption (TPA) nonlinear optical process, which occurs only due to high-intensity optical pulses. When light from the laser beam is concentrated on the lens, it creates chemical and thermal changes in the vicinity of the focal spot that are narrower than even the focal spot's diameter. It is expected that application of these properties will be possible in a wide range of

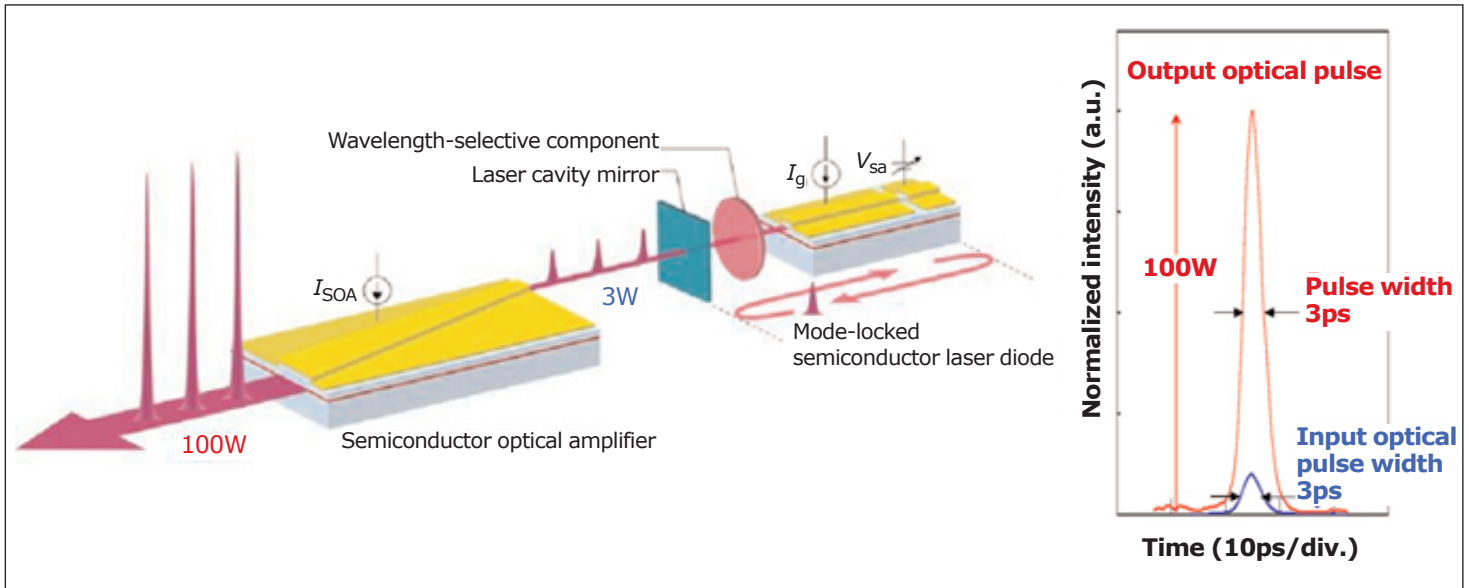


Figure 3. Blue-violet ultra-fast pulsed semiconductor laser system (left) and temporal waveforms of light using streak camera measurement (right): wavelength 405nm (GaN-based laser); peak optical output 100W or more; repetition frequency 1GHz; pulse width 3ps.

fields such as three-dimensional (3D) nano-fabrication of inorganic/organic materials of the order of nanometers, and next-generation large-capacity optical disc storage.

Sony says that it has tested the principles for applying the technology in next-generation large-capacity optical disc storage by creating void marks with a diameter of about 300nm at intervals of 3 μ m on the interior of plastic material, and then successfully read these marks using the laser beam (see Figure 4).

The experimental results have been achieved through the integration of Sony's semiconductor laser diode

expertise with Tohoku University's fundamental ultra-short pulse laser technology (Tohoku is promoting a joint research program for industry-academic collaboration based on materials and devices).

Tohoku and Sony aim to develop the fundamental technology further to achieve even higher output and multi-functionality, while developing practical applications to make the systems more compact and stable. ■

www.tohoku.ac.jp/english

www.sony.net

http://apl.aip.org/applab/v97/i2/p021101_s1

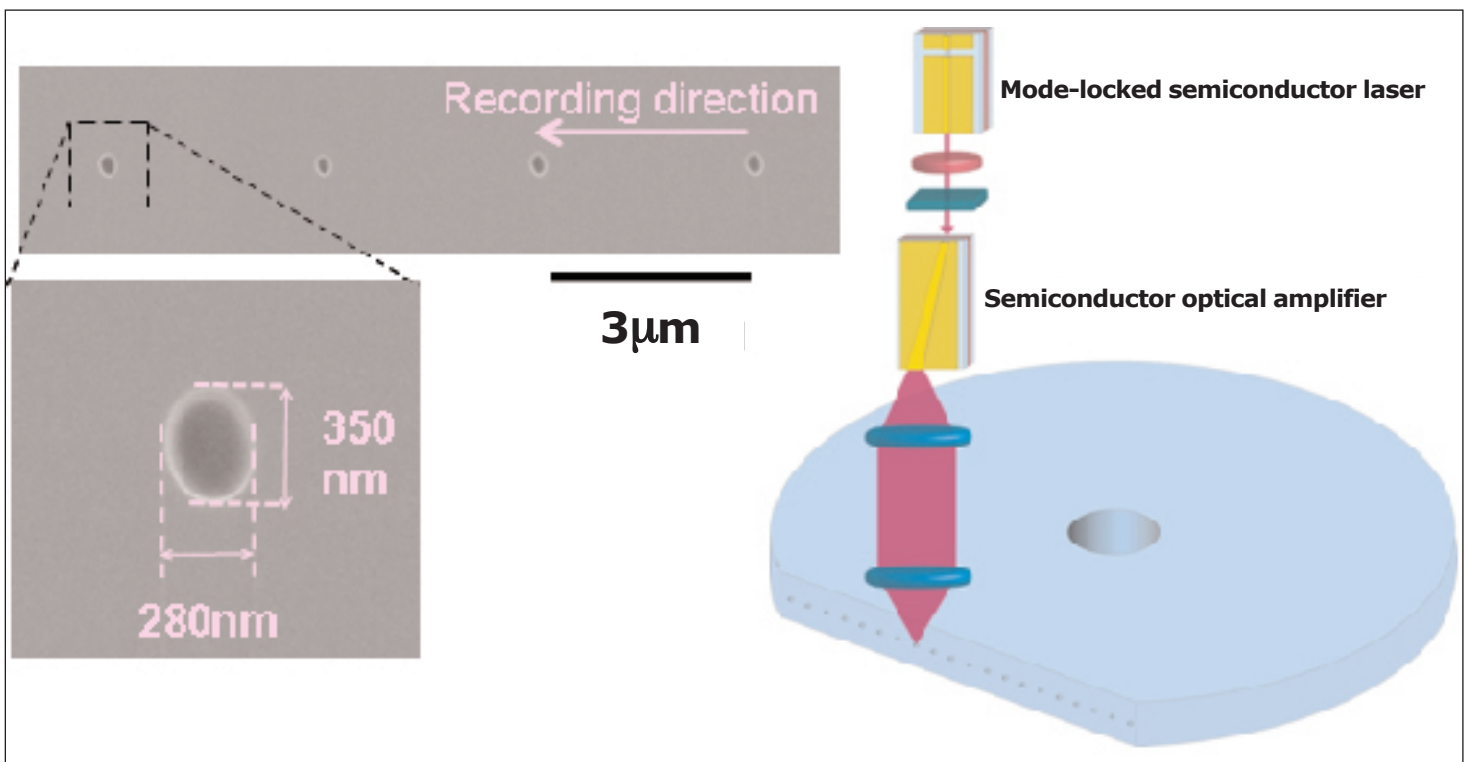


Figure 4. Testing the principle of optical disc storage using an experimental laser.

Low threshold for m-plane nitride semiconductor lasing

UCSB grows m-plane violet lasers with comparable characteristics to state-of-the-art c-plane lasers.

Threshold currents for aluminum gallium nitride (AlGaN) cladding-free m-plane indium gallium nitride (InGaN) laser diodes (LDs) have been reduced to levels comparable to those for traditional 'state-of-the-art' c-plane InGaN/GaN laser diodes in research carried out by University of California Santa Barbara (UCSB) [R. M. Farrell et al, Appl. Phys. Lett., vol96, p231113, 2010].

UCSB has been working since 2007 on m-plane laser diodes without AlGaN cladding. LDs grown in the m-plane direction of the nitride semiconductor crystal structure do not suffer from high polarization field effects seen in devices grown in different directions such as the c-plane. These polarization fields can reduce recombination into photons by tending to separate the electron-hole charge carriers, decreasing the effectiveness of light-emitting devices.

The use of non-polar and semi-polar nitride semiconductor material is predicted to boost optical gain, an important aspect of achieving laser emission. Non-polar LEDs have achieved as much as 50% external quantum efficiency, and semi-polar material has been used to extend the wavelength range of nitride semiconductor laser diodes from the blue-violet region into the green region. UCSB has also recently done some work on semi-polar laser diodes [www.semiconductor-today.com/news_items/2010/MAY/UCSB_040510.htm].

Cladding layers in laser diodes are used to confine the optical field, creating the conditions needed for stimulated emission. However, the AlGaN material often used for this has a large lattice mismatch with the underlying structures and is therefore difficult to grow with sufficient quality (e.g. without cracking, and with low defect density, etc).

The new UCSB LDs (Figure 1) were grown using metal-organic chemical vapor deposition (MOCVD) on free-standing GaN substrates supplied by Mitsubishi Chemical. InGaN separate-confinement heterostructures (SCH) were used to waveguide the optical field. The only AlGaN in the structure is a very thin 15nm electron-blocking layer, designed to stop electrons from overshooting the active region and recombining in the p-type hole injection layers.

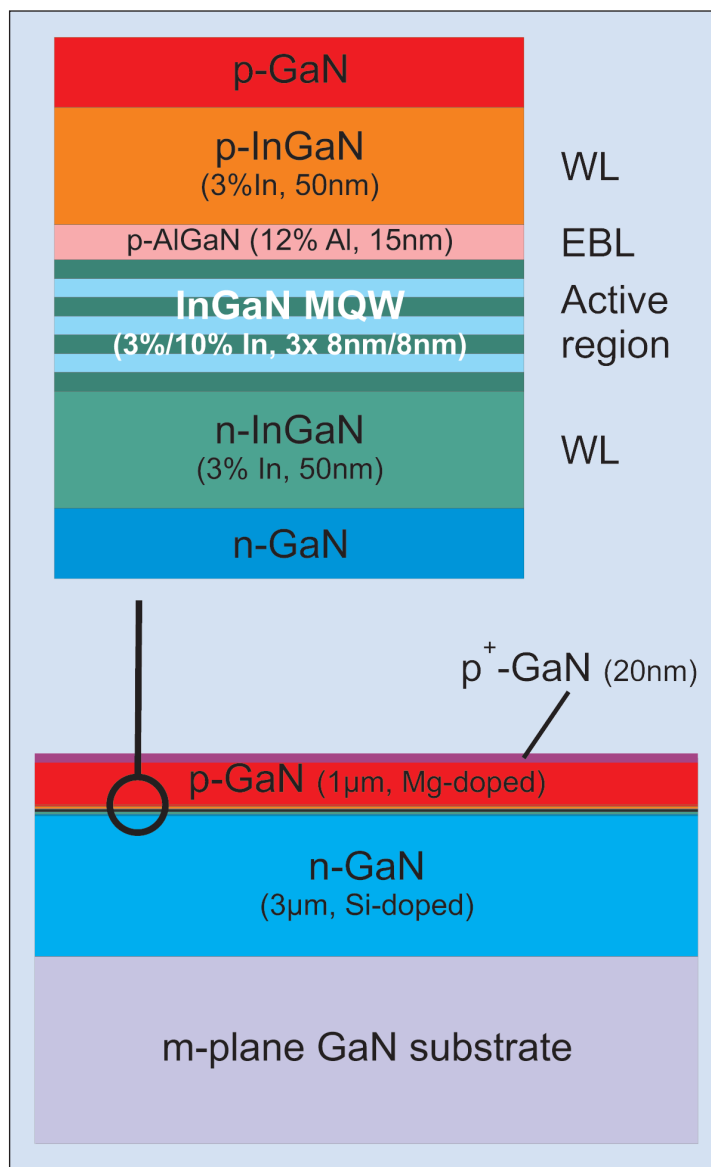


Figure 1. Epilayer structure of UCSB's latest laser diodes without AlGaN cladding: EBL = electron-blocking layer; WL = waveguide layer.

The material was then formed into standard ridge-waveguide laser diode structures with self-aligned dry etch and insulator lift-off. The ridges were aligned in the c-direction of the nitride semiconductor crystal structure. Mirror facets for the laser cavity were formed using dry etch. Silicon dioxide was used for

electrical insulation. Palladium-gold and aluminum-gold were used for the p- and n-type contacts, respectively.

Characterization was carried out under controlled temperature conditions (mostly 20°C). Pulsed testing was carried out at 1kHz with a width of 2 μ s (0.2% duty cycle). The measurements were made with one device before and after facet coating with a highly reflective (HR) six-period sequence of quarter-wavelength layers of silicon dioxide/tantalum pentoxide (SiO₂/Ta₂O₅).

Before coating, the threshold was 584mA (2.16kA/cm² density); this was reduced to 416mA (1.54kA/cm²) after coating, "which is comparable to the best reported threshold current densities for c-plane laser diodes" (Figure 2). The after-coating threshold of 5.3V is relatively low for such a device, and comparable to values that are typical for c-plane LDs, the researchers say. Coating reduces the slope efficiency from 0.56W/A to 0.26W/A. This corresponds to an internal loss of 7/cm.

Coating also increased the lasing wavelength slightly — red-shifting it from 412.0nm to 412.9nm. Since there are no polarization fields to shift the emission spectrum, a blue-shift in the sub-threshold spectrum is attributed to 'band filling'; as the injection current increases and the bands fill up, the energy separation between the hole and electron states increases, giving a blue-shift in emission. Since the threshold is lower in the coated device, it starts lasing when the bands are less full, giving the slight red-shift in lasing wavelength.

Temperature variation of the threshold for the uncoated device gave a characteristic temperature (T_0) of 112K — "comparable to values reported for early c-plane laser diodes" (Figure 3).

The researchers believe that even lower threshold currents could be achieved using lower numbers of quantum wells.

The work was supported by the Solid State Lighting and Energy Center (SSLEC) at UCSB as well as the US Defense Advanced Research Projects Agency (DARPA) Visible InGaN Injection Lasers (VIGIL) program. ■

<http://engineering.ucsb.edu>

<http://link.aip.org/link/APPLAB/v96/i23/p231113/>

[s1doi:10.1063/1.3443719](https://doi.org/10.1063/1.3443719)

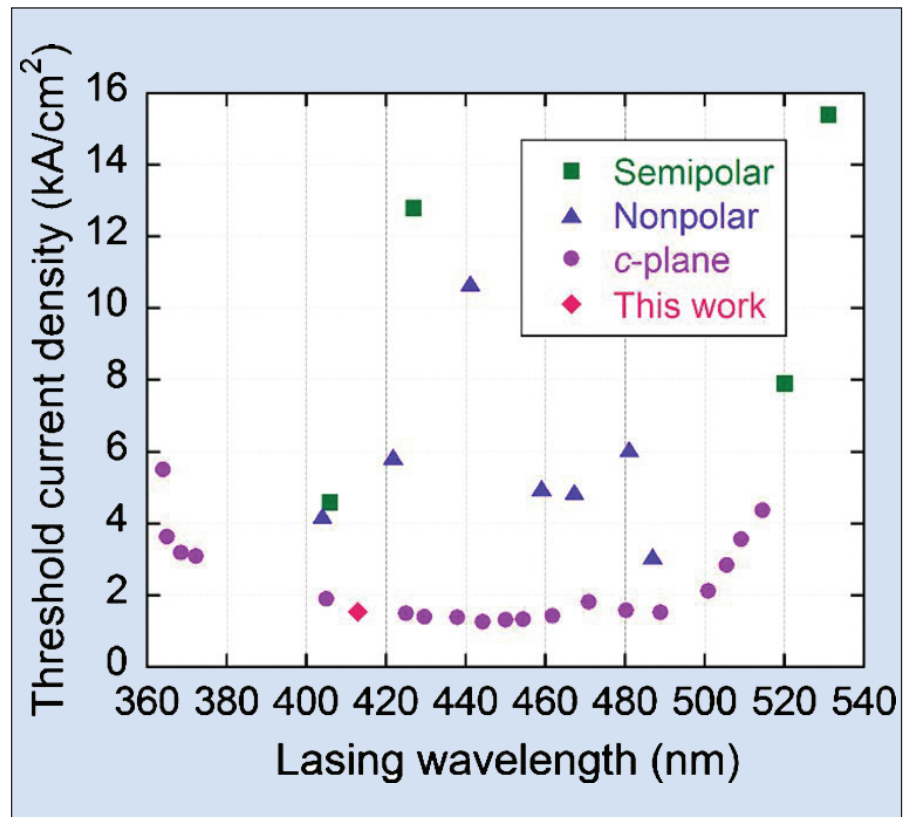


Figure 2. Dependence of best reported threshold current density on lasing wavelength for semi-polar, non-polar, and c-plane InGaN/GaN laser diodes.

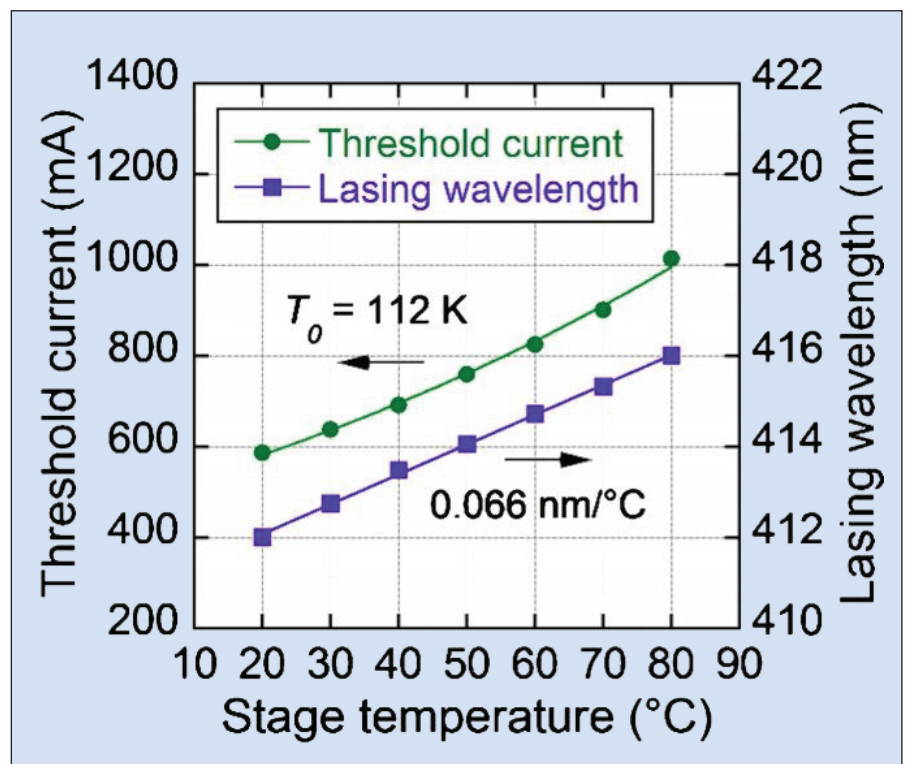


Figure 3. Dependence of threshold current and lasing wavelength on stage temperature.

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

Nitride superluminescence expands blue-violet capability

Potential applications for high spatial coherence of superluminescent light-emitting diodes (SLEDs) include optical coherence tomography, fiber-optic gyroscopes and speckle-free displays. Mike Cooke reports.

Two research groups, based in Switzerland and Poland, have recently reported separate studies aimed at developing nitride superluminescent light-emitting diodes (SLEDs). The Swiss group has been extending the wavelength range of its devices, while the Polish group has considered the temperature characteristics with a view to improving performance.

SLEDs are edge-emitting devices, rather like laser diodes (LDs), but with a larger LED-like bandwidth. The resulting emissions have high spatial coherence (with low speckle), but low temporal coherence. Their edge-emitting character gives them good coupling to external optical components and fibers. Possible applications include optical coherence tomography (OCT), fiber-optic gyroscopes (FOGs), testing of fiber-optic equipment, and speckle-free displays. OCT is of interest for biomedical and industrial imaging.

The coherence of emitted light results from stimulated emission that occurs along the waveguide structure of the device, providing amplified spontaneous emission (ASE). The broadband nature of the output occurs due to the suppression of feedback (reflection) and round-trip gain that normally would lead to narrow laser emission modes.

Existing commercial red-infrared (650–1650nm) SLEDs are based on indium phosphide (InP) and gallium arsenide (GaAs) technology.

It is only in the past year that devices using nitride semiconductors have been successfully demonstrated by the Swiss group, which consists of researchers from Ecole Polytechnique Fédérale de Lausanne (EPFL) and EXALOS, a Swiss company that develops and markets red-infrared SLED-based modules and systems [E. Feltn et al, Appl. Phys. Lett., vol95, p081107, 2009]. The nitride SLED produced by them last year was a continuous-wave device emitting violet light at a wavelength of 420nm with a bandwidth of 5nm.

Wavelength extension

EXALOS/EPFL now report extended SLED performance [Marco Rossetti et al, Appl. Phys. Express, vol3, p061002, 2010]. Continuous-wave operation was achieved in the wavelength range 410–445nm. The Swiss nitride semiconductor epitaxy company Novagan was also involved in the latest research.

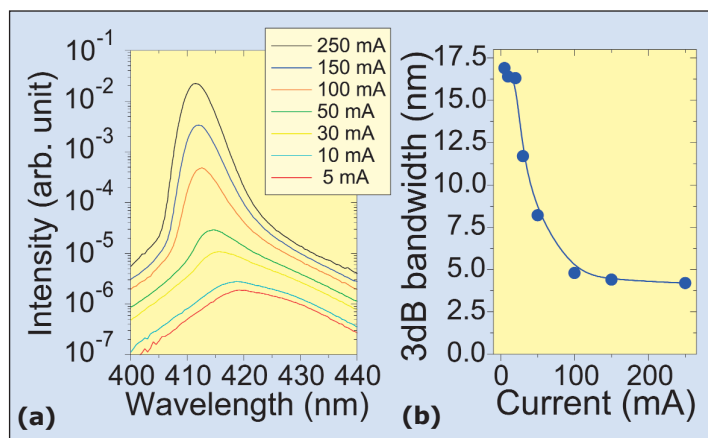


Figure 1. (a) Typical spectra for varying injection current for SLEDs produced by EPFL/EXALOS. (b) Corresponding bandwidth (FWHM) versus current injection (blobs, line is guide for eye).

In the new devices, the SLED layers consisted of indium gallium nitride (InGaN) multi-quantum wells (MQWs) embedded in a p-n waveguide with aluminum gallium nitride (AlGaIn) cladding. The layers were deposited using metal-organic chemical vapor deposition (MOCVD) on c-plane free-standing GaN substrates.

Ridges were formed using plasma etching. The output facets were designed to have low reflectivity by tilted cleaving of the ridge and application of anti-reflective (AR) coatings. The temperature of the device during operation for most of the characterizations was controlled at 25°C, enabled by mounting single chips on copper or diamond heat spreaders.

Along with pulsed and continuous light output power (L) testing, the researchers also studied coupling into single-mode optical fibers. At 150mA the coupling reached an 'excellent' maximum value of 55%. The pulsed operation tests suggest that thermal effects begin to adversely affect the operation of the device for currents greater than 250mA. Increased currents also lead to a narrowing of the spectrum of the SLED (see Figure 1). This is attributed to the selective effects of single-pass amplification.

The SLED output wavelength can be shifted by varying the indium content of the wells (see Figure 2). Three devices achieved similar output powers at high

injection current, centered at 412nm, 424nm and 432nm with full-width at half-maximum (FWHM) in the range 4–5nm. The fourth device (D in Figure 2) had a lower-power spectrum centered at 445nm, and a wider FWHM of ~8nm. The poorer performance of this last device is blamed on non-optimized growth conditions leading to degradation of the active region. The longer wavelength of D requires higher concentrations of indium, which is a factor that commonly reduces material quality and creates inhomogeneities that can affect the gain performance of MQW systems.

The thermal performance of the SLEDs was also tested by varying the heat-sink temperature in the range 20–100°C in pulsed operation. A characteristic temperature (T_0) was defined from an exponential fit of the currents required to achieve 10mW output. The 140K value obtained is comparable to the characteristic temperature for threshold current of blue-violet LDs, indicating good thermal stability of the SLEDs.

Funding for the research came from the Swiss Innovation Promotion Agency and National Centers of Competence in Research (NCCR).

Thermal performance

The Institute of High Pressure Physics of the Polish Academy of Sciences and TopGaN have been studying the temperature dependence of such violet devices emitting at about 405nm in the temperature range 263–295K [Katarzyna Holc, *J. Appl. Phys.*, vol108, p013110, 2010].

The Polish devices were fabricated using epitaxial wafers that were constructed in the same way as for laser diodes. Free-standing gallium nitride substrates were produced using hydride vapor phase epitaxy (HVPE). To improve the quality of the subsequent epitaxial layers, the surface was mechanically polished to introduce an intentional misorientation of the surface by 0.5° with respect to the c-plane of the GaN crystal structure.

The researchers comment: “The mis-cut is critical to obtain the particular step-flow growth mode and desired indium incorporation during the epitaxial structure build-up”.

The wafer was then subjected to a mechano-chemical polish and a high electron carrier density layer of GaN was deposited in a high-pressure reactor. The electron density in the layer is $5 \times 10^{19} \text{cm}^{-3}$ compared with $\sim 10^{18} / \text{cm}^3$ for the HVPE-GaN. The electron density arises from oxygen donors that are a feature of the deposition process that is used. Such an electron-rich layer “constitutes an excellent bottom cladding layer in the laser epi-structure, preventing the optical mode from leaking into the substrate entirely”.

Having prepared the substrate, the researchers then used MOCVD to finish the epitaxial structure: 600nm n-Al_{0.08}Ga_{0.92}N bottom cladding, 50nm n-GaN

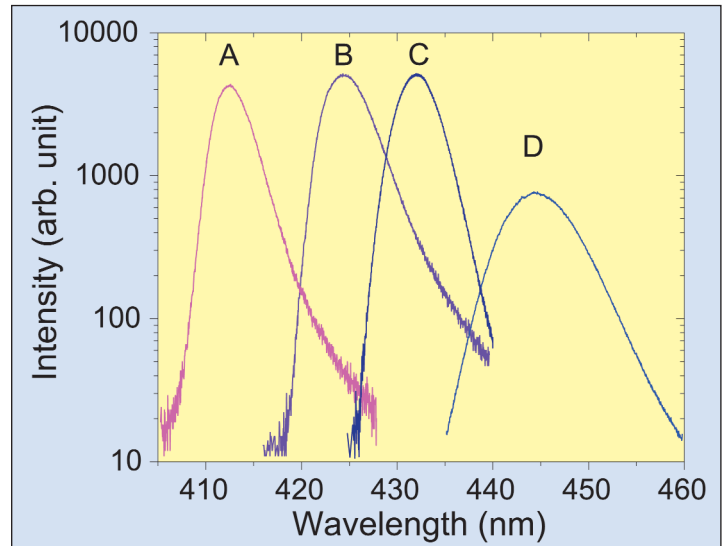


Figure 2. High-injection spectra of EPFL/EXALOS SLEDs with varying amount of indium in the active region.

lower waveguide, 50nm In_{0.02}Ga_{0.98}N injection layer, three pairs of In_{0.1}Ga_{0.9}N/n-In_{0.02}Ga_{0.98}N (3.5/8nm) quantum wells and barriers, 20nm p⁺-Al_{0.2}Ga_{0.8}N electron-blocking layer (EBL), 80nm GaN waveguide, 330nm p-Al_{0.08}Ga_{0.92}N upper cladding and a 30nm p⁺-GaN subcontact. The n-type doping was silicon and the p-type doping was magnesium.

The processing of this epitaxial material into SLEDs was similar to that used for ridge-waveguide, oxide-isolated LDs. Mesa structures measuring 3µm wide and 300nm high were created through a reactive ion etch. To prevent standing waves/optical feedback between the cleaved facets outputting the light, the ridge was tilted 5° with respect to the cleavage plane. Standing waves would create laser action, not superluminescence. Laser diodes were created side-by-side with the SLEDs to allow for comparisons. The researchers did not use any dielectric coatings for their SLEDs or LDs.

The chips resulting from this process were soldered p-side down on diamond heat spreaders and mounted in custom packages. The devices were tested under constant current conditions. A thermoelectric cooler was used for temperature control. A constant-flow dry nitrogen atmosphere was used to avoid water condensation.

Comparison of SLED and LD light output versus current shows an exponential increase for the SLED as opposed to the threshold behavior for LDs at 250mA. The output is more than an order of magnitude smaller for the SLED — an effect that the researchers attribute to overheating in the active region. SLEDs are therefore very temperature sensitive.

The FWHM for the SLED emission spectrum, under pulsed operation, is 8.14nm at 160mA, reducing to 5.23nm at 400mA. A blue-shift in the emission is also seen under higher current injection, reflecting the shift in gain characteristics. ➤

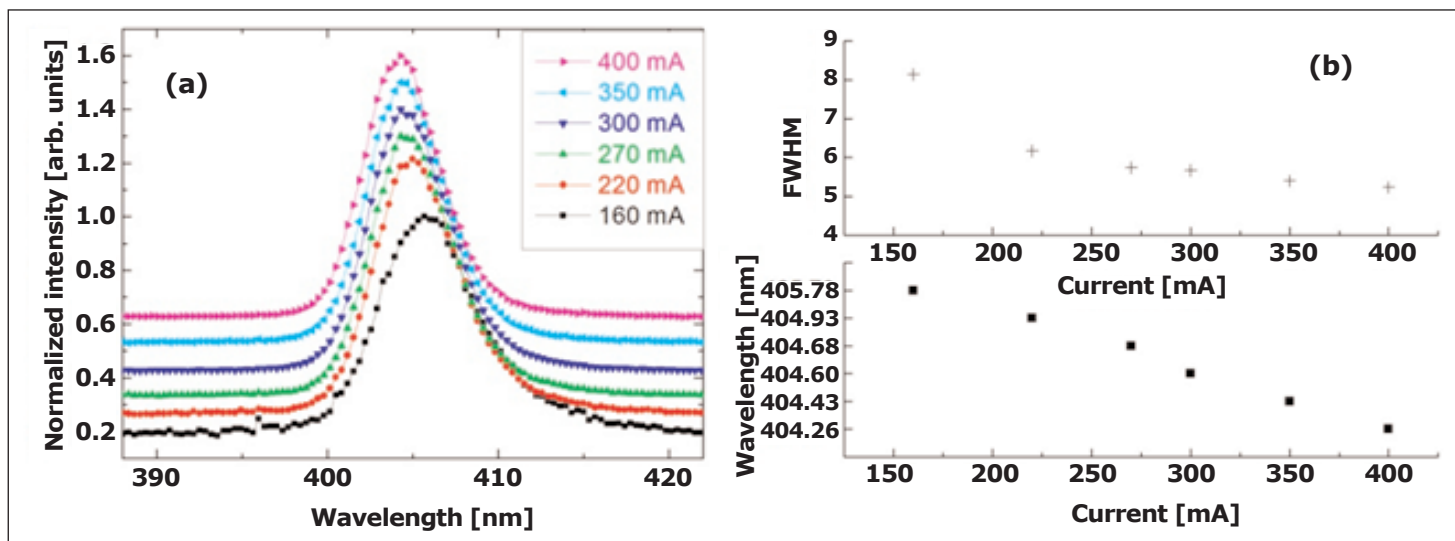


Figure 3. (a) Polish Academy of Sciences/TopGaN SLED spectra measured at different current densities and (b) central wavelength at different currents and corresponding FWHM values.

By comparing experimental data from pulsed operation and temperature control with a simple model (Figure 4), the researchers have come to believe that the problems shown by the temperature dependence of the devices arise primarily from the spontaneous emission. Temperature variation of the gain that is provided by stimulated emission has only secondary importance in the behavior.

The researchers conclude: "The results strongly indicate the need for reducing nonradiative recombination in SLED devices and tight temperature control of all the elements within those structures."

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

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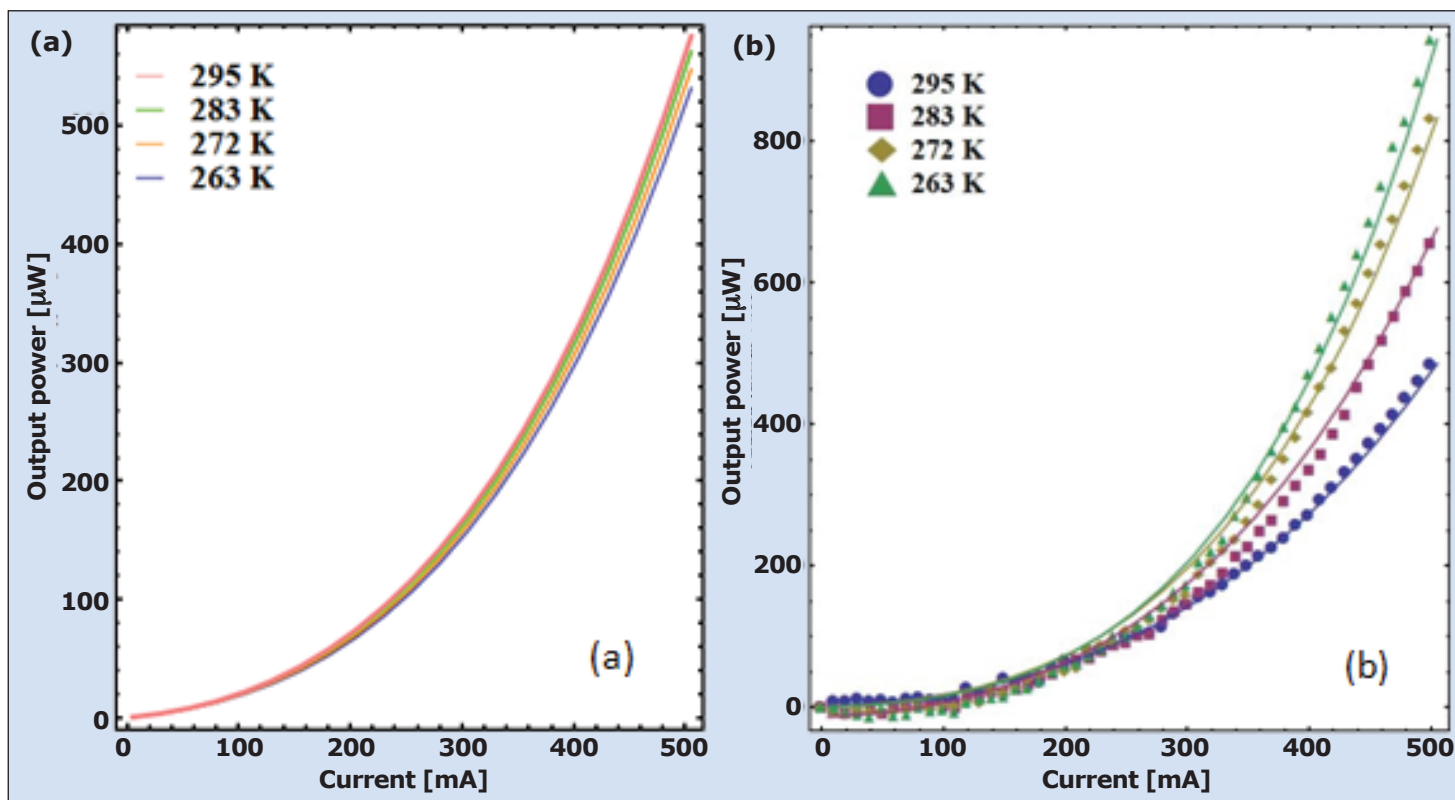


Figure 4. (a) Calculated power output vs current including only gain at different temperatures; (b) measured SLED output power (symbols) and calculated signal (solid line) taking into account spontaneous emission.

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AlN substrate used to make 260–240nm UV LEDs

Crystal IS reduces threading dislocations in strained active layers by growth on high-quality bulk aluminum nitride substrates.

Cystal IS Inc of Green Island, NY, USA has reported research results for LEDs emitting in the 260–240nm mid- or ‘deep’ ultraviolet (UV) range of wavelengths [James R. Grandusky et al, Appl. Phys. Express, vol3, p072103, 2010]. Unlike other companies producing mid-UV devices, Crystal IS uses high-quality bulk aluminum nitride (AlN) substrates as opposed to growing AlN template layers on sapphire substrates.

Like many researchers in the area, one of the more immediately proposed applications of mid-UV LEDs is for water and air purification. UV radiation in this frequency range has the capability of disrupting biological material such as DNA, killing micro-organisms.

One reason for using AlN substrates is the hope of reducing threading dislocation densities (TDDs) through the active region. Without special measures, such as lateral overgrowth or migration-enhanced/pulsed growth, TDDs on sapphire tend to be in the region of $10^{10}/\text{cm}^2$. More specialized techniques on sapphire can manage to reduce this to $10^8/\text{cm}^2$.

The impact of high TDDs tends to limit both the efficiency of the resulting devices and reliabilities. External quantum efficiencies (EQEs) for these types of devices are presently limited to about 3% or even less [www.semiconductor-today.com/news_items/2010/JUNE/NAGOYA_140610.htm].

Crystal IS has previously found that pseudomorphic (strained) layers of AlGa_{0.3}N grown on AlN can be grown to greater thicknesses than expected from thermodynamic considerations. AlGa_{0.3}N with 60% Al is expected to have a critical thickness of only 40nm, while Crystal IS managed layer thicknesses of up to 0.5μm without strain relaxation (and hence without threading dislocation densities being formed by such relaxation). For 70% Al layers, this thickness increases to 1μm.

These are the sort of thicknesses needed for the underlying n-type contact layers. The latest Crystal IS LEDs (Figure 1) consisted of a silicon-doped n-type Al_{0.7}Ga_{0.3}N layer, a five-period multi-quantum well (MQW) with n-Al_{0.7}Ga_{0.3}N barriers and Al_{0.55}Ga_{0.45}N wells,

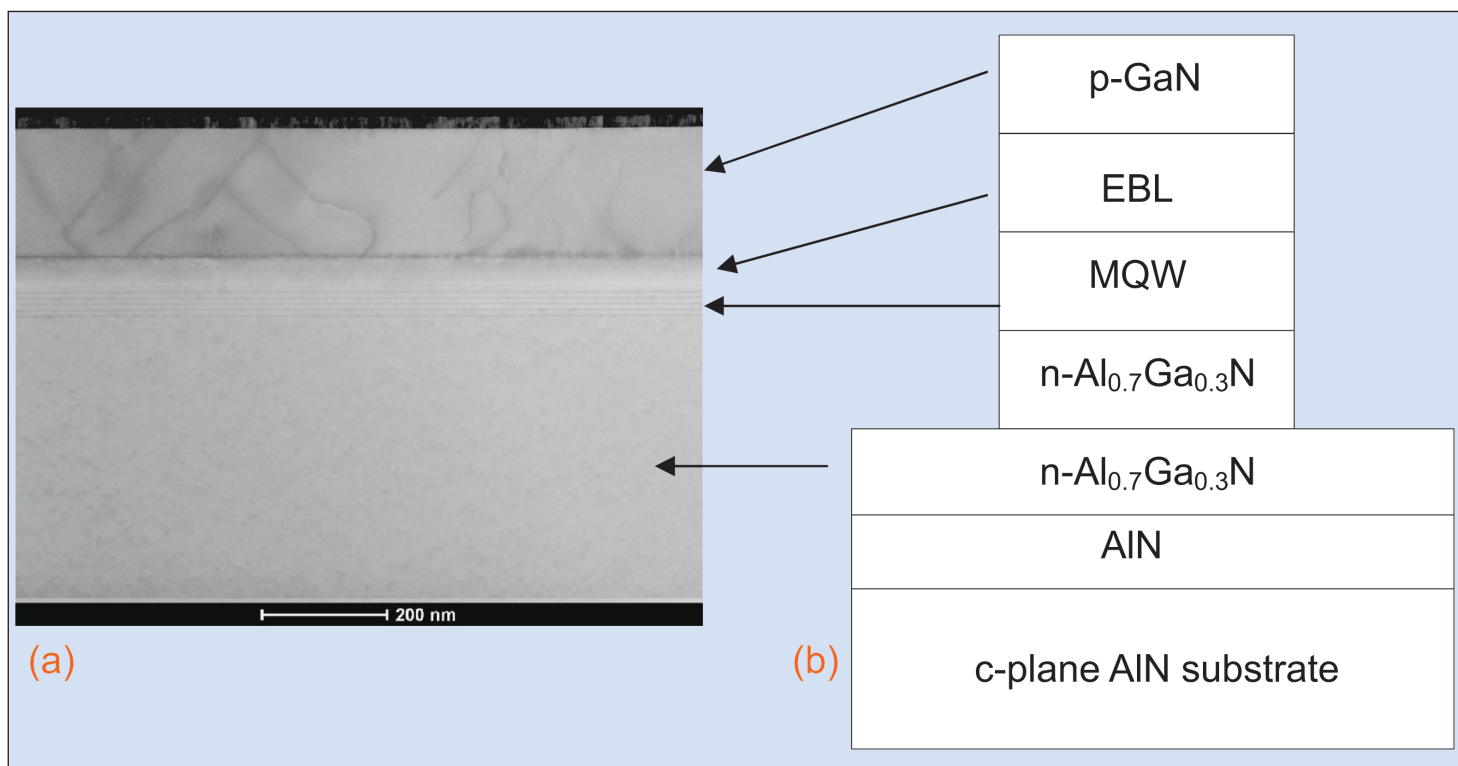


Figure 1. TEM image showing low dislocation density in the active region (a), and corresponding schematic of the device structure (b).

an $n\text{-Al}_{0.8}\text{Ga}_{0.2}\text{N}$ electron-blocking layer (EBL) and a p-GaN contact.

The epitaxial material was formed into 360 μm -diameter circular mesas. The n-contact metal consisted of titanium/aluminum/titanium/gold and the p-contact was nickel/gold. The LED wafer was thinned to 200 μm thick and the surface roughened to improve extraction.

The material quality was examined using cross-sectional transmission electron microscopy (TEM). Although the dislocation density in the pseudomorphic layers below the p-contact is described as 'low', including the active MQW, the mismatch between the AlGaIn EBL and the thick p-GaN contact was large ($\sim 2.4\%$), creating a TDD above the EBL of around $10^{10}/\text{cm}^2$.

Pulsed and continuous-wave (CW) currents were used to test the output from the device. No heat-sink was used, so the pulsed testing (10 μs , 1% duty cycle) was used initially to avoid self-heating effects that can impact efficiency and reliability.

A device with a 248nm emission peak had a full-width half-maximum (FWHM) for the spectrum of 13.9nm at 20mA current and 14.9nm at 300mA. The EQE ranged from 1.44% at 20mA to 1.09% at 300mA. The output power at 300mA was 16.3mW. The high forward voltage of 18V at 300mA is blamed on the difficulties in contact formation and non-optimized device geometry. The researchers say that this problem "is being addressed in future designs".

The devices have a fast initial decay in performance over several hours, followed by more prolonged degradation. The researchers believe that, since no burn-in period was used, some of the decay in EQE of the 248nm device with increased current can be attributed to this degradation.

Another device emitting at 243nm was tested using pulsed and CW currents (Figure 2). The peak light output power for CW operation was 2mW, while the pulsed figure was 15mW. The EQE peaked at 30mA and fell quickly, indicating self-heating effects. Under pulsed operation, the fall-off after the peak is much slower (14.6mW output power and 0.72% EQE at 400mA). The smaller drop in EQE compared with the 248nm device is attributed to the burn-in effect of performing CW tests before pulsing.

The wavelength also shifted 23meV under CW operation between 20mA and 70mA, indicating a junction temperature rise of $\sim 57^\circ\text{C}$. With pulsed operation there was no such shift.

The researchers found relatively consistent performance in devices produced within a wafer and within epi runs. Some 438 dies emitting in the 240–250nm range had a mean output power of 1.1mW under CW operation, with the peak being 5.8mW. For 137 devices emitting at 250–260nm, the mean power was 2.5mW, with a 5mW peak.

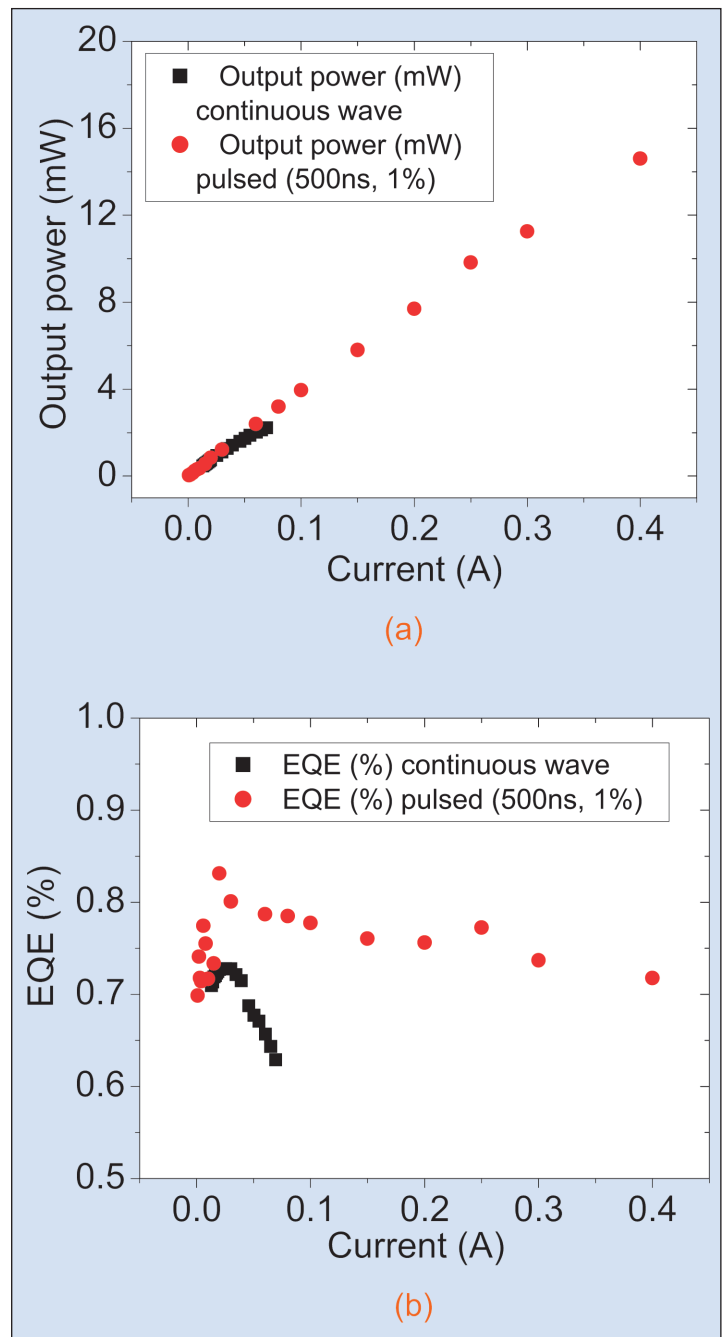


Figure 2. The output power (a) and external quantum efficiency (b) versus current for a 243nm device operating in continuous-wave mode and with a 1% duty cycle and 500ns pulse width.

The research was funded by a US National Institute of Science and Technology (NIST) Advanced Technology Project (ATP) grant and money from the US Department of Energy (DOE) and the US Army Research Laboratory (ARL).

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The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

InAlN barrier strain used to shift nitride transistor thresholds

Georgia Tech produces normally-off (E-mode) FETs using piezoelectric fields.

Researchers at Georgia Institute of Technology have used polarization and strain effects to shift the threshold of nitride semiconductor field-effect transistors (FETs) into enhancement mode [Suk Choi et al, Appl. Phys. Lett., vol96, p243506, 2010].

Nitride semiconductor hetero-structure FETs (HFETs, also known as high-electron-mobility transistors or HEMTs) usually operate in depletion mode, where the channel is conducting when the gate potential is 0V (normally-off). These devices have excellent high-frequency and power performance, even at high temperature, creating opportunities in military and commercial applications (e.g. mobile communication network transmission power amplification).

Some researchers have begun looking to nitrides for voltage-switching and digital opportunities. These applications are often best served by normally-off (enhancement-mode) operation to reduce power consumption in the idle state.

A number of techniques have been used to shift the threshold voltage in aluminum gallium nitride/gallium nitride (AlGaN/GaN) devices, such as low-aluminum content of the AlGaN barrier, recessed gates, fluoride plasma treatment, p-type gates, and non-polar materials.

Recently, indium aluminum nitride (InAlN) material quality has improved to the level where some researchers are exploring its use in nitride semiconductor devices. Among the new possibilities that the material opens up are HFETs on GaN with a lattice-matched InAlN barrier (with an estimated indium content of about 18%, based on a simple 'Vegard Law' linear interpolation). Further, InAlN barriers with in-plane compressive strain are possible, unlike in AlGaN, which is always in tension on GaN. This is the feature that Georgia Tech used to shift the threshold voltage to enhancement mode.

Strain has a particularly strong piezoelectric effect in nitride semiconductors. This is in addition to the spontaneous electric polarization fields that arise from the more ionic nature of nitride semiconductor bonds compared with more traditional

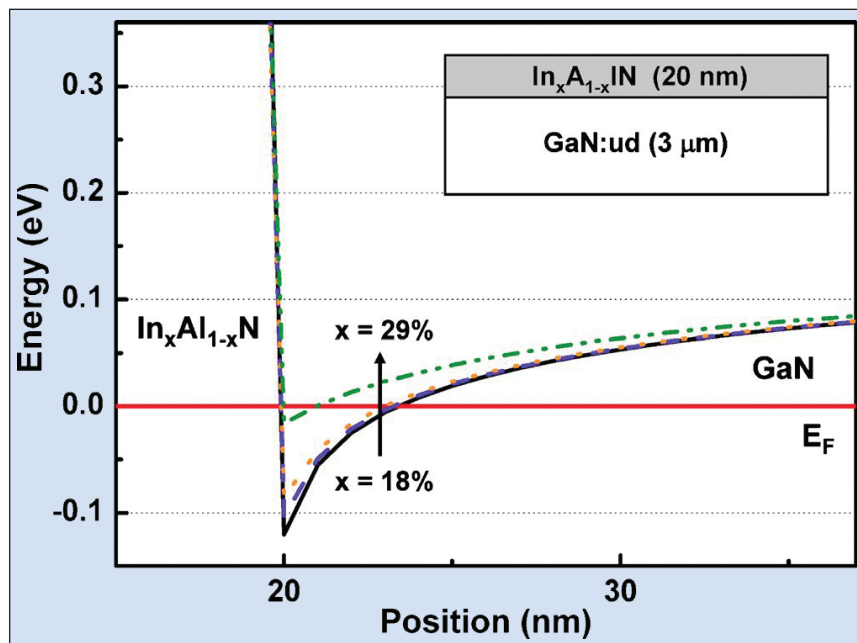


Figure 1. Calculated electronic band diagrams of the InAlN/GaN HFET structures with various InAlN layer compositions: solid line for 18% In; dashed line for 22%; dotted line for 25%; and dashed-dotted line for 29%. As the dip below the Fermi level (E_F) at the InAlN/GaN interface becomes shallower, the ability to form a two-dimensional electron gas (2DEG) channel at zero gate potential is reduced.

semiconductors such as silicon or even gallium arsenide.

The Georgia Tech researchers performed simulations (Figure 1) and created actual InAlN/GaN structures using metal-organic chemical vapor deposition (MOCVD). The HFET structures were grown on sapphire substrates and consisted of an iron-doped semi-insulating GaN layer (400nm), an unintentionally doped GaN layer (2.6μm), an unintentionally doped AlN layer (1nm) and an unintentionally doped InAlN barrier (20nm).

Table 1. Contactless sheet resistance and Hall-effect measurement results for InAlN/GaN HFET structures with various In compositions in InAlN barrier layer.

Sample	In content %	Sheet resistance W/sq	Sheet carrier concentration $\times 10^{12}/\text{cm}^2$	Hall mobility $\text{cm}^2/\text{V}\cdot\text{s}$
A	~18	255	15.7	1110
B	~22	879	4.89	683
C	~25	>50k

▶ The purpose of the AlN layer was two-fold: to enhance carrier mobility in the two-dimensional electron gas (2DEG) channel when the transistor was 'on', and to protect the GaN surface during cooling from its growth temperature of 1050°C to the lower temperature needed for InAlN growth.

The indium content of the InAlN layers was determined using x-ray diffraction. These measurements determine differences in the c-direction parameter, which is different than that for GaN

even when the layers are lattice matched. However, the relation of this measurement to In content is rather uncertain, since a simulation that is rather sensitive to the Poisson ratio (relating in-plane and perpendicular c-direction strains) needs to be used to extract a value. The researchers therefore give a rather large error bar for the In mole fraction for unstrained InAlN/GaN of 14–22%. However, the corresponding author on the paper, Jae-Hyun

Ryou, comments that the relative indium contents between the various samples should be reliable.

Three samples were measured for sheet resistance and carrier mobility (Table 1). The sample with the highest In content (25%) had a very high sheet resistance (~50kΩ/sq), which is attributed to the depletion of the 2DEG. The source of the mobility decrease is less clear, although localized state formation is a possible cause.

Localized states are thought to often form in InGaN material used in producing visible light-emitting devices. These states form in regions where the indium fraction varies due to segregation effects. "In fact, thermodynamic calculations suggest that InAlN is more prone to form localized states than InGaN," comments Ryou. "However, we have not seen clear peak separation in x-ray diffraction from our samples containing InAlN with a thickness of ~20 nm — we only observed a rather broad single peak, possibly due to the thinness of the InAlN layer. This is the case even for InGaN, unless we grow a very thick layer," Ryou adds. "This segregation effect on the mobility, together with actual existence/evidence of indium segregation, requires further study."

HFETs were created from the epitaxial material with ohmic source–drain contacts of titanium–aluminum–titanium–gold and a Schottky gate contact of nickel.

Strain has a particularly strong piezo-electric effect in nitride semiconductors. This is in addition to the spontaneous electric polarization fields that arise from the more ionic nature of nitride semiconductor bonds compared with more traditional semiconductors such as silicon or even gallium arsenide

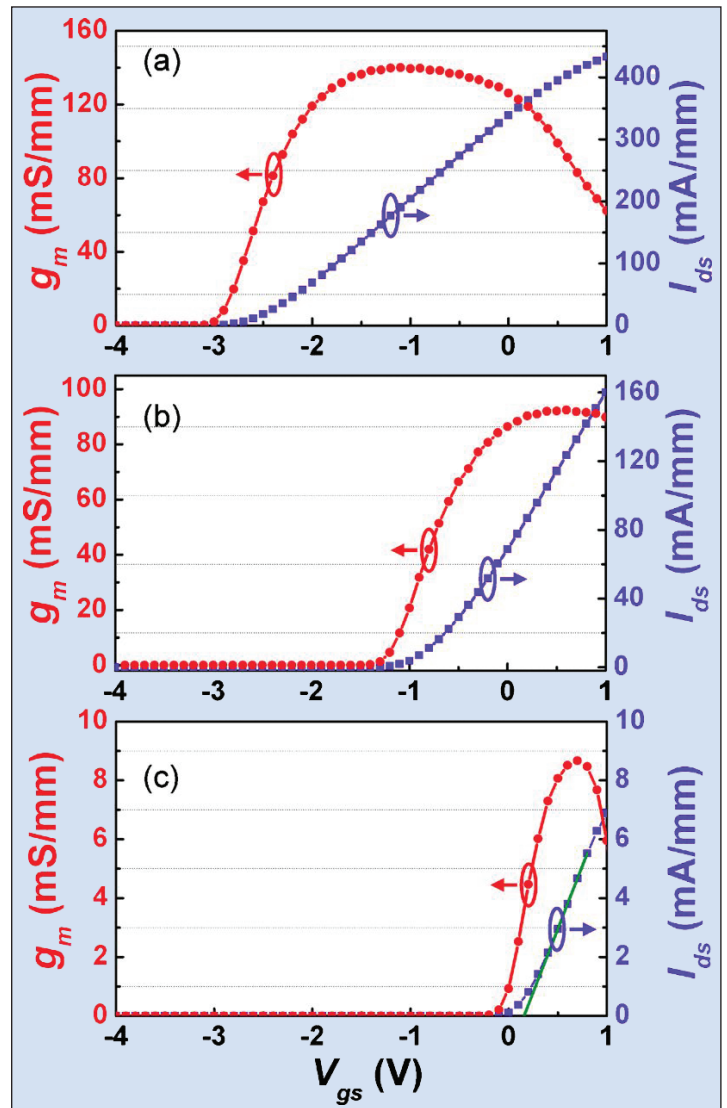


Figure 2. DC transfer characteristics of 3μm gate-length InAlN/GaN HFETs with various InAlN layer compositions: (a) 18%, (b) 22%, and (c) 25%. The source–drain voltage was 5V.

The gate length was 3μm.

By varying the indium content of the InAlN barrier, the threshold voltage (determined by linear extrapolation of the drain current around the point of maximum transconductance, g_m , Figure 2) increased from -2.5V at 18% to +0.2V at 25%. At a gate potential of 1.5V, the 25% In barrier enhancement-mode device had a relatively high on-resistance of 354Ω·mm.

The Georgia Tech researchers want to develop devices with 2DEG conducting regions under the source and drain, so that parasitic resistances are reduced, while maintaining the positive threshold under the gate for enhancement-mode characteristics. The researchers also promise to explore "further electronic band engineering and epitaxial structure development". ■

<http://link.aip.org/link/APPLAB/v96/i24/p243506/s1>

The author Mike Cooke is a freelance technology journalist who has worked in the semiconductor and advanced technology sectors since 1997.

Index

- | | |
|--|---|
| 1 Bulk crystal source materials p100 | 14 Chip test equipment p104 |
| 2 Bulk crystal growth equipment p100 | 15 Assembly/packaging materials p104 |
| 3 Substrates p100 | 16 Assembly/packaging equipment p104 |
| 4 Epiwafer foundry p101 | 17 Assembly/packaging foundry p104 |
| 5 Deposition materials p101 | 18 Chip foundry p104 |
| 6 Deposition equipment p102 | 19 Facility equipment p105 |
| 7 Wafer processing materials p102 | 20 Facility consumables p105 |
| 8 Wafer processing equipment p103 | 21 Computer hardware & software p105 |
| 9 Materials and metals p103 | 22 Used equipment p105 |
| 10 Gas & liquid handling equipment p103 | 23 Services p105 |
| 11 Process monitoring and control p103 | 24 Consulting p105 |
| 12 Inspection equipment p104 | 25 Resources p105 |
| 13 Characterization equipment p104 | |

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9 Materials & metals

Goodfellow Cambridge Ltd

Ermine Business Park,
Huntingdon,
Cambridgeshire
PE29 6WR,
UK

Tel: +44 (0) 1480 424800

Fax: +44 (0) 1480 424900

www.goodfellow.com

Goodfellow

Goodfellow supplies small quantities of metals and materials for research, development, prototyping and specialised manufacturing operations.

TECDIA Inc

(see section 16 for full contact details)

10 Gas and liquid handling equipment

Air Products and Chemicals Inc

(see section 7 for full contact details)

Cambridge Fluid Systems

12 Trafalgar Way, Bar Hill,
Cambridge CB3 8SQ,
UK

Tel: +44 (0)1954 786800

Fax: +44 (0)1954 786818

www.cambridge-fluid.com

CS CLEAN SYSTEMS AG

Fraunhoferstrasse 4,
Ismaning, 85737,
Germany

Tel: +49 89 96 24 00 0

Fax: +49 89 96 24 00 122

www.cscleansystems.com

EMF Semiconductor Systems Ltd

(see section 6 for full contact details)

IEM Technologies Ltd

Fothergill House, Colley Lane,
Bridgewater, Somerset TA6 5JJ,
UK

Tel: +44 (0)1278 420555

Fax: +44 (0)1278 420666

www.iemtec.com

Power + Energy Inc

106 Railroad Drive,
Ivyland,
PA 18974,
USA

Tel: +1 215 942-4600

Fax: +1 215 942-9300

www.powerandenergy.com

SAES Pure Gas Inc

4175 Santa Fe Road,
San Luis Obispo,
CA 93401,
USA

Tel: +1 805 541 9299

Fax: +1 805 541 9399

www.saesgetters.com

11 Process monitoring and control

EMF Semiconductor Systems Ltd

(see section 6 for full contact details)

k-Space Associates Inc

3626 W. Liberty Rd.,
Ann Arbor,
MI 48103,
USA

Tel: +1 734 668 4644

Fax: +1 734 668 4663

www.k-space.com

k-Space Associates Inc specializes in in-situ, real-time thin-film process monitoring tools for MBE, MOCVD, PVD, and thermal evaporation. Applications and materials include the research and production line monitoring of compound semiconductor-based electronic, optoelectronic, and photovoltaic devices.



LayTec GmbH

Seesener Str.
10-13, 10709

Berlin, Germany

Tel: +49 30 39 800 80 0

Fax: +49 30 3180 8237

www.laytec.de



LayTec develops and manufactures optical in-situ and in-line metrology systems for thin-film processes with particular focus on compound semiconductor and photovoltaic applications. Its know-how is based on optical techniques: reflectometry, emissivity corrected pyrometry, curvature measurements and reflectance anisotropy spectroscopy.

Optical Reference Systems Ltd

OpTIC Technium,
St Asaph Business Park,
St Asaph, LL17 0JD,
UK
Tel: +44 (0)1745 535 188
Fax: +44 (0)1745 535 186
www.ors-ltd.com

WEP (Ingenieurbüro Wolff für Elektronik- und Programmentwicklungen)

Bregstrasse 90, D-78120
Furtwangen im Schwarzwald,
Germany
Tel: +49 7723 9197 0
Fax: +49 7723 9197 22
www.wepcontrol.com

12 Inspection equipment

Bruker AXS GmbH

Oestliche Rheinbrueckenstrasse 49,
Karlsruhe, 76187,
Germany
Tel: +49 (0)721 595 2888
Fax: +49 (0)721 595 4587
www.bruker-axs.de

KLA-Tencor

160 Rio Robles, Suite 103D,
San Jose, CA 94538-7306,
USA
Tel: +1 408 875 3000
Fax: +1 510 456 2498
www.kla-tencor.com

13 Characterization equipment

J.A. Woollam Co. Inc.

645 M Street Suite 102,
Lincoln, NE 68508,
USA
Tel: +1 402 477 7501
Fax: +1 402 477 8214
www.jawoollam.com

Lake Shore Cryotronics Inc

575 McCorkle Boulevard,
Westerville, OH 43082, USA
Tel: +1 614 891 2244
Fax: +1 614 818 1600
www.lakeshore.com

14 Chip test equipment

Keithley Instruments Inc

28775 Aurora Road,
Cleveland, OH 44139, USA
Tel: +1 440.248.0400
Fax: +1 440.248.6168
www.keithley.com

SUSS MicroTec Test Systems

228 Suss Drive,
Waterbury Center, VT 05677, USA
Tel: +1 800 685 7877
Fax: +1 802 244 7853
www.suss.com

15 Assembly/packaging materials

ePAK International Inc

4926 Spicewood Springs Road,
Austin, TX 78759, USA
Tel: +1 512 231 8083
Fax: +1 512 231 8183
www.epak.com

Gel-Pak

31398 Huntwood Avenue,
Hayward, CA 94544, USA
Tel: +1 510 576 2220
Fax: +1 510 576 2282
www.gelpak.com

Williams Advanced Materials

2978 Main Street, Buffalo, NY 14214,
USA
Tel: +1 716 837 1000
Fax: +1 716 833 2926
www.williams-adv.com

16 Assembly/packaging equipment

Ismeca Europe Semiconductor SA

Helvetie 283, La Chaux-de-Fonds, 2301,
Switzerland
Tel: +41 329257111
Fax: +41 329257115
www.ismeca.com

J P Sercel Associates Inc

220 Hackett Hill Road,
Manchester, NH 03102,
USA
Tel: +1 603 518 3200
Fax: +1 603 518 3298
www.jpسالaser.com

Kulicke & Soffa Industries

1005 Virginia Drive,
Fort Washington, PA 19034, USA
Tel: +1 215 784 6000
Fax: +1 215 784 6001
www.kns.com

Palomar Technologies Inc

2728 Loker Avenue West,
Carlsbad, CA 92010, USA
Tel: +1 760 931 3600
Fax: +1 760 931 5191
www.PalomarTechnologies.com

TECDIA Inc

2700 Augustine Drive, Suite 110,
Santa Clara, CA 95054, USA
Tel: +1 408 748 0100
Fax: +1 408 748 0111
www.tecdia.com

Tecdia is a  manufacturer of single-layer chip capacitors, chip resistors, DC boards, bias-Ts, diamond scribing tools and dispensing nozzles.

17 Assembly/packaging foundry

Quik-Pak

10987 Via Frontera,
San Diego, CA 92127,
USA
Tel: +1 858 674 4676
Fax: +1 8586 74 4681
www.quikicpak.com

18 Chip foundry

Compound Semiconductor Technologies Ltd

Block 7, Kelvin Campus,
West of Scotland, Glasgow,
Scotland G20 0TH,
UK
Tel: +44 141 579 3000
Fax: +44 141 579 3040
www.compoundsemi.co.uk

United Monolithic Semiconductors

Route departementale 128,
BP46, Orsay, 91401,
France

Tel: +33 1 69 33 04 72

Fax: +33 169 33 02 92

www.ums-gaas.com

19 Facility equipment**MEI, LLC**

3474 18th Avenue SE,
Albany, OR 97322-7014,
USA

Tel: +1 541 917 3626

Fax: +1 541 917 3623

www.marlerenterprises.net

20 Facility consumables**W.L. Gore & Associates**

401 Airport Rd,
Elkton, MD 21921-4236,
USA

Tel: +1 410 392 4440

Fax: +1 410 506 8749

www.gore.com

**21 Computer hardware
& software****Ansoft Corp**

4 Station Square, Suite 200,
Pittsburgh, PA 15219, USA

Tel: +1 412 261 3200

Fax: +1 412 471 9427

www.ansoft.com

Crosslight Software Inc

121-3989 Henning Dr.,
Burnaby, BC, V5C 6P8,
Canada

Tel: +1 604 320 1704

Fax: +1 604 320 1734

www.crosslight.com

**Semiconductor Technology
Research Inc**

10404 Patterson Ave., Suite 108,
Richmond, VA 23238,
USA

Tel: +1 804 740 8314

Fax: +1 804 740 3814

www.semitech.us

22 Used equipment**Class One Equipment Inc**

5302 Snapfinger Woods Drive,
Decatur, GA 30035,
USA

Tel: +1 770 808 8708

Fax: +1 770 808 8308

www.ClassOneEquipment.com

23 Services**Henry Butcher International**

Brownlow House, 50-51
High Holborn,
London WC1V 6EG,
UK

Tel: +44 (0)20 7405 8411

Fax: +44 (0)20 7405 9772

www.henrybutcher.com

M+W Zander Holding AG

Lotterbergstrasse 30,
Stuttgart,
Germany

Tel: +49 711 8804 1141

Fax: +49 711 8804 1950

www.mw-zander.com

TECDIA Inc

(see section 16 for full contact details)

24 Consulting**WSR Optical Device Solutions**

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

Tel: +1 908 428 4986

www.wsr-ods.com

25 Resources**SEMI Global Headquarters**

3081 Zanker Road,
San Jose, CA 95134,
USA

Tel: +1 408 943 6900

Fax: +1 408 428 9600

www.semi.org

Yole Développement

45 rue Sainte Geneviève,
69006 Lyon,
France

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2–3 September 2010

5th Space Agency — MOD Round Table Workshop on GaN Component Technologies

ESTEC, Noordwijk, The Netherlands

E-mail: esa.conference.bureau@esa.int

www.congrex.nl/10m32

6–9 September 2010

12th China International Optoelectronic Exposition (CIOE 2010)

Shenzhen Convention and Exhibition Center, China

E-mail: shirly@cioe.cn

www.cioe.cn/html/list_543.html

6–9 September 2010

NUSOD: 10th International Conference on Numerical Simulation of Optoelectronic Devices

Georgia Institute of Technology, Atlanta, GA, USA

www.nusod.org/2010

6–10 September 2010

25th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) and 5th World Conference on Photovoltaic Energy Conversion

Feria Valencia, Valencia, Spain.

E-mail: pv.conference@wip-munich.de

www.photovoltaic-conference.com

6–10 September 2010

35th International Conference on Infrared, Millimeter, and Terahertz Waves (IRMMW-THz 2010)

Pontificia Università San Tommaso d'Aquino, Rome, Italy

E-mail: irmmwthz2010@enea.it

www.irmmw-thz2010.org

13–17 September 2010

Solid-State Device Research — 40th European Conference (ESSDERC-2010) and Solid-State Circuits Research — 36th European Conference (ESSCIRC-2010)

Seville, Spain

E-mail: cor.claeys@imec.be

www.esscirc.org

26–29 September 2010

27th North American Conference on Molecular Beam Epitaxy (NAMBE 2010)

Breckenridge, CO, USA

E-mail: della@avs.org

www2.avs.org/conferences/nambe

27 September – 1 October 2010

13th European Microwave Week (EuMW2010)

Paris, France

E-mail: eumw2010@iemn.univ-lille1.fr

www.eumweek.com

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EV Group	63	Riber	37
Evatec	57	Semicon Europa 2010	95
III/V-Reclaim	35	Tecdia	23
IQE	31	Temescal	55
LayTec	43	Veeco Instruments — MBE	11
Oxford Instruments Plasma Technology	45	Veeco Instruments — MOCVD	2
Oxford Instruments-TDI	53	Wafer Technology	33

27–28 September 2010

**Oxford Instruments 2010 Seminar Series:
Workshop on Dry Processing for
Nanoelectronics and Micromechanics**

University of Freiburg, Germany

E-mail: plasma@oxinst.com

www.oxford-instruments.com

27–29 September 2010

**Strategies in Light Europe (SIL Europe
2010)**

Frankfurt, Germany

E-mail: kellys@pennwell.com

www.sil-ledeurope.com

29 September – 1 October 2010

**LED Japan Conference & Expo:
Strategies in Light**

Pacifico Yokohama, Japan

E-mail: tcarli@strategies-u.com

www.sil-ledjapan.com

3–6 October 2010

**2010 IEEE Compound Semiconductor IC
Symposium**

Monterey, CA, USA

E-mail: customer.service@ieee.org

www.csics.org

5–9 October 2010

**CEATEC JAPAN 2010 (Combined Exhibition
of Advanced Technologies)**

Makuhari Messe, Tokyo, Japan

E-mail: contact@ceatec.com

www.ceatec.com

10–15 October 2010

**218th Electrochemical Society (ECS)
Meeting**

Riviera Hotel, Las Vegas, NV, USA

E-mail: meetings@electrochem.org

www.electrochem.org/meetings/biannual/218/218.htm

19–21 October 2010

SEMICON Europa 2010

Dresden, Germany

E-mail: ktorres@semi.org

www.semiconeuropa.org

20–22 October 2010

**3rd International Workshop on
Concentrating Photovoltaic Power Plants:
Optical Design and Grid Connection**

Bremerhaven, Germany

E-mail: workshop@concentrating-pv.org

www.concentrating-pv.org

26–28 October 2010

**PV Taiwan 2010 (Taiwan International
Photovoltaic Forum and Exhibition)**

Taipei, Taiwan

E-mail: pv@taitra.org.tw

www.pvtaiwan.com

18–19 November 2010

3rd Concentrated Photovoltaics Summit

Sevilla, Spain

E-mail: maria@cpvtoday.com

www.cpvtoday.com

30 November – 2 December 2010

Photovoltaics USA 2010

Santa Clara Convention Center, CA, USA

E-mail: info@IDTechEx.com

www.idtechex.com/printedelectronicsusa10/pv.asp

6–8 December 2010

**IEEE International Electron Devices Meeting
(IEDM 2010)**

Hilton Washington and Towers, San Francisco, CA

E-mail: iedm@his.com

www.ieee.org/conference/iedm

22–27 January 2011

SPIE Photonics West 2011

San Francisco, CA, USA

<http://spie.org/photonics-west.xml>

20–24 February 2011

**IEEE International Solid State Circuits
Conference (ISSCC 2011)**

San Francisco, CA, USA

E-mail: isscc@ieee.org

<http://128.100.10.145/isscc>

22–24 February 2011

Strategies in Light 2011

Santa Clara Convention Center, CA, USA

E-mail: lubah@pennwell.com

www.strategiesinlight.com

22–24 February 2011

SNEC PV POWER EXPO 2011

Shanghai New International Expo Center (SNIEC), China

E-mail: teresa.wen@sneec.org.cn

www.sneec.org.cn/indexe.asp

1–4 March 2011

LED CHINA 2011

China Import and Export Fair Pazhou Complex, Area B,
Guangzhou, China

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