Thursday, February 7, 2013

SPIE

Photonics West® Show Daily

In association with: optics.org

Raman tools and direct diodes scoop Prisms

Spectroscopic technologies for cancer diagnosis and real-time volcanic ash detection star among the 2013 winners.

An early-stage diagnostic tool for skin cancer, a portable device to test for toxins in water and food, and a 2kW direct-diode system are among the ten winners of the annual Prism Awards for Photonics Innovation, announced last night at a gala dinner in San Francisco.

Sponsored by Photonics West organizer SPIE and Photonics Media, the annual awards recognize problem-solving and life-improving photonic products that break with conventional ideas.

Spectroscopy technologies featured heavily this year, with Raman tools picking up two awards. Vancouver, Canada company Verisante Technology was recognized in the "Life Science and Biophotonics" category for its first product: the Aura system. The hand-held Raman probe can distinguish between benign and malignant skin lesions using a 785nm excitation source. Verisante is now working on regulatory approval of a similar system dubbed "Core", to play a similar role in diagnosing early-stage internal cancers including of the lung.

There was a tie in the "Green Photonics" category, between French firm LEOSPHERE, whose "R-MAN510" dual-polarization Raman lidar system is designed for atmospheric monitoring, including "unambiguous" ash threat detection, and Visualant, whose ChromaID device tests virtually any

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Photo: Amy Nelson

Arun Chhabra and Erik Klaas from Texas-based 8tree won the 2013 SPIE and Jenoptik-sponsored StartUp Challenge on Wednesday afternoon. Beating nine other shortlisted finalists, 8tree claimed the $10,000 prize with its fastCHECK system designed for rapid inspection of aircraft rivets. Photo: Matthew Peach.

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Government Initiatives and Opportunities for Growth in Photonics; Eugene Arthurs, SPIE. Learn about national priorities and funding trends that impact the optics and photonics industry. 8:45 to 9:30 am; Room 134

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Defense downturn balanced by alternate market demand

If there was a consensus to be had at the "Executive Perspectives" panel on Wednesday afternoon, it might be summed up as "some good, some bad."

High-level executives from several photonics corporations reviewed their companies' experience in the year just ended. Battling against an uncertain defense market due to US budget issues, Dennis Werth, vice president of Newport Corporation, said after a down year in that sector, "we're hoping we've reached the bottom."

Werth said that many technologies developed for the military had matured enough to "get out of defense and into consumer applications." He cited forward-looking infrared systems as an example. Newport reported double-digit growth in industrial applications as well as the life and health sciences; meanwhile research applications and semiconductor processing were down 8% and 10% respectively.

Edmund Optics CEO Robert Edmund, who reported a flat year across all sectors after two years of growth, expressed some surprise that the defense sector for his company had done as well as it did. "The decline was not really as big as expected," he said. Several panelists attributed this to increases from other countries' defense spending, with the realization that the US may no longer "have their back" due to its own challenges. "It's good for business, but bad for other things," Edmund said.

Dirk Rothweiler of Jenoptik said that his company's industrial metrology division had its best year ever in 2012, crediting "not revolutionary steps but evolutionary steps to address economies of scale." Most of the company's growth was in North America and Asia, he said.

Christof Lehner of Trumpf said that the industrial laser cutting sector remains strong, and tools for EUV technology in semiconductor manufacturing have shown "tremendous growth."

Linda Smith, a consultant from Ceres Technology Advisors, said that the number of transactions involving photonics company acquisitions and mergers doubled in 2012, and that typical sales were to "strategic buyers," a trend she called good for the industry. "It gives [the acquired company] access to capital and distribution, and helps the technology develop. Maybe the growth wasn't organic, but I think it's good," she said.

Lehner said that Trumpf has increased employees on the engineering side, but not so much on the production side. He was surprised to find how difficult it is to find trained people for production work in the US, a sentiment that Rothweiler echoed.

David Marks, CEO of Qioptiq, was more blunt about the employment situation, saying that increasing efficiency is key to making money for shareholders. "Everybody is trying to make more things with fewer people, that's the truth. We're trying to get more out of what we've got."

A bright spot in the view of most panelists was the biomedical area, which Turan Erdogan — the new VP of marketing and business development at IDEX Optics and Photonics pointed out is different to most other market sectors.

However, one factor inhibiting even more robust growth, he said is "inertia in the medical community to adopting new technology." Sometimes available technology is delayed five to 15 years before it is widely in use. "We've got to wait for a generation of doctors to disappear and a new one to come up," he said.

RICH DONNELLY

Prisms

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material, liquid, gas, aerosol or color using spectral pattern matching technology. Bikash Koley, Tech Lead and Manager of Network Architecture at Google, presented the two firms with their award.

"This year's Prism winners serve as inspiring examples of the many ways photonics technologies enable diseases to be cured, safe food and water to be delivered, and safety maintained in our communities, as well as solve problems for researchers who are addressing those and other challenges," said SPIE CEO Eugene Arthurs. "While the Prism Awards provide well-deserved recognition for these innovative companies, they also serve to underscore the powerful role of photonics R&D in effecting positive change in the world."

MIKE HATCHER

The full list of Prism Award winners is:

- **Defense and Security: OEwaves** Micro-Opto-Electronic-Oscillator, information systems on UAVs and other platforms
- **Green Photonics (tie): Visualant** ChromaID, environmental-toxin and food-safety testing and **LEOSPHERE R-MAN510**; real-time detection of atmospheric hazards
- **Industrial Lasers: TeraDiode** TeraBlade 2kW High Brightness Direct Diode Laser, beam combining for 1-µm fiber or disk laser brightness and direct-diode wall-plug efficiency and compactness, for industrial metal cutting and welding
- **Scientific Lasers: Continuum** Horizon OPO, full-spectrum spectroscopy research tool
- **Detectors, Sensing, Imaging, and Cameras: Princeton Instruments** IsoPlane SCT spectrograph, research-grade imaging spectrograph
- **Life Sciences and Biophotonics: Verisante Technology** Aura, multimodal imaging for skin cancer detection
- **Manufacturing: Heidelberg Instruments** MicroPG501 Direct Write Lithography System, desktop maskless lithography tool for small patterns
- **Optics and Optical Components: TAG Optics:** TAG Lens 2.0, ultra-high-speed acoustics to increase depth of field
- **Test, Measurement, Metrology: Linden Photonics** Lindex Optics Cleaners, cleaning media for fiber optics

View on innovation: 1,238 exhibitors showed their latest products to 20,700 registered attendees at Photonics West 2013. Photo: Joey Cobbs

Biopsies illuminate cancer

The potential for photonics techniques to improve cancer diagnosis rates and investigate the complex inner mechanisms of the disease as it develops were underscored in Tuesday's BiOS session on optical biopsy.

"Forty percent of breast-conserving surgeries ultimately need further re-excision procedures, so a better interpretative method of diagnosis is needed," said Anna Yaroslavsky of the University of Massachusetts, Lowell.

One answer could lie in combining different imaging techniques into a multimodal detection regime, so the advantages of one help to counteract the relative weaknesses of the other.

The team at UMass Lowell paired wide-field fluorescence polarization spectroscopy at wavelengths between 390 and 730 nm, with OCT imaging at 1310nm, employing them as a follow-up to an initial histology assessment.

"Wide-field fluorescence polarization spectroscopy can be effective at the rapid identification of tumors in breast cancer when used to create *en face* images, but does not look deep into the tissue," commented Yaroslavsky. "OCT provides depth perspective, but cannot always delineate the periphery of a tumor as sharply as is needed. Combining both methods can delineate malign and benign areas without the need for an excision."

TIM HAYES

Finding a needle in the photonics haystack

Crowd-sourcing, says Jason Eichenholz, will let that needle in the photonics haystack find you. He intends to make that happen through his "Photonic Horizons" program, to recruit innovators for match-ups with companies needing ideas.

Jason Eichenholz at the BiOS exhibition, where the former Ocean Optics CTO was on the look-out for innovators. Photo: Matthew Peach.

The "crowd" can include scientists at big or small labs, or just an inventor working in his garage, said Eichenholz, CEO of Open Photonics Inc., at a demonstration in Tuesday's main exhibition.

To a researcher who received $2 million in grants from the government, he suggests, "Now how about making some license fees for your intellectual property?"

Former Ocean Optics CTO Eichenholz and his board, which includes a Nobel laureate, will award $10,000, no strings, just to take a good idea to proof-of-concept. And if five inventors are involved, he'll give five grants of $10,000. If they succeed, they'll get a $100,000 grant for up to 12 months to move the idea along to a product prototype and facilitate technology transfer. "Open innovation is open to thinking outside the four walls," he said.

Eichenholz said his company aims to connect up innovations from hundreds of researchers around the world with the needs of companies who have the channel-to-market for those ideas. They want to accelerate the movement of those ideas along the chain from the lab to product development, manufacturing and marketing.

"You start with the fundamental assumption that not all the smart people in the world work for you," he said, defining how he applies open innovation to commercialization in photonics. "In fact, there are a lot of smart people out there."

"What I notice is that a company like GE, say, or Procter and Gamble may have a $100 million open innovation program, creating a huge opportunity," Eichenholz said. "But how does a small company get access to that network? We have figured out how to do that."

So a small company may work out the chemistry for a device, for example to find prostate cancer, but they may need help on the optical side to figure out a way to build the instrument. "We match their chemistry with the right people in optics," he said. "Or we may even assemble a completely new kind of company drawing on the knowledge and experiences of the people we work with."

"It's a matter of putting the pieces together. We see the puzzle differently and it works for us because we focus just on one domain, photonics. We know the best people in the labs, the manufacturers and the supply chain. We know how to bring in the missing pieces of the puzzle."

FORD BURKHART

TopGaN pushes blue laser performance

TopGaN, the Warsaw, Poland, developer of blue lasers, announced just ahead of the show that it had successfully demonstrated a powerful new device architecture. Using a gallium nitride substrate material from fellow Polish company Ammono, the laser produces 4W continuous-wave with a blue laser array of 16 stripes.

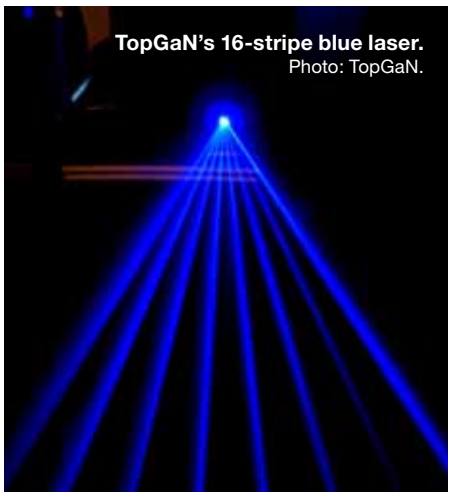
TopGaN product manager Piotr Kruszewski said, "This achievement is based on two main characteristics of Ammono-GaN: high carrier concentration of the substrate, which is 10^{19} cm^{-3}, with a low dislocation density, which is 10^{4} cm^{-2}.

"We believe that this result is the best gallium nitride laser performance in the world to date. It shows the very high potential of our device, and Ammono's substrates for pushing the blue laser technology to even further limits."

The company's product range now includes near-UV and violet laser diodes, blue laser diodes and laser diode arrays. It is also is offering customized wafers of AlGaIn-nitride epitaxial structures, including those suitable for HEMTs, LEDs and lasers.

These can be grown on GaN bulk substrates, sapphire, SiC and on silicon up to 4 inches in diameter. TopGaN is manufacturing engineering samples of laser diodes emitting in the spectral range from 380 up to 440 nm. These devices are assembled in 5.6mm (TO-56) packages.

MATTHEW PEACH



TopGaN's 16-stripe blue laser. Photo: TopGaN.

Coated germanium lenses from IDEX's Semrock subsidiary, on the exhibition floor at Photonics West. The large-scale optics are typically used in defense applications, and the company was highlighting its new 8-inch size thin-film filter (far left), which transmits in the green. Photo: Joey Cobbs

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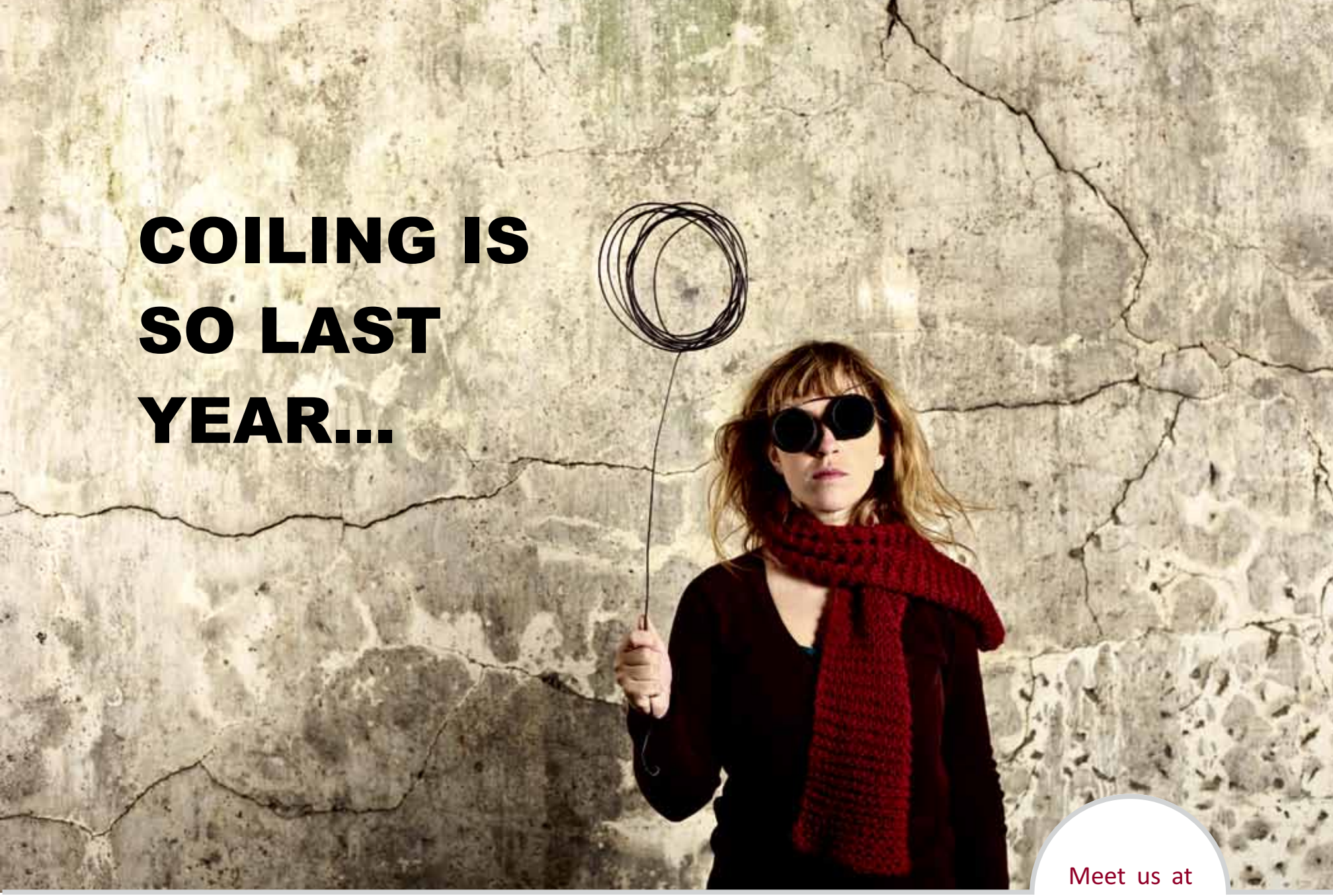

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Business meets technology at the Moscone Center


Melles Griot's telecentric objective lens, at Photonics West this week.

So the 49ers' comeback wasn't quite enough to snatch the Superbowl title from Baltimore's grasp. That might have left the city of San Francisco feeling a little deflated, but it did nothing to dampen spirits at the Moscone, where another record-breaking Photonics West was already off to a flying start.

Happily, there were no power outages here either (at least, up until the time of writing), just plenty of energy in the conference rooms and on the exhibition floor. With a record-breaking attendance at the weekend, where proceedings are dominated by the BiOS exhibition and conference, the heightened level of interest in biophotonics was palpable with SPIE reporting a remarkable turnout of 2500 for a humble poster session.

Come Tuesday, the emphasis had of course shifted to the main exhibition, and the aisles still looked to be buzzing. As one major industry vendor said: "We're crazy-busy. I need to hire some more booth people..."

"The field has matured, the business side has started to make its presence felt."

One of the notable things at any photonics event is the sheer breadth of technologies on show, and the remarkable diversity of applications that they enable. That can hardly have been illustrated better than by Wednesday's LASE plenary session, which began with the development of laser plasmas for future compact particle accelerators, and ended up at the more prosaic matter of remote-welding car seats (via a presentation on laser writing of three-dimensional metamaterials).

That huge diversity can be regarded as both a strength and a weakness. As laser market analysts regularly report, when one application field is down, another is up — and in any case there's always a bunch of new applications coming down the pipe. The only problem is that, when it comes to selling the story of photonics to politicians, the breadth, diversity and enabling nature of the technology can be difficult to label and pigeonhole. With the industry in the US now looking to lobby Washington DC in a bid to get the idea for a National Photonics Initiative (NPI) off of the ground, it's a tricky message to convey to the uninitiated.

Also noticeable at this year's event was what appeared to be an additional level of interest in the commercial side of the business. That might not necessarily be what a diehard scientist wants to hear, but here's an example to illustrate it: in Monday afternoon's session on fiber lasers, in one of the Moscone's largest rooms, there was standing-room only for a talk given not by a CEO, or even a CTO, but a *CFO* — IPG Photonics' Tim Mammen. Has that ever happened at Photonics West before?

Audiences were similarly squeezed into Tuesday's ever-popular silicon photonics panel session, thus far a perennial "future technology", but perhaps one that is finally now starting to make real commercial progress.

Can we deduce anything from such a trend? Well here's what I deduce. Photonics West has long been a high-level meeting of photonics scientists and technologists, and that hasn't changed. What has changed is that as the field has matured, the business side has started to make its presence felt to a greater degree. In essence, that is bringing the top technical and business brains in photonics into closer proximity; something that ultimately ought to help convince the power brokers in DC that a NPI would indeed be worth backing.

And back it they should. The energy and buzz at Photonics West this week has been remarkable, perhaps surprising given the state of the fragile global economy. It shows the health and potential of global photonics — both in the lab and out in the field — and suggests that photonics will continue to outperform economic norms.

ABOUT THE AUTHOR

Mike Hatcher is the editor of optics.org, *and, for the past week, the* Photonics West Show Daily.

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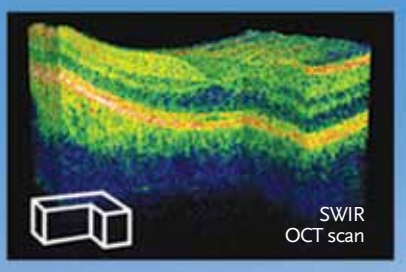
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A venture perspective on the European start-up market

Differing legislation and cultural attitudes can be as significant as economic pressures, from an international investor's perspective — as VC Paul Thurk tells Tim Hayes.

Venture capitalists everywhere share a common goal: a successful exit strategy for the start-ups they invest in, and as substantial a return on their investment as possible — with a minimum of trouble.

But the economic constraints and prevailing cultural climate in different locations can vary drastically and introduce a range of complicating factors for an investor to be aware of, especially when viewing one region from a base elsewhere.

Paul Thurk, managing director of US-based seed and early-stage investors ARCH Venture Partners, has headed the company's European office in Dublin since 2011, and is in a position to appreciate the fine distinctions between VC investments in the US and the equivalent activity underway in continental Europe.

One immediate baseline difference is the scale of VC activity on either side of the Atlantic. "Start-up investments in Europe amounted to the equivalent of $5.2 billion in 2011, while in the US the figure is nearer $29.5 billion," says Thurk. "The European figure represents around 0.029 percent of GDP, while the US invests 0.19 percent, nearly seven times as much."

Many European labor laws keep jobs safe and intractable.

European start-ups also tend to raise substantially less on average in each round of funding than their US counterparts, potentially leaving them underfunded for the task at hand and running the risk that they will ultimately fall into the hands of others.

Thurk has seen formed investments that he would classify as Series B actually being characterized as Series A in Europe. "European VC is more focused on later stage investment, and start-ups may wait until they have enhanced resources and full teams in place before raising institutional capital," he says. "A deliberate and resourceful approach is commendable, but only as long as it doesn't compromise the opportunity available, which can happen in competitive, fast-moving and high-potential opportunities."

On a more positive note, the scale of Europe's angel investment activity is of comparable magnitude to that of its venture capital, and there is a trend toward those investors organizing into larger angel groups. This increases the odds that someone in the group will have the relevant domain experience needed, and opens up greater opportunities for help, connections and advice.

Risk and reward

Any regulations or complexities that inhibit risk-taking and recruiting have an adverse effect on the successful launch of high-potential projects, by impeding the entrepreneurial process. Some of the most significant complications can arise from regional variations in either industrial environmental or employment-related factors, which Thurk stresses cannot be ignored.

"Whenever I talk about entrepreneurship and venture capitalism in a European context, it is usually only minutes until someone in the room brings up the perceived greater risk aversion in Europe as a problem. I see great innovation underway in Europe, but there may be some truth in the idea that the reduced debt forgiveness and certain bankruptcy regulations that pertain across the EU may discourage the appetite for risk, and that can be unhelpful."

Corporate tax burden

Labor laws and severance expectations perhaps pose an even larger issue. Thurk's figures suggest that while in Europe labor costs account for over 40 percent of the total corporate tax burden when averaged across the whole of the continent, the equivalent labor tax figure in the US is just 10 percent.

"The size of severance deals expected by European employees in some regions can also be a significant issue. Start-ups have a rapid turn-over of personnel, for better or worse, and promising each of them a large severance is impossible for a cash-constrained start-up. Equally, the ability for entrepreneurs and investors to attract the talented individuals they want requires an understanding of the risk-reward profile as it applies in their region. Many European labor laws keep jobs safe and intractable, giving the prospective recruits a safety net in their current jobs, and the entrepreneur has to convince them to exchange that safe position for an uncertain one. It raises the bar."

Venture view: Paul Thurk, managing director of US-based seed and early-stage investors ARCH Venture Partners, sees a wind of change on the European start-up horizon.

So too does any unfavorable tax treatment towards capital gains; at present many European nations are moving up tax rates as part of the ongoing Euro crisis.

Winds of change

In the final analysis there is no escaping the need for capital in every geographic region, and that particular commodity remains limited in a tough economic climate. The VC industry in both the US and Europe has suffered meaningful declines, with clear consequences for the early-stage funding available for important innovation.

However, the current dearth of start-up funding has created an opportunity for forward-looking nations and cities to attract both capital and entrepreneurs with innovative programs, and several are cashing in on it. Thurk sees meaningful efforts towards creating a "critical mass" of support and entrepreneurship underway in Eindhoven, Helsinki, Cambridge, and other European centers, modeled on the success of San Francisco's Bay Area.

Thurk also believes that positive steps are being taken by European regulators, aimed at supporting growth in Europe as a whole. "The EU is looking to implement new procedures under its Horizon 2020 program, and at ways to change its regulations in order to make cross-border transactions easier and bring more risk capital to bear," he says. "The winds are changing in right direction, and a global economic crisis at least has the benefit of forcing people to rethink how things are done. The world is in this together."

ABOUT THE AUTHOR

Tim Hayes is a freelance journalist based in Bristol, UK.

PHOTONICS WEST LINKS

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Lasers and optical technologies: the emerging opportunity in next-generation hard-disk drives

Despite the emergence of cloud computing, demand for hard-disk drives continues to grow — and it looks like creating a major new market for optical components.

For decades now, the storage capacities of consumer hard disk drives (HDDs) have grown inexorably. In order to maintain such increases without increasing their physical size, the next generation of drives will need to be capable of storing more than a terabit of data per square inch.

To achieve such high-density storage, several laser and optical technologies and techniques have emerged as key components. So what are the technologies promising to revolutionize next-generation hard disk drives? And will the rapid rise of cloud-based data storage reduce or increase demand?

The heat is on

Last year, HDD manufacturer Seagate Technology demonstrated record levels of storage density using a magnetic recording method capable of squeezing up to a terabit of information onto every square inch of a standard 3.5-inch disk. The method, known as heat-assisted magnetic recording (HAMR), applies heat to magnetic regions on a disk holding individual bits of data — meaning that those regions can be made smaller, and storage density increased.

"The basic concept is to take a source of electromagnetic energy such as a laser and bring its radiation onto the disk to illuminate an area around the size of one bit. That will heat the media and so allow the writer to then apply a magnetic field to encode the bit in the appropriate binary state," explains Professor Robert Bowman of Queens University, Belfast. He is part of a research team working alongside Seagate Technology to train the next generation of data storage scientists in the use and integration of photonic elements required to implement HAMR.

"First a suitable laser has to be chosen and then in combination a light delivery scheme has to be adopted to take the laser beam and deliver it into the near-field," he adds.

That's the basic concept but, as Robert Lamberton, recording head design director at the storage giant Seagate Technology explains, the integration of lasers with recording heads remains an engineering challenge, and is still some way off of full volume production.

"Productization of HAMR is expected sometime after 2016 and a volume supply of lasers in the required visible wavelength range will be needed from that time," he says.

Laser requirements

To illustrate the potential scale of the opportunity for photonics, he also points out that at Seagate's recording head fabrication facility in Derry, Northern Ireland, more than one million recording heads are fabricated each day.

"For HAMR, each recording head will require a laser, therefore the supply and ability to integrate lasers is central to the future of the hard drive industry," Lamberton said.

In his view, laser technology for HAMR will be driven by the need for improved reliability, reduced cost and shorter cycle times. He also highlights the fact that the HDD's recording head typically operates at temperatures in excess of 70°C, placing more stringent high-temperature operation requirements on lasers than most other commercial applications.

"In future, it is likely that improvements will be achieved through advances in laser attachment techniques," he says. "Increased integration of the laser with the recording head would enable reduced cost and cycle time to the maximum extent. This has been demonstrated in principle, in collaboration with the

"Productization of HAMR is expected sometime after 2016 and a volume supply of lasers in the required visible wavelength range will be needed from that time."

Robert Lamberton, recording dead design director Seagate Technology.

Equipment at epiwafer foundry IQE's facility in Cardiff, UK. The company is helping to develop integrated optoelectronic structures based on a silicon substrate to support future HDD requirements. Credit: IQE

Tyndall Institute and [US company] Semprius."

Manufacture of such laser devices is based on advanced compound semiconductor wafer production — exactly what the Cardiff, UK, epiwafer foundry IQE specializes in. "The heat source that makes the whole method possible is a semiconductor laser device emitting 10mW or more of optical power," says Chris Meadows, a spokesman for the firm.

Work published in the August 2012 edition of *Nature Photonics* describes a milestone achievement by the Tyndall National Institute, Semprius and Seagate Technology in successfully combining a high-power compound semiconductor laser structure with a silicon substrate. It uses Semprius' proprietary microtransfer technology to print epitaxial layers produced by IQE in Cardiff. According to Meadows, the demonstrated level of optoelectronic integration will enable HAMR to meet growing demand in the high-performance, high-capacity, and low-cost storage markets.

The near field

Early last year, an international team of researchers from across Europe and Asia demonstrated a different way of using laser heat (rather than magnetic fields) to store data on HDD. They exposed a material made from iron and gadolinium to 60 femtosecond laser pulses. According to University of York, UK, physicist Thomas Ostler, who led the research project, the iron and gadolinium are aligned in 'anti-parallel,' meaning that their charges are pointing in opposite directions. However, after exposure to the laser pulse, the iron demagnetizes more quickly than the gadolinium, and always switches direction when it cools. This phenomenon, known as a 'single switching event,' is one of the most basic actions of storage technology.

Ostler says that the approach could also be used to help improve future HAMR techniques. In doing so, he also argues that the use of near-field optical transducers (NFOTs) in the next generation of HAMR drives is essential, particularly because they enable confinement of the optical signal. He adds that a great deal of effort has been made to increase the throughput of the NFOT for use in the HAMR drive, at increasingly impressive levels of accuracy.

"The NFOT can be integrated onto the write head of the magnetic hard drive, flying over the surface of the media at a separation distance of 1nm or less," he says.

While lasers and other optical components are clearly becoming important for HDD development, Ostler predicts that they will drive the industry beyond even HAMR.

"There has been an increasing use of lasers and optical setups to not only induce changes in magnetic materials but also detect their changes. Understanding the physical processes involved when laser systems are used to heat these materials on such short time-scales is of increasing importance for developing new materials and technologies," he says.

"The use of laser systems is enabling scientists to understand the underlying physical processes, so in that sense they are important not only in next-generation technology, but also beyond."

The cloud

As always, predicting future market trends is difficult. But it does appear likely that the widespread adoption

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Lasers and optical tech continued from p.13

of cloud computing — though meaning that consumers might be less inclined to buy hardware with large local storage capacity — could well drive a higher demand for HDD technology overall. In 2011, a quarter of all storage shipped was destined for the cloud. By 2020 that figure is expected to rise to 60%.

"This could push up demand for high-end hard drive products — server-grade hardware," Ostler says. "However, how this affects the consumer market for desktop and laptop devices is harder to predict."

Jon Piazza, corporate communications chief at Seagate Technology, suggests that cloud service providers do things 'just a little bit different than their traditional IT brethren', pushing harder to increase efficiencies and reduce costs. He explains that Seagate is trying to fully understand those differences and figure out what opportunities exist to optimize storage devices for this market.

"In addition to capacity and performance improvements ... cloud service providers seek to drive as much cost out of the data-center as possible and the storage device is a critical piece," says Piazza.

"It comes down to total cost of ownership, and how a storage device or mix of devices can help drive down operational, environmental, personnel, and of course, acquisition costs," he adds.

A lot of cloud infrastructures are virtualized in terms of workload utilization and, as Seagate talks to the architects of the cloud, Piazza highlights that a lot of them are in the process of 'revamping' their file systems and their software stacks, and want to improve the utilization of their key components.

"They are basically saying that the workloads one year from now will look nothing like they do today. They say that whenever a processor isn't calculating, isn't processing, we [the service provider] are not making any money," he says.

"At the same time, whenever a hard drive is not reading and writing, the service provider is not making any money. So what's ideal for them, what's nirvana for them, is for the hard drives to read and write all the time, 24×7, with no idle time," he adds. "This is challenging because we use idle time to do background checks and to do some scans. So in addition to drives being used in harsher environments, they are going to be working harder in these harsher environments."

"It comes down to innovation at the device level to help lower the total cost of ownership, while also enabling cloud providers to maximize their device utilization, or return on investment."

Photonics opportunity

More generally, Bowman predicts that lasers and other optical components will be 'critical' to the HDD industry in the coming decade — though he believes that the photonics community and industry is still broadly unaware of the ramifications of HAMR.

"The scientific and engineering challenges to bring photonics components into close integration with a recording head are the source of increasing attention, and if we wish to continue to benefit from storage capacities at current costs there is huge opportunity for the photonics industry here," he says.

With Seagate already producing in excess of one million recording heads *each day* at its Derry facility alone, and the annual market for HDDs expected to grow to one billion units by 2020, this is an industry could emerge as one of the largest markets for optical devices.

ANDREW WILLIAMS

Seagate's heat-assisted magnetic recording (HAMR) technology uses a laser to increase the areal storage density in HDDs. For mass production, a huge supply of lasers will be required. Credit: Seagate Technology.

the business of photonics

optics.org product focus

2013 Photonics West®

Welcome to the optics.org Product Focus which we have published specifically for Photonics West 2013 in partnership with SPIE and the Photonics West Show Daily.

Here you will find an effective at-a-glance guide to some of the latest products available on the market with booth numbers if available making it easy for you to check out the products for yourself.

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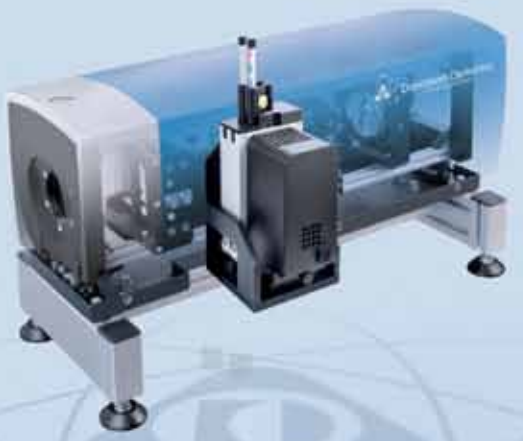

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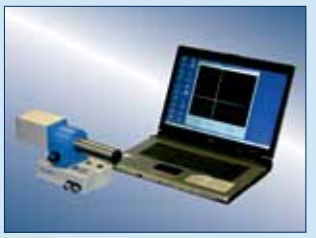

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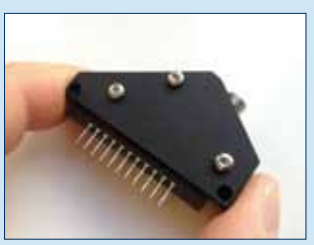

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JGMA is offering a $1,000 (13%) Photonics West Show discount on new Model 928 and Model 830 drivers ordered by Feb 15, 2013. Additional discounts are available for orders of two or more units. For example, if a Model 928 and Model 830 are ordered at the same time, the Model 830 is offered at about half price. We have 928 and 830 units in stock and ready for immediate delivery. For more information and product data sheets, please visit: http://jgma-inc.com/24834.html

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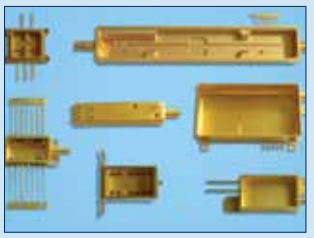

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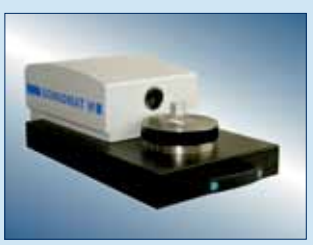

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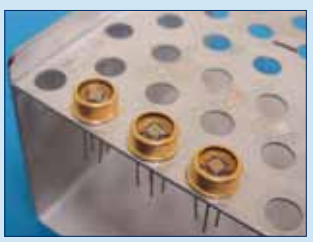

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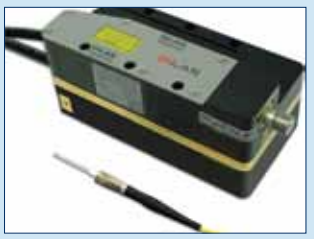
DILAS' fiber-coupled tailored bar

DILAS' fiber-coupled tailored bar (T-Bar) modules are now capable of delivering up to 100W from a 200µm fiber at 793nm.

The T-Bar was developed so that an automated active optics alignment can be utilized for efficient fiber coupling into a 200µm fiber.

The device is a monolithic multi-emitter source which takes advantage of handling multiple emitters during each individual manufacturing step to lower complexity and enhance reproducibility of the beam quality and hence the fiber coupling.



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Varioptic

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Arctic 39N0 - 3.9mm clear aperture variable focus lens

Varioptic, the liquid lens company, announces a 3.9mm clear aperture variable focus lens.

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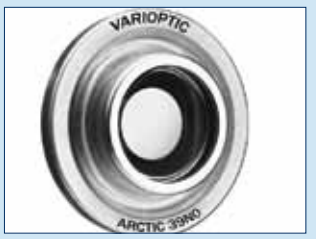
Arctic 39N0 is the ideal choice for demanding applications such as machine vision, medical imaging, optical equipment and biometric devices.

Come and see this new lens on Photonics West 2013 – booth #5402.



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BMW rolls laser welding into the fast lane

Car giant's Mini panels facility in Swindon, UK, will host laser processes in the near future.

The use of lasers in car manufacturing is nothing new. But as technology evolves, all of the major vehicle manufacturers are updating their processes and buying new lasers to help improve key design features, reduce vehicle weight and meet more stringent safety requirements.

Since the car industry emerged from the global financial crisis in 2009, there has been a boom in orders for the likes of IPG Photonics and Trumpf, whose 4kW lasers are the workhorses for many automotive laser welding applications. Last August, Trumpf announced a major contract to provide BMW with 14 of its 4kW disk lasers.

Stefan-Markus Baginski heads up BMW's planning for body-in-white processing technology, including the development of new joining technologies for car bodies. Back in 1995, when BMW introduced its very first laser process — a welding application on the roof of its old 8-Series model, performed with a carbon dioxide laser — Baginski was still a student and such installations were a novelty.

Since he joined BMW just over a decade ago, lasers have become a fundamental part of car production. And Baginski is convinced that they are set to play an even greater role in the cars of the future: starting with the Mini.

"In the future we will see this technology in every car," he confidently predicts of the remote laser welding technology currently being installed in a series of robotic "cells" in Swindon, pointing out that the new approach gives BMW's designers a degree of freedom that they have never previously enjoyed.

Baginski explains. "At BMW the design process and laser technology are working in parallel." That is very important, he adds: "If you want to gain all of the benefits from laser welding, you must have the parts designed for laser applications — then you can get the best out of the laser technology."

Watertight welding

So what exactly will the lasers be doing to the hang-on parts at BMW? One of the new key processes being introduced is a technique for watertight welding that is used at BMW's Regensburg site in Germany to produce doors for its 1-Series cars.

"It is a new door design that has no "hemming" and no sealer," says Baginski. "[We] laser around the door to give a watertight part." The motivation for that comes largely from a design perspective, as the bottom of the door usually features a large flange that looks bulky and restricts design freedom.

"In the future we will see this technology in every car."

This process also helps to save on both manufacturing and — happily for the eventual customer — running costs: conventional joining technologies might sound simpler than lasers, but all of the hemming, glueing and sealing required does take lots of time and also adds weight to the car.

All this is contributing to a trend that Baginski believes will lead to the laser-welded content in an average BMW car doubling over the coming five years or so. "What we have done at the new 1-Series is a new milestone for the BMW door production" he says.

Baginski has a neat set of pie charts to demonstrate what an impact lasers have already had. Of all the joining processes used to make the company's old 5-Series car, only 3% represented laser-welding — mostly to join the hang-on parts. But the figure for the new 3-Series, launched in 2010, has jumped to 13%, largely because of the model's aluminum doors. "It's looking like we'll extend this [percentage] from year to year now," he adds.

On top of that the overall joining requirements will also increase, reflecting the need to meet ever stricter crash test requirements, for example. "We are looking to lasers to give the stiffness requirements and to reduce the number of

continued on p.20

BMW's Minis: the company has just posted a record-breaking sales year for the iconic design in the UK, with 51,234 vehicle registrations in 2012 — the highest figure since the brand's BMW-led revamp in 2001. Credit: BMW Group.

BMW laser welding

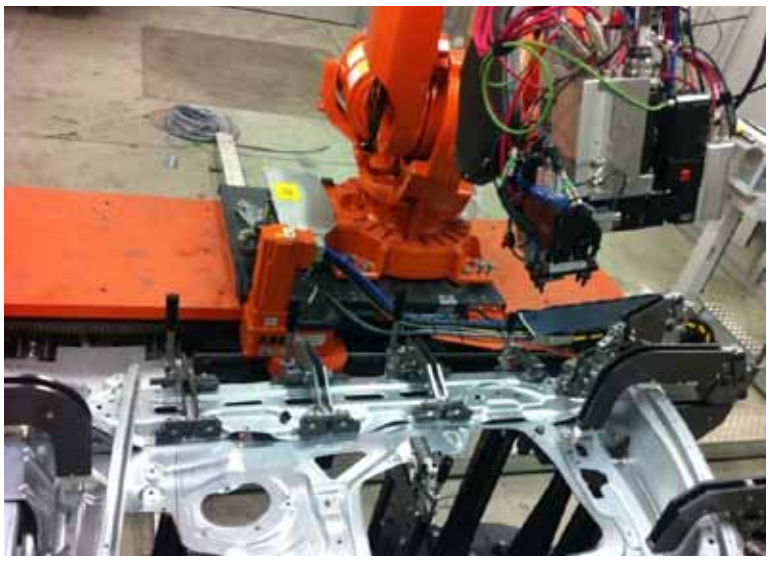
continued from p.19

spot welds required," Baginski says.

Over the past few years, it has primarily been BMW's investment in IPG Photonics' 4kW fiber lasers that has driven that percentage increase — this "bread-and-butter" laser is used in all the facilities where BMW builds its current 1-Series and 3-Series models.

The decision to also use Trumpf's disk lasers was no reflection on the technological capability of either source — Baginski refers to the two companies as "the cream of the crop" when it comes to selecting suppliers — but more of a strategic decision reflecting a need to position for a future in which many more lasers will be purchased overall.

As a result, Baginski and BMW will be glad to see the competition emerging in the high-power fiber laser space, though they remain behind the market leaders for now. "The landscape is changing; others are catching up now," Baginski says. "I hope that they continue doing it. They are trying hard, [and the] need for them over next 18 months is to come to the level of IPG."



Remote laser welding of prototype parts at BMW. The car manufacturing giant is currently installing several new laser welding "cells" at its Mini part production facility in Swindon, UK. Over the next five years, the company expects laser processes to grow quickly as a fraction of overall joining activity. Credit: BMW Group.

Ultrafast potential

Outside of fibers and disks, there could also be possibilities for ultrafast sources — though not for a while. Although they hold great promise for composite materials and are being tested, Baginski believes that it will be at least five years before they feature in production. That is not so much a reflection of the laser technology as the detailed knowledge of the materials that still needs to be developed.

"Because of BMW's global perspective, I need specifications of materials defined first," says Baginski. "The process needs so much accuracy and [at the moment] the material mix is unclear, so we can't decide on laser processing times, thicknesses and so on. This needs to be developed together with the laser equipment."

Despite the potential of composites, and the widespread introduction of aluminum, he still believes that steel offers some critical advantages to which lasers are closely tied.

"If you want to gain all of the benefits from laser welding, you must have the parts designed for laser applications — then you can get the best out of the laser technology."

Stefan-Markus Baginski, Department Manager Installations Control and Joining Technique at BMW Group.

"In my opinion, and from the overall sustainability perspective, aluminum recycling is expensive and not easy. Overall, the energy balance with steel is best, and so we are looking to push steel forward. Everybody is looking at composites, hybrid materials and so on, [but] using lasers to introduce stiffness into the body can reduce the thickness of the steel instead."

Since he has been at BMW, Baginski has seen the cost of a 4kW laser fall dramatically — he estimates by a factor of ten — from bulky and costly CO_2 systems to today's more user-friendly disks and fibers. What that has meant is that it has become economically feasible to use more laser joining processes in small production cars such as the Mini, and not just in the luxury models.

"This means that we can now put this technology into a mid-range or small car rather than only a 5-Series," he says. Baginski completely agrees with recent statements from IPG that the auto industry is merely at the beginning of its period of laser adoption, and that demand will grow and grow.

Looking back at his pie charts, he says that over the next five years, the laser proportion of the joining technologies used will grow to between 25% and 30% across all of BMW's models.

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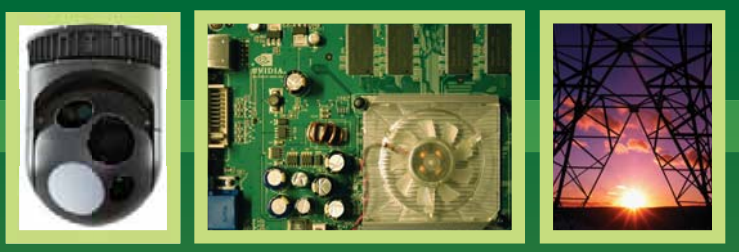

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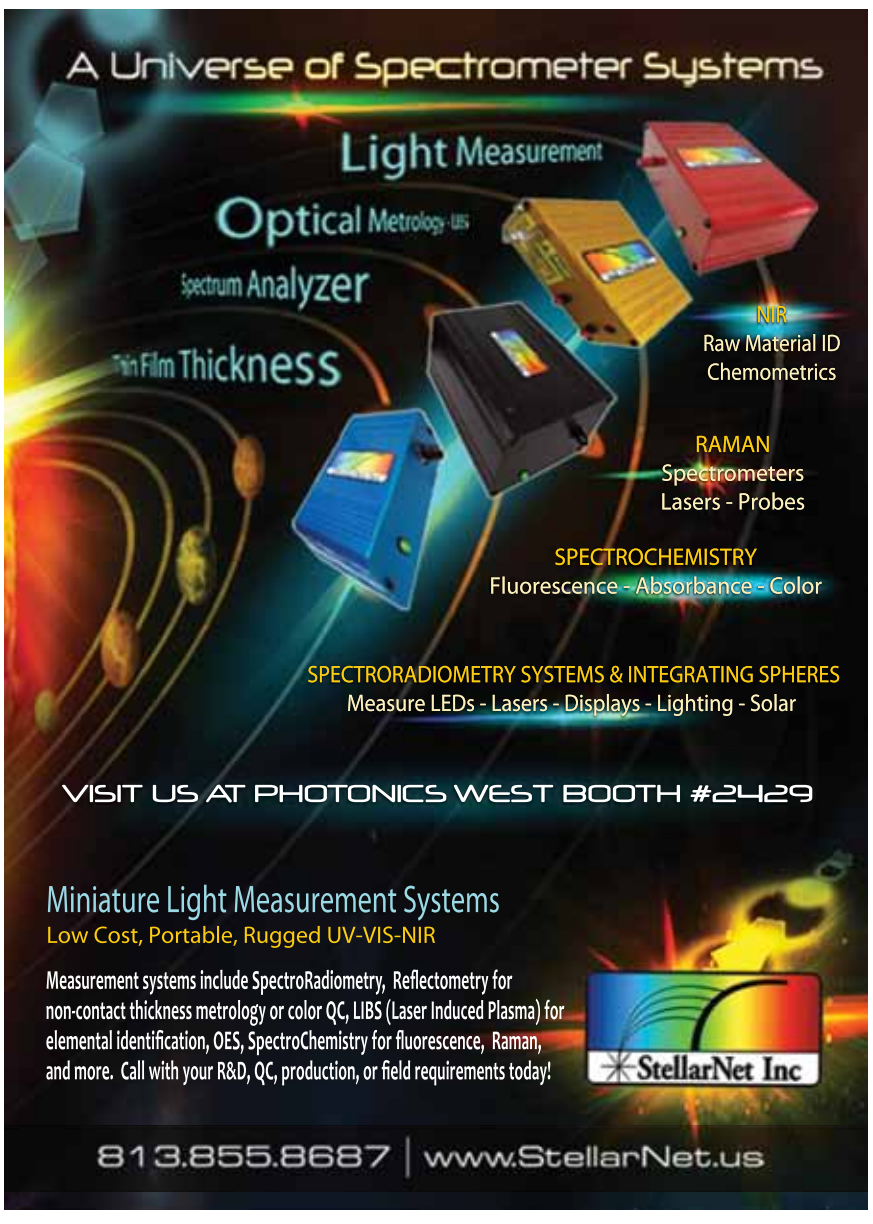


Ultrafast trending; fiber lasers here to stay

Mark Douglass, senior equity analyst for industrial technology at Longbow Research, talks to Mike Hatcher about the macro trends impacting the laser market.

What have been the stand-out trends in the industrial laser space over the past twelve months?

The big trend continues to be the adoption of fiber lasers, at the high-power end in particular. Fiber lasers had already established themselves in low-power applications, but we are now seeing high-power platforms at each of the "big five" machine tool OEMs — Trumpf, Amada, Bystronic, Mazak and Mitsubishi.

That adoption has stepped up in the past twelve months, and 2012 really confirmed that this technology is here to stay. The cutting OEMs are taking advantage of both fiber and disk laser capability, now that they really understand the benefits.

Is that because of falling prices?

To some degree it's pricing — we saw price points come down significantly in 2010 and 2011. Industrial [tool] markets are slower moving than, say, technology markets, and they would intend to keep such a laser for five, six or more years, so it's a much slower adoption cycle. They really care about service, reliability and longevity — people will pay for uptime.

For the most part, solid-state lasers are taking market share from carbon dioxide lasers, though the overall market is increasing somewhat too.

How is the automotive market looking?

The European car manufacturers, companies like Volkswagen and BMW, tend to lead in the adoption of laser technology and in general the European market has slowed a little. But we are seeing a lot of new models launched in the US and the elsewhere. We are also starting to see a lot more laser welding of doors, bodies and seats.

There's certainly still plenty of runway for lasers in automotive. However, car makers also have to design for the laser welding processes, and have to justify the additional up-front costs of laser welding for each different model — so the investment can be somewhat model-specific and can take time. Remote laser welding is coming through, and I don't think that we are seeing a false start this time around.

Auto firms are continuing to invest, despite the wider macroeconomic situation, and trends such as using high-strength steels are a big growth driver for lasers. These materials reduce the weight of automobiles, but because they are harder, they are much more difficult to machine.

A lot depends on the materials that the manufacturers select: steel is good for the laser industry; aluminum I think the jury is still out, but likely not an overwhelming positive. You also have to remember that spot welders are a very cheap technology. And the market opportunity for lasers is not a direct like-for-like replacement for each one of those spot-welder robots — each laser will replace perhaps five or six spot welders.

Laser technology has been around car manufacturing for a long time, but we have still not seen wholesale adoption, and I think that we will still see incremental adoption rather than a wholesale shift.

How are macroeconomic trends impacting the industrial laser world?

In fact, a lot of the companies that I talk to are more affected by regional politics than national or global effects. Some US regions are just not affected by the sovereign debt crisis in Europe. Sequestration fears are mostly affecting the defense and research sectors, and not so much the industrial space, so this isn't such a big issue for many.

What the industrial space was pleased to see in the latest US budget deal was for tax issues to be cleared up, and although there may be worries about the US national debt, that is really because of the negative effect that it might have on the economy — and we are not really seeing that at this stage.

In China, the market appears to have stabilized since early 2012, though not with the big rebound that some had expected. Things have slowly improved, and even though there is the uncertainty surrounding a new government there, 2013 looks better.


Mark Douglass

Personally, I am curious to see how much more investment needs to be made in China — there is overcapacity in steel manufacturing globally and also in construction equipment, and this makes me wonder how much more they need to do. It's not the [economic] juggernaut of previous years.

We are seeing investment in North America — including in Mexico, where there is a lot of automotive production — and here it looks like we are set for continued growth. Latin America is increasingly important, though we have not yet seen as much investment in Brazil as we had expected. The effect of the 2014 World Cup and the 2016 Olympics have not yet rolled through, but we are optimistic that they will. Europe is still struggling, and we think will be flat at best in 2013.

What's your motivation for attending Photonics West, and which new technologies will you be checking out?

For me, it's a great networking opportunity. It's not a major industrial show, but many who sell into the industrial markets are there. So I'm interested in checking out the supply chain, seeing who is looking to make inroads into the fiber laser market, and hearing about new technologies — often for the first time at this event.

Ultrafast is interesting, and certainly has a lot of promise. And with the recent Lumera/Coherent deal [Coherent acquired Lumera for $52 million in December 2012] and Newport's purchase of High Q it is clearly becoming a priority for the bigger fish, in particular for materials processing applications. But ultrafast still only holds a very small share of the overall industrial laser market.

Direct diode lasers are another area of interest, and in theory they can cut operational costs because of their higher electrical efficiency. Until recently they couldn't be used for remote welding or cutting, but they are good for welding thin-gauge materials and Laserline has been reasonably successful in certain welding and brazing applications. However, this past year we have seen a few start-ups introduce high brightness diode lasers that could add another tool to the industrial laser arsenal.

We've seen lots of consolidation activity in recent weeks: will that continue?

Consolidation will always be there, especially in photonics, where you have a lot of smart people innovating, pushing the envelope and creating entrepreneurial niches. But I think deals from the larger companies will be smaller in nature and infrequent rather than a wholesale roll up of the industry. So we'll always see "technology" deals, but these are more strategic in nature and aren't meant to add meaningfully to sales and earnings in the short term — the companies are preparing for long-term growth. It remains to be seen if any other "non-photonics" companies engage in photonics in the way that IDEX has done.

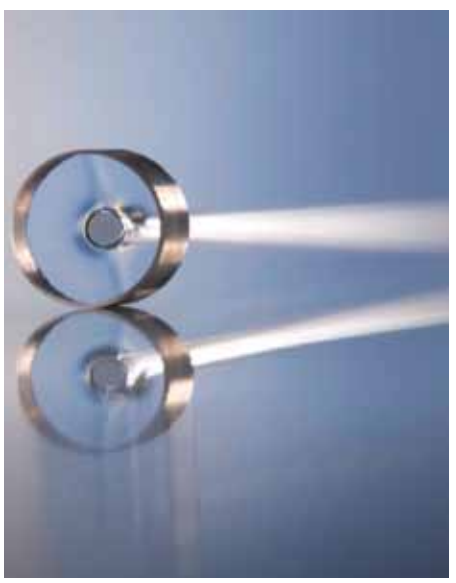
There's no doubt that there would be some benefits for the overall industry if it was more consolidated, but I don't see things changing too much. A lot of companies are not differentiated enough to justify a purchase, and an acquisition would just mean buying a sales base — sometimes it makes more sense to just

NKT Photonics aeroGAIN-ROD gain fibers ready to revolutionize the ultra fast laser market

The new aeroGAIN-ROD fibers from NKT Photonics are a new generation of ytterbium gain fibers designed specifically for the ultra-fast fiber laser marked.

They offer the highest peak power capability in the industry while keeping pristine mode quality and robust coupling, making them the ideal gain media for the next generation of high-power ultra-fast fiber lasers.

Fiber lasers has long been displacing solid state and gas lasers in the CW and slow pulse segments but the fiber revolution now moves towards ultra fast systems in the picoseconds and femtosecond regime. In this segment, nonlinear effects are the major limitation for output power and fiber systems has typically been limited to a few Watts. Bigger cores and shorter fiber are traditionally the go-to solution but often with compromises in mode quality and stability to follow. Not anymore. Utilizing the latest PCF technology, the new aeroGAIN-ROD fibers offer rock solid performance with long lifetime and they can handle peak power in the mega Watt regime while keeping a perfect near-diffraction limited beam quality; ideal for direct processing at 1µm or for further frequency conversion.



The aeroGAIN-ROD is available in a PM55 and a PM85 version with 55 and 85 µm polarization-maintaining cores, respectively. Each model is available in a Standard and a Power version designed for different power levels so that you can chose exactly the fiber you need.

The aeroGAIN line is already being used by several of the leading laser OEMs in the industry.

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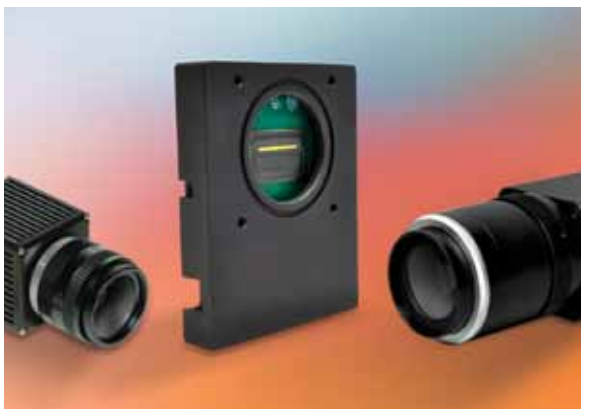

We offer a wide variety of high performance, near-infrared (NIR) and SWIR cameras, and 1- and 2-dimensional focal plane arrays. See our new 2048-pixel shortwave infrared (SWIR) digital linescan camera with 10 micron pitch for Spectral Domain Optical Coherence Tomography (SD-OCT) at Photonics West. This camera breaks new ground when used at the center wavelengths of 1.05, 1.31, or 1.55 microns by delivering A-line rates of >76,000 lines per second, near maximum for Base Camera Link® interfaces. Also on display, our next generation, high-resolution, mil-rugged GA1280JS SWIR camera, offers 30Hz full frame rate video, snapshot mode, global shutter function, and high sensitivity of 1.3 megapixel resolution at 1280 x 1024 pixels with 12.5 micron pitch. In addition, see our compact 640KTS large format camera image through a silicon boule to reveal cracks, voids, and abnormalities. It features high response from 0.9 µm to 1.7 µm at 30 frames per second and is easy-to-use with built-in non-uniformity corrections, automatic gain control, and basic image enhancement. Stop by Photonics West Booth #811 to see our full line of compact, shortwave infrared cameras ideal for a wide variety of applications including biomedical, machine vision/inspection, security/surveillance, military, spectroscopy, commercial and industrial use, and imaging through fog, dust, and haze.

DRS Technologies expands Tamarisk® product line with introduction of high-resolution infrared camera core

DRS Technologies, a Finmeccanica Company, expands the popular Tamarisk® line by introducing the high-resolution, feature-rich Tamarisk®640, which is designed for original equipment manufacturers (OEMs) to incorporate into their products.

The Tamarisk®640 uncooled thermal imaging camera provides an improved level of performance while maintaining its compact size. With a camera core weighing less than 60 g, the Tamarisk®640 offers remarkable performance, generating large, detailed analog and digital thermal images with a resolution of 640 x 480 pixels from its 17 µm focal plane array.

The Tamarisk®640 core measures 46 x 40 x 31 mm and draws less than 1.5 watts of power. Six Athermalized lens options are available from a wide field of view (FOV) of 44° to a narrow FOV of 9°, as well as a no lens configuration allowing OEMs to mount their own specialized optics. Performance improvements include: a wide dynamic range from -40°C to +80°C, improved pixel saturation logic to maintain image quality at temperature extremes, Dynamic Image Contrast Enhancement (DICE) for greater image detail in both low and high contrast scenes and color output via Camera Link®.

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Photonics-based components and multi-µ-functional devices

Optical device manufacture requires command of interdisciplinary microfabrication.

CDA GmbH (Suhl, Germany) is a specialist manufacturer of optical components and solutions in plastic for photonics-based applications. CDA also provides their customers with access to several high-end technologies for the development and manufacture of complex miniature devices incorporating printable electronics components and microfluidic channels.

Optical elements

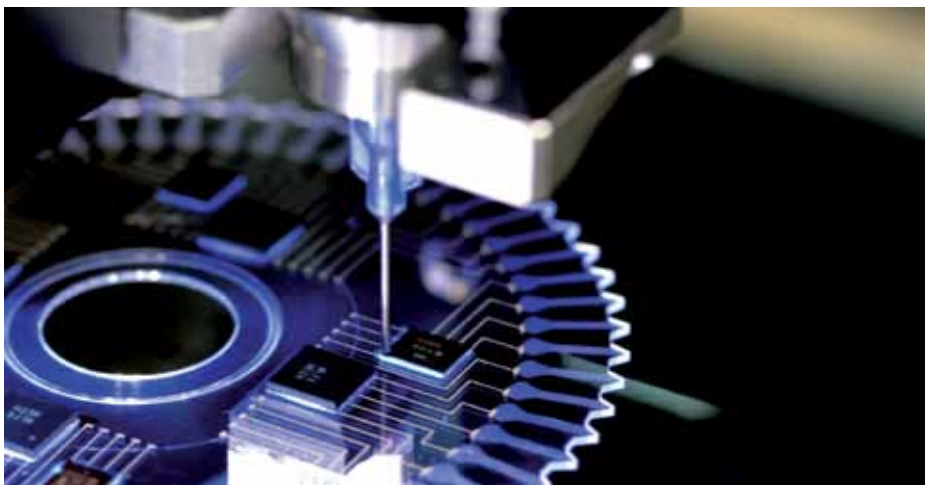
Optical elements can be designed with spherical, aspherical or even non-rotationally-symmetric freeform surfaces, and arranged in any 2D array desired. Each individual element can comprise refractive structures exhibiting diffraction-limited performance, or binary/multi-level diffractive structures optimized to provide the best efficiency for the intended application. Both types ensure optimal optical performance in a broad range of real-world applications.

The primary intended uses for these components are for general illumination tasks, for example as diffusors or for improving efficiency in light emission from (3D) displays and OLED panels. Further applications include imaging systems for multi-channel cameras or for improving the effective fill factor of CMOS image sensors, or as projection optics for LED, VCSEL and fiber arrays.

While silicon and glass remain important material options, the vast majority of applications are served exceptionally well by various types of plastics, such as polycarbonate, PMMA and cyclo-olefin-copolymers. These materials provide all of the performance aspects required in most applications, but are lighter, lend themselves to high volume replication via injection molding, and are more cost efficient.

Application diversity through added functionality

CDA is additionally a champion of more complex devices that integrate several functions on a single chip. So-called ›lab-on-a-chip‹ and other compact but sophisticated and sensitive devices are becoming increasingly important, for example, where physical chemistry, electrical and/or optical properties need to be tested on a small scale. Appropriate devices lend themselves well to high levels of parallelization, bringing cost reductions into a design but their manufacture does require a fully integrated process chain and command of several cutting-edge microfabrication technologies.



The manufacture in plastic means producing highly complex and functional microstructures with extreme precision, and doing so very cost efficiently under mass production conditions. The CDA approach is so attractive because of the number of available process steps and due to the nature of the functionalities – optical, electronic, microfluidic – that can be combined freely so as to optimize the performance of a device for the intended application. Finally, coatings can enhance specific optical performance or induce other specific physical properties, such as hydrophilic or hydrophobic behaviour.

According to Pia Harju, Business Development Manager at CDA, "We believe the market for both micro-optical elements and for integrated devices is absolutely global and we are targeting a range of industries including machine vision, lighting, medical devices, environmental applications and food production."

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QCLs begin tapping into commercial markets

The quantum cascade laser (QCL) is finally emerging as a leading laser technology for exploiting the mid-infrared region of the spectrum, enabling applications such as spectroscopic instruments, imaging, and infrared countermeasures to protect military forces and aircraft.

Speaking at the Lasers & Photonics Marketplace Seminar event running alongside Photonics West on Monday, Petros Kotidis, the CEO of Block Engineering, Marlborough, MA said that the widely tunable QCL is becoming an important light source for the so-called 'fingerprint' region in both field and laboratory settings.

Kotidis explained, "There are three types of QCLs available: ultra-widely tunable, narrowly tunable, and high power-narrowly tuned. QCL gain media may be integrated in an external-cavity configuration, where a wavelength-selecting component, such as a diffraction grating, enables the tuning. Under such configuration and with the proper coatings on the facets of the gain medium, these lasers can provide ultra-wide tunability, which allows exciting new applications."

Block Engineering CEO Petros Kotidis: the QCL company is working closely with pharmaceuticals giant Pfizer, indicating the growing commercial maturity of quantum cascade lasers. Photo: Matthew Peach.

The CEO gave a comprehensive list of their potential, including pharmaceutical cleaning verification — an area where Block Engineering, which offers a range of hand-held QCL systems for scanning and analysis, has recently signed a development contract with Big Pharma's Pfizer. Other real-world possibilities exist in the characterization of lubricants, trace detection of explosives, chemical reaction monitoring, identification of IEDs and biological threats, perimeter monitoring and coatings analysis of curved surfaces, such as on artificial limbs.

MATTHEW PEACH

Super-aligned nanotubes bridge nano and macro worlds

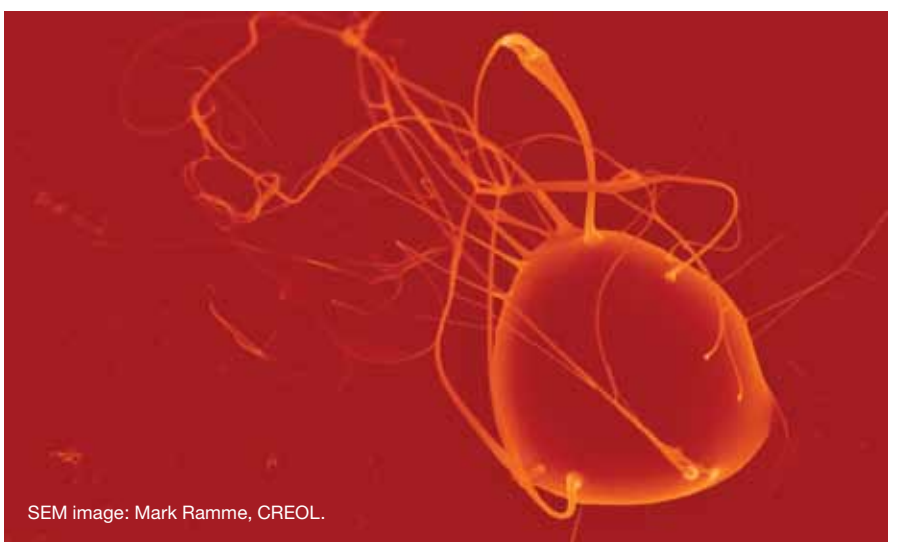
With graphene the focus of so much attention lately, the early promise of carbon nanotubes (CNTs) has fallen by the wayside in some respects. But the material remains of wide photonics interest, and found itself the subject of a MOEMS-MEMS plenary talk by Kaili Jiang of China's Tsinghua University.

Cylindrical CNTs are intriguing enough; but forcing them to line up into materials called super-aligned carbon nanotubes (SACNTs) could lead to several novel applications. "CNT powder consists of tangled or curved nanotubes, but arrays of aligned tubes can be grown by methods such as chemical vapor deposition," explained Jiang. "These arrays can then be drawn into thin films, or spun into continuous yarns in a dry process. The question is, can they be useful?"

One intriguing possibility could be the manufacture of transparent loudspeakers, in which stretched SACNT film produces an audio output. More directly in the photonics field, a modified SACNT film has been shown to produce incandescent light that may one day extend over a very broad range of the spectrum, thanks to a process including screen printing and laser etching steps.

"Emitted light from these films is polarized, and could potentially range from the deep ultraviolet to the far IR," commented Jiang. And with their transparency and ability to stretch, SACNT films are an inherently attractive proposition for future touch-screen technology, perhaps competing with the conventional glass and indium-tin-oxide materials currently in use.

TIM HAYES



SEM image: Mark Ramme, CREOL.

A jellyfish? No, nano-fibers generated on a bubble of molten glass on the surface of fused silica, after the bulk material was irradiated with tightly focused MHz-repetition rate femtosecond radiation from an Amplitude Satsuma laser system. The formation of these novel structures is being investigated by a collaborative research team from the LOMA-CNRS laboratory at the University of Bordeaux I and the Laser Plasma Laboratory at the Townes Laser Institute at the University of Central Florida.

Gorilla glass machined with ultrafast source

Ultrafast laser micromachining and light-matter interactions were the topics in Tuesday morning's "Frontiers in Ultrafast Optics" conference, part of the LASE symposium. Glass machining has long been identified as a likely industrial application for such lasers, and in an invited paper (8611-44) Electro Scientific Industries showed rapid-fire machining of Corning's Gorilla glass, dicing up large sheets of the rugged material.

Regina Moser from the University of Applied Sciences in Munich, Germany, presented work that could increase the efficiency of large industrial printing machines, by reducing absorption losses from the titanium foil used as vacuum windows (8611-45). The printing machines generate electron beams to dry freshly printed colored ink, but the titanium foils, which cannot be rolled to thicknesses of less than 15 microns, create absorption losses that reduce overall system efficiency. Moser showed a picosecond processing technique that reduced the foils to one-third of their original thickness, representing a huge potential reduction in absorption losses.

Also from the University of Applied Sciences, Matthias Domke showed the effects of confined heating of molybdenum by focusing femtosecond light onto a sample of the metal bonded to a layer of glass (8611-46). That created enough pressure to blow off a circular section of the sample from the glass. As Domke explained, the effect was discovered during processing of photovoltaic cells, and was so unique that it merited an independent study of its own.

Kasey Philips from Harvard University (8607-14) showed how titanium samples could be doped using femtosecond laser processing, with individual studies of magnesium, nickel, and chromium. The goal, Philips explained, was to find a way to increase the absorption of titanium for applications that will harness the light of the sun.

CHRISTINA C.C. WILLIS

Exhibition briefs

No Moving Parts

Insight Photonic Solutions demonstrated its newest product — claimed as the only swept laser with no moving parts, no mirrors, no drive mechanisms — to a rapt, packed-in audience. The fingernail-thick, all-semiconductor, akinetic tunable laser emits at 1310nm and 1550nm for sensing, spectroscopy and optical coherence tomography applications.

"It's blazing fast," said Jason Ensher, director of engineering at the firm, with up to 400kHz of flexible, stable power. Rapid sweeps reduce the time a patient is under observation, which is crucial for imaging blood flow in patients with heart disease or cardiac failure. It also switches wavelengths in nanoseconds. "With a digital interface, you can tell the laser what to do," he said. "It's hardy. There is nothing to become misaligned. You want your laser to perform as well on day one and day 600, or years afterwards."

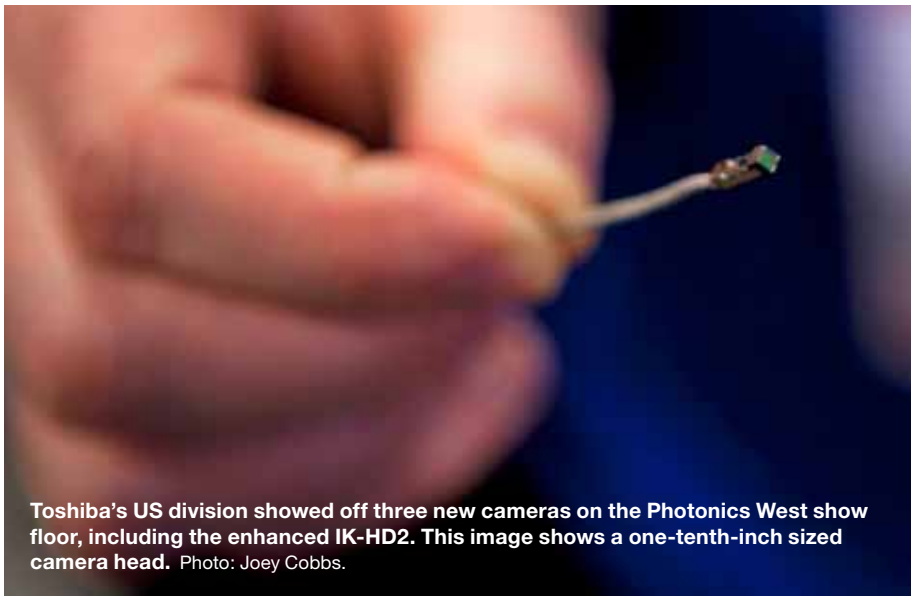
Supercontinuum source

Tucson's Advalue Photonics demonstrated a new "supercontinuum" laboratory light source covering the spectrum from 1850nm to 2500nm. The broadband device offers portability for applications like gas analysis and spectroscopy, while keeping the cost down. Alternatives are bulkier, the company said, and few of them will reach as far as 2500nm.

Speedy camera

For a low-light camera, the xSCELL is ten times faster than any competing product. It takes 1,000 frames per second at full 1Mpx resolution, with a full field of view. "And that's pushing it to the limit," said Marc Neglia, director of imaging products at Photonis USA. "It makes no compromises, like most other cameras have to do to get speed." He said that the camera is ideal for ultra-fast work, with high image quality through pixel level offset and gain correlation features.

FORD BURKHART



Toshiba's US division showed off three new cameras on the Photonics West show floor, including the enhanced IK-HD2. This image shows a one-tenth-inch sized camera head. Photo: Joey Cobbs.

Raman sheds light on fibroblasts

Raman spectroscopy can shed light on the the mysterious way in which healthy cells become cancerous. "During normal proliferation, a mass of biochemical changes are underway in the cell," said Susie Boydston-White of the Borough of Manhattan Community College in a session on optical biopsies. "Resonance Raman spectroscopy can collect particular molecular fingerprints relatively easily, and so could potentially identify which spectra are associated with normal changes, and which are linked with developing cancer."

To test the theory, spectra were taken from the nuclei of normal fibroblast cells, and compared with those from fibroblasts that had become cancerous. Initial results have confirmed qualitative differences between the two.

Further investigation should now help to pin down some of the complexities still involved, and also which chemical species are critical. "Our study was limited specifically to cell nuclei, rather than a more extensive structural investigation, since it would take many hours to scan an entire cell," noted Boydston-White. "We also needed to lower the power of the laser to avoid burning the fragile biological material."

TIM HAYES

A sensor for all seasons

Look carefully. You see a compact sensor head, as small as the tip of your little finger. This is the new real-time interferometric sensor from Attocube, based in Munich, Germany. Competing products are huge by comparison, as big as an iPhone. Florian Ponnath says that the FPSensor is uniquely all-fiber-optics based, with no electronics on the sensor head. It works in extreme environments, down to milli-Kelvin temperatures, near high magnetic fields, or in micromachining applications.

With a laser output at only 75 microwatts, it can give a high-speed, precise vibration measurement, with picometer resolution, in real time. The basic FPSensor Series product costs around $24,000.

FORD BURKHART

The Attocube sensor measures vibrations at resolution of 1 picometer. A system could range from $20,000 to $60,000. Photo: Ford Burkhart.

Graphene beats ITO for OLED emission

An invited paper by a collaborative team involving Pohang University of Science and Technology in Korea showed advances in flexible OLEDs in Monday's session on "OLEDs and OLED lighting". Tae Woo Lee explained that replacing the traditional indium tin oxide (ITO) anode with graphene yielded high transmittance and excellent mechanical properties.

Overcoming earlier problems with the new "wonder material," newly reported devices have a high work function and low sheet resistance, and achieve extremely high luminous power efficiencies (37.2 lm/W in fluorescent OLEDs, 102.7 lm/W in phosphorescent OLEDs), significantly higher than those of optimized devices with an ITO anode.

Ludvig Edman of Umeå Univ. (Sweden) reported work on light-emitting electrochemical cells (LECs), a low-cost alternative to LEDs (paper 8641-14). Based on "green" carbon-based materials and produced with low-cost methods, Edman said they are "remarkably similar to an LED" in many important ways. The LECs utilize "mobile ions" that are redistributed to generate an enormous electric field. Electrochemical doping takes place in the device and a p-n junction can form, emitting light.

The devices utilize air-stable electrodes and thick or uneven active materials, making them economical to produce. The group has demonstrated ambient fabrication of low-cost and flexible light-emitting sheets using roll-to-roll coating techniques. A long-term goal, said Edman, is a scalable, solution-based fab in a "normal lab" — no vacuum, no high-temperature methods, and no cleanroom would be necessary. Since the device is insensitive to thickness or variations in the active material, high-precision fabrication techniques are less critical.

One of the challenges still remaining is to lengthen operational lifetimes that are "not impressive" so far, Edman said. Also, the LEC will not lend itself to applications such as high-speed displays. *In situ* doping has resulted in turn-on time of 0.1 to 10 seconds. Possible gains in efficiency may be made by refining designs of the doping structures.

RICH DONNELLY

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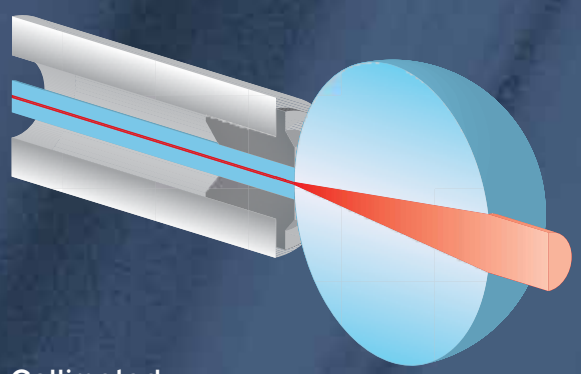

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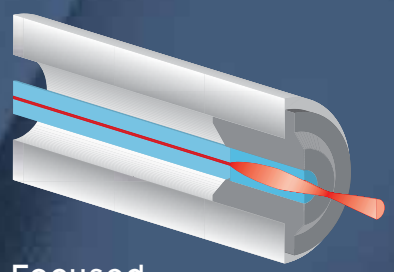

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