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Photonics West® Show Daily

WEDNESDAY EDITION

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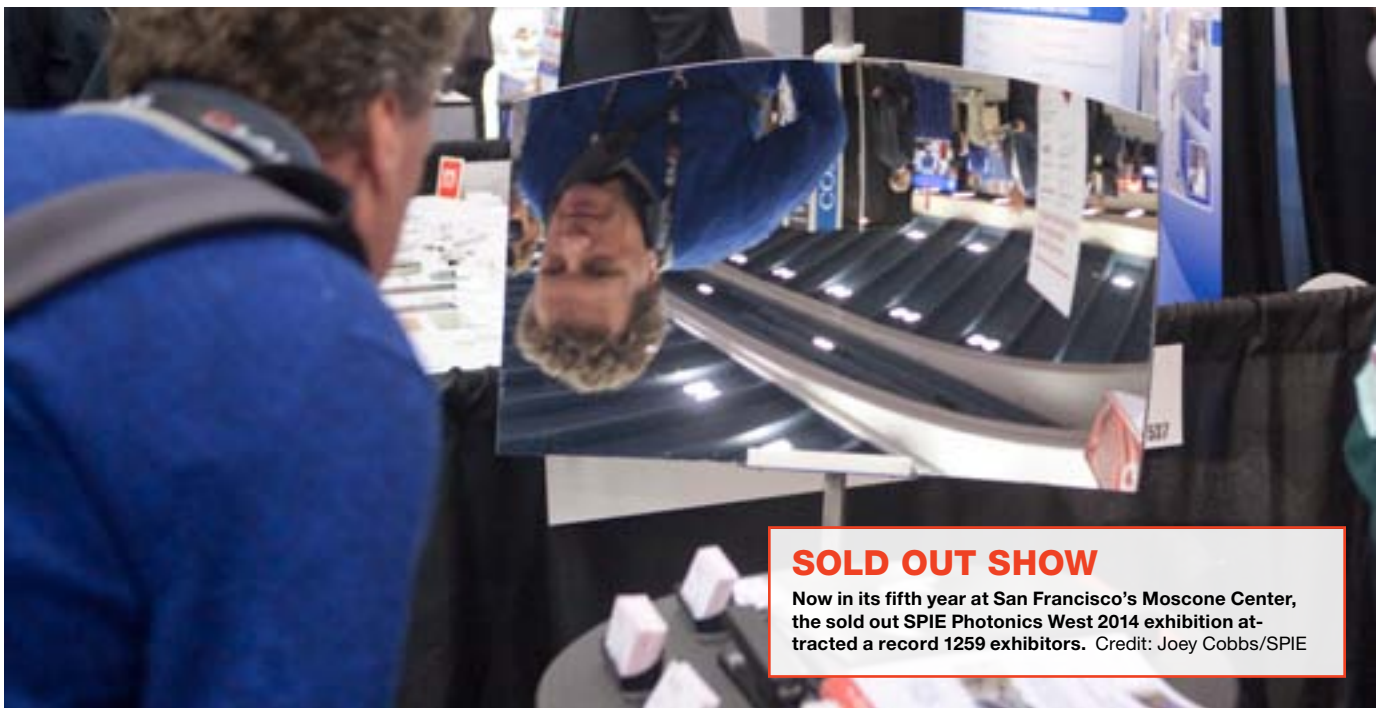

SOLD OUT SHOW

Now in its fifth year at San Francisco's Moscone Center, the sold out SPIE Photonics West 2014 exhibition attracted a record 1259 exhibitors. Credit: Joey Cobbs/SPIE

TODAY'S NEWS

Accelerating your startup's success

So you have what you think is a great idea for a product that leverages cutting-edge technology and might even be a market "disruptor." But how do you know if it warrants launching your own company? And if you decide it does, where do you start?

These were some of the questions a panel of financial and legal advisers addressed Monday at the Accelerator Forum, "What Startups Need to be Successful."

In recent years, SPIE has made a concerted effort to help the community bridge the gap between benchtop research and commercial product development through workshops and seminars designed for budding photonics entrepreneurs. And judging by the standing-room-only attendance at the Accelerator Forum, the timing is right.

"There is a portfolio of entrepreneurial activities happening here at SPIE Photonics West that mirror what is going on around the country," said moderator Andrea Belz, CEO of Belz Consulting. "We are moving into a new and exciting entrepreneurial era."

Joining her to answer audience questions on topics ranging from the importance of patent protection and nondisclosure agreements to building a top-notch management team that can help attract investors were:

- James Schaefer, Mark Schaefer Associates
- Liz Nevis, Intermolecular
- Ken Itrato, Faber Group
- Ellen McGuirk, Masterplan Consulting

continued on p.30

Don't miss

LASE Plenaries* (10:20am-12:30pm)

- Photonics21 and perspectives from the European photonics industry (Michael Mertin, Jenoptik)
- Femtosecond laser 3D micromachining and its applications to biochip fabrication (Koji Sugioka, RIKEN)
- A new plasmonics-enhanced ultrafast laser multinanoscalpel (Michel Meunier, Ecole Polytechnique de Montréal)

Industry Events

- Photonics West Exhibition (10am-5pm)
- Inbound marketing: How to bring customers to you (10:30-11:30am)
- Commercialization of photonics technology (1-2pm)
- Executive perspectives on the world of optics and photonics (1:30-2:30pm)
- Marketing roundtable: wins and lessons learned in our industry (3:30-4:30pm)
- SPIE Startup Challenge finals (3:30-6pm)

See the technical program and exhibition guide for details on daily events.

All industry events are open to all registration categories.

* Conference registration required at Plenaries.

Inside this issue

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OPTO plenary: 'They said it couldn't be done'

Tuesday's OPTO symposium plenary talks showcased two technologies — silicon photonics and ultrafast thin-disk lasers — that just a decade or two ago were considered "impossible."

"If you had asked any laser expert 20 years ago if it is possible to do what we do today, they would have said 'no,'" said Ursula Keller of ETH Zurich in her presentation on ultrafast laser advances. "But today we have picosecond laser oscillators with no additional amplifier that generate 100 microjoule pulses at megahertz pulse rep rates and femtosecond/picosecond laser oscillators with no additional amplifier that can generate 300 W average output power."

In addition to industrial applications such as high-speed and high-precision micromachining, ultrafast laser sources with high average powers have become a promising tool for strong-field physics and other research disciplines.

"The key for high-average-power ultrafast sources is heat removal," Keller explained. "You have to optimize your surface-to-volume ratio either with the fiber or with the thin disk."

Over the last decade, her group at ETH has been working with thin-disk lasers and semiconductor saturable absorber mirrors (SESAMs) to push the performance of ultrafast lasers. By using the SESAMs to passively modelock the lasers, they have achieved unprecedented pulse widths, average powers and repetition rates, Keller noted. Today average power scaling in a thin-disk geometry supports 10 kW from Yb-doped solid-state and 100 W from vertical-external-cavity surface-emitting-lasers (VECSELs).

"SESAM modelocked thin-disk lasers have demonstrated highest average powers and highest energies of any ultrafast oscillator technology," she noted. "People thought solid-state lasers could not be modelocked; we now know that is not the case."

Keller sees much promise for thin-disk VECSEL and MIXEL technologies, especially in data communications.

"I really believe in VECSEL technology, optically pumped VECSELs, for big data centers," she said. "Recently we have seen 100W+ VECSELs, so these are high-power semiconductor lasers. But what gets me really excited is the MIXSEL (modelocked integrated external-cavity surface-emitting laser). They offer scalability in repetition rate, have no Q-switching instabilities and offer extremely low-noise performance."

What is the limit in terms of energy and output power for thin-disk lasers? "I want to keep pushing it," Keller said. "A modelocked oscillator in the kilowatt — that would be great, wouldn't it?"

The future of silicon photonics is also bright, according to Michal Lipson of Cornell University. "This field has made enormous advances in the last 10 years, challenges we as a community overcame," she said.

Left: Michal Lipson of Cornell University. Above: Ursula Keller of ETH Zurich Credit: Stacey Crockett/SPIE.

Pushing this development has been the need to alleviate power dissipation in computers and transmit huge amounts of data. Optics was the natural solution.

"The industry knew this was coming 10 years ago and has been looking for solutions," Lipson noted. "The condition was that anything you do in optics has to be completely compatible with the billion-dollar CMOS electronics infrastructure."

Today photonics-on-a-chip schemes enable monolithic integration of optics and microelectronics for applications in which high data streams are required in a small footprint. Lipson and her group have been instrumental in pushing the development of these active devices, particularly ultrahigh-frequency modulators, silicon waveguides and optical isolators on a silicon chip.

"The performance of these modulators is as good as traditional modulators based on traditional optical communications materials, and we have learned how to make the waveguides very well, with very low loss," she explained.

Multimode photonics on a chip is another area of interest for data communication and storage as a way to increase bandwidth, Lipson noted.

"The goal of silicon photonics is to enable the transmission of enormous amounts of data over very short distances," she said. "If you can do this, you are golden."

KATHY KINCADE

Oracle investing in silicon photonics

The world's growing demand for mobile electronics coupled with technology companies' need to scale infrastructure and systems to meet those demands is driving database software giant Oracle to make major investments in silicon photonics.

Data centers of the future must have extremely high-efficiency processors, memory chips and interconnects, and silicon photonics will be key to revolutionizing those communication systems, according to Ashok Krishnamoorthy, chief technologist for photonics at Oracle.

Krishnamoorthy gave an overview of Oracle's work on developing photonics solutions for data centers and cloud computing at a luncheon on Monday where 34 of the 76 newly promoted SPIE Fellows were officially recognized. He also participated in a panel discussion on Tuesday on silicon photonics and photonic integrated circuits as part of an expanded industry program track at Photonics West this year.

He said Oracle Labs is working with industry, government and academic partners to break through today's technology limits with manufacturable and low-cost solutions to support a world that is becoming increasingly dependent on tablets and smart phones.

"The future is mobile, and as a consequence of that, the Internet, media and commerce is being dragged along," said Krishnamoorthy, who has worked for more than 20 years on integrating photonic devices with silicon CMOS circuits.

Krishnamoorthy was Distinguished Engineer and director at Sun Microsystems, which Oracle acquired in 2010.

Today Oracle researchers have a vision for an optically interconnected supercomputer, a "macrochip," and are working on low-power and high-density optical transceivers, active cables, heterogeneous processor chips, and other components that would improve efficiencies up to a factor of seven.

Oracle Labs has already set records in its multiwavelength silicon-based optical channel components, but has yet to overcome the challenge of using silicon-assisted lasers to reduce power consumption, he said.

"The need for mobility is very, very strong," he said of a world that demands high-speed interconnects for instant communications.

After all, he joked, "I txt thr4 I am."

KATHY SHEEHAN

Exhibition opening: Moving Technology to Market™

Additive manufacturing "hits inflection point"

3D printing has enjoyed a recent surge in interest, but *Laser Marketplace Seminar* speaker Jim Ricchiuti, a senior equity research analyst at Needham & Co, was quick to dispel the idea that the technology has just arrived.

Ricchiuti, who prefers to refer to the technology as laser additive manufacturing or simply "AM", said: "Most people who have heard the terms seem to think that additive manufacturing has materialized in the past few years but in fact it dates back to the mid-eighties."

"It was actually in 1983 that Chuck Hull invented stereolithography and subsequently in 1986 founded 3D Systems in Rock Hill, South Carolina, so it's an industry that has been around for quite a while."

The AM industry is now at what Ricchiuti calls an inflection point, with implications for developers of certain lasers and photonics systems. "Awareness of long-term capabilities of the technology has now penetrated executive ranks of large global manufacturing companies," he said. "Thermoplastics have dominated applications so far, but additive manufacturing of metals is expected to be a major growth driver for industry over the next several years. Metals-based AM represents an attractive opportunity for suppliers of industrial lasers."

Another change is that large-scale AM is now on the horizon, so machines will have to become larger and faster. Ricchiuti added, "With ongoing technology advances, today's industry forecasts could actually be rather conservative."

On which note, he presented some estimates of the value of the AM market, which he believes to be currently worth about $2.7 billion per year. "The market grew over 25 percent in 2012 to $2.2 bilion and [another] 25 percent in 2013. Wohlers Associates is forecasting that the market will turn over $4 billion in 2015, rising to $6 billion in 2017 and $11 billion by 2021."

Which processes and companies are the key players in this modern industrial revolution? Ricchiuti identified several laser-related technologies at the heart of AM: stereolithography; fused deposition modelling; digital light processing, selective laser sintering and melting; direct metal laser sintering, e-beam melting and laser-engineered lens shaping.

And perhaps because it had previously been evolving in "stealth mode", AM remains dominated by a handful of players, notably Stratasys, (with a 62 percent share), 3D Systems (19), Envisiontec (5), EOS (2), with the rest shared by the likes of Materialise, ExOne, Optomec and Arcam. Another key trend will see AM transition from providing prototypes to the total production of final parts — expected to happen over the next few years.

Notable customers of AM so far include the medical device sector (hearing aids, dental and orthopedic devices), aerospace (Boeing, for example, has at least 32 laser-sintered components in its 787 Dreamliner), and the automotive sector.

MATTHEW PEACH

Femtolasers wins Livermore laser tender

Tuesday at the Femtolasers booth saw the Austrian company sign a deal to provide the high-performance seed laser for the European Extreme Light Infrastructure (ELI) Beamlines science facility — currently under construction in Prague, Czech Republic.

Co-signing the deal was Lawrence Livermore National Laboratory (LLNL), which will integrate a dual-chirped pulse amplifier system based around the ultrafast pulse seed oscillator that is scheduled to ship from LLNL to Prague in 2016. "First light" is expected in 2018, said Constantin Haefner, project manager of the high-repetition-rate advanced petawatt laser system (HAPLS) effort at LLNL.

He was joined by Femtolasers CEO Andreas Stingl and ELI Beamlines technical director Bruno Le Garrec for the ceremonial signing. Le Garrec told *Show Daily* that the Femtolasers source would seed the "L-3" laser line in Prague, one of four lines in total to be constructed at the site. It is one of three "pillars" that form the wider ELI project, with others set for Hungary and Romania. "This is the first milestone for the whole of ELI," he added.

Once transferred from LLNL and ramped to its full performance, the line should be able to deliver a stream of 30 fs, 30 J (i.e. petawatt) pulses at a repetition rate of 10 Hz.

From left: Andreas Stingl, Constantin Haefner and Bruno Le Garrec. Credit: Matthew Peach/SPIE

Exhibition visitors in need of a vision check were in luck at booth #5419 as Varioptic showed off a prototype phoropter based on the Parrot-owned company's new liquid lenses. Now measuring 8 mm in diameter and with eight electrodes, the demonstration kit is able to measure both astigmatism and tilt, to give a full prescription in under ten minutes. Patients can control the corrective effect of the liquid-lens spectacles themselves by simply turning a knob, in contrast to conventional vision tests.

Varioptic's Olivier Jacques-Sermet said that the company would begin an early adopter program aimed at optometrists in Q2 of 2014, with a full release expected next year. Varioptic's in-house optometrist Anaïs Curpanen, shown here on the right, said that the product should allow for a more comfortable, faster and intuitive procedure. Credit: Joey Cobbs/SPIE

A backspin on startup theory

Don't write that long business plan for the "angels." Just go get a few early customers, even ones who only promise to pay one day, if you can deliver, and you put it in writing. With that credibility, the financing will follow.

That was one of the counterintuitive suggestions at a one-man talk Monday in the industry events series on "The Science of Financing Startups" by John Dexheimer, president of LightWave Advisors Inc., in Westport, Connecticut.

He cited examples of companies that broke the rules. Cisco was turned down by 70 venture capital (VC) companies, "almost everybody," before going public in 1990. Success followed.

Broadcom took no VC money, made a "lean launch," and started collecting customers. "Bootstrap as best you can until you have those customers," Dexheimer said.

"Let's bring a bunch of customers together," said Illumina. The investments followed. Cree worked with GE, Sumitomo and others in Japan, and soon raised $13 million.

"Momentum matters," he said. You must leverage your customers, and produce a score to show that they are satisfied — as Apple did.

For all the talk of VC funds, Dexheimer showed that the CEO is often the first to go. "You no longer control your own company," he said. "You have a 50/50 chance of being gone."

There's talk of companies that make ambitious investments, but of 22,000 VC-backed firms in a survey, he said, the founders of three-quarters had made little else at exit except a salary. In non-VC funded companies, the CEO was more likely to survive, and financial goals and product milestones were more likely to be achieved.

Marketing? Don't spend on that. Take yourself on the road. Dexheimer said: "You define the product. It isn't worth anything until somebody spends money on it."

And about that lovely business plan? Forget it. "Don't put too much down on paper. A lot of VCs never read it."

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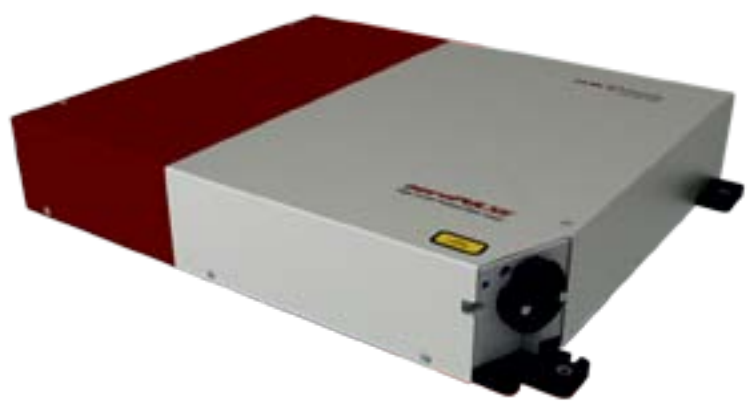

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Crossing the "valley of death"

Huge investment in research has created a wealth of great ideas, inventions and intellectual property in photonics. But not all of them make it to market. Thursday's Technology Transfer Showcase aims to help change that. Attendees will hear from the "best of the best"; the top universities and laboratories that are actively seeking commercialization partners. Here's panel moderator David Wick, licensing executive at Sandia, on what to expect.

David Wick, licensing executive at Sandia National Labs, will moderate a panel discussion on technology transfer in the exhibition hall demo area on Thursday at 10.30am Credit: Sandia National Laboratories

Show Daily: What is the Technology Transfer Showcase, and who should be looking to attend?

David Wick: It is an opportunity for universities and federal research labs to showcase technologies they believe are ready for market penetration with a little maturation. I think any company that is looking to expand into new business areas should attend. Many incredible technologies languish in the so-called "valley of death". The truth is, it takes investment beyond R&D to mature those technologies to the point where they are ready for commercial products. This showcase is simply an opportunity to jump-start some of those conversations, and perhaps, start to pull some of these technologies through the valley.

What are the key requirements for successful technology transfer out of a large national lab like Sandia?

Relationships, relationships, relationships. Rarely do I simply license a technology to a company, and they are able to successfully deploy a product without any support. Sometimes, that support is fairly minimal, but often it takes forming a relationship with the inventor(s) and working with them to further the technology for the particular application of interest.

Do those principles extend to all labs and institutions, regardless of size, or does a smaller lab (perhaps without a dedicated licensing resource) need to approach it differently?

Every lab/institution is different. Within Sandia, we have various models. We have organizations that are focused on more basic research, similar to universities, and others that deploy very complex systems for the federal government. Each organization is dealt with differently.

Which particular technologies within the photonics sphere are attracting the most attention right now?

Silicon photonics is gaining a lot of interest, and Sandia has a large and very broad silicon photonics portfolio. Biomedical applications, sensors, and displays all continue to be of great interest in the industry.

What would you say has been the most successful example of photonics technology transfer out of Sandia?

Vertical cavity surface-emitting lasers (VCSELs). Sandia played a key role in developing these microcavities, which spawned a large portfolio of patents. These patents were licensed by a number of companies, helping to create products for optical fiber communication, medical devices, laser machining, and even the laser mouse on your computer.

Photonics is typically described as an enabling technology, with applications in many different vertical markets. Does that lead to any specific challenges?

It does. An enabling technology is not usually the core technology that makes something work, but it might make a product work better, more efficiently, and/or for lower cost. With silicon photonics, for example, the modulators, switches, and detectors provide building blocks that can significantly improve data interconnection performance. Silicon photonics can significantly increase bandwidths, reduce energy consumption (dissipation), and lower cost in the next generation of supercomputers, local area networks, data centers, and long-distance communication systems.

What's your best single piece of advice for aspiring entrepreneurs currently in the lab, who want to see their work cross over into "real-world" applications?

Don't stop after you've submitted your journal article or presented your work at an SPIE conference. The most successful stories at Sandia are the ones where the inventor took the time to identify the market and make contact with potential companies. That starts the ball rolling.

MIKE HATCHER

New LASE conference sets focus on 3D manufacturing

The high-profile application sector of 3D printing will be under discussion on Wednesday and Thursday. Co-chair Henry Helvajian tells us what to expect.

Always one of the big draws at Photonics West, this year's LASE conference features a new 28-presentation track dedicated to the fast-growing sector of "Laser 3D Manufacturing" (conference 8970). Four conference chairs have developed the agenda, with the aim of bridging the gap between academic research and industrial applications: Henry Helvajian of The Aerospace Corporation, Alberto Piqué from the US Naval Research Laboratory, Bo Gu of Bos Photonics and Martin Wegener from the Karlsruhe Institute of Technology in Germany.

Besides research and transferable photonics technologies, the Laser 3D Manufacturing conference is also concerned with the understanding and development of appropriate types of materials that can respond favorably to laser treatments — either for prototyping or final production.

Photonics West Show Daily spoke with Helvajian, a senior scientist within the Micro and Nano Technology Department at the Aerospace Corporation, to hear his thoughts on what is sure to be a popular topic in San Francisco this week. Here's what he said:

Show Daily: What's the thinking behind the new conference?

Henry Helvajian: What we are trying to do is explore techniques, tools and processes that use lasers to put energy on a material's surface as a unique process for 3D manufacturing. While beam shaping and other optical processes are well known by the academic community, not all techniques are transferable to industrial 3D manufacturing. Because manufacturing throughput is cost-related, the incorporated techniques must be performed fast, without loss in reliability.

Typically, the materials people at Photonics West are primarily interested in making materials for optics and for delivering photons onto a surface — materials that lase and do other photonics-related functions. What's often missing in the 3D manufacturing equation are materials scientists with knowledge of light-matter interaction phenomena to develop the materials that form the parts being manufactured. The photonics materials scientists, who nominally attend the OPTO sessions in Photonics West, could be the key resource missing.

What are the main themes?

Conference topics include 3D printing and laser 3D manufacturing. The aim is to explore the principles of advanced photonics and related tools that use digital design information to accurately deliver laser treatments onto materials. The National Network for Manufacturing Innovation (NNMI) is also aiming to present such tools and techniques at high school and early college level, so that 3D manufacturing becomes a widespread trade rather than a specialized academic discipline — like traditional engineering but with lasers.

As chairs of these sessions, our aim is to attract materials developers who can make these 'photolytically activate-able' materials, for example novel polymers and metal powders for sintering and alloying metals. While the photonics materials scientists do reside in Photonics West, the question is how can we draw in groups such as the American Ceramic Society, for example, and the mechanical engineering societies to this show and conference.

How did the new conference come about?

At the annual chairs luncheon of the LASE symposium conferences a few years ago, there was a discussion on laser 3D manufacturing and associated technologies. The positive response prompted the decision to have a special session within the Laser Applications in Microelectronics and Optoelectronics Manufacturing (LAMOM) Conference. I co-chaired that session last year with the consequence that SPIE asked for a formal conference to be assembled. Mimicking the LAMOM meeting, we assembled four chairs to launch this new conference, with the goal of exploring laser 3D processing from the nano to the macro realm.

How did you decide on the range of presenters to this conference?

Given that this is the first meeting of its kind at Photonics West and also that 3D printing is making headway in the US and elsewhere, the chairs agreed that we should start with an overview of the US government's investment in this technology (through DARPA, NSF etc.), followed by worldwide research and development. The goal was not to focus too much on a particular material type and its potential for 3D fabrication (such as polymers), but to explore 3D manufacturing in general, where lasers are used to build 3D structures by polymerization, melting and sintering of powders — or just moving solid shapes into position through direct transfer techniques, or by altering the local material into a complex 3D shape.

We have tried to add another basic tenet: presentations should be advances that could lead to transfer into the manufacturing realm. The techniques had to be scalable with regards to throughput and so on.

I am hoping that our two initial presenters will give an overview of the US investment in this area. The NNMI is a growing, fairly large national US initiative that was initiated by the White House — and which includes, as sponsors, the government's defense and energy departments. This conference will provide a forum for exploring novel development ideas that could advance manufacturing further via a laser 3D processing approach.

What are the basic principles of 3D manufacturing?

One is the ability to prototype and to add complex 3D structures to existing structures, such that the whole process flow is amenable to manufacturing at reasonable cost, by way of automation. The design stage requires the use of 3D software tools that are physics-based and have a predictive feature (for error analysis). Developing or engineering the optimum material is another basic tenet, intended to optimize the desired light-matter interaction. The benefit of 3D manufacturing is the physical integration of the necessary functions into a seemingly organically grown form that achieves the overall aim as well as is possible.

It is common knowledge that 3D printing methods minimize material waste, but this benefit is lost if the overall form is ridden with critical defects. Consequently, *in situ* diagnostics must be implemented during 3D manufacturing to allow for *in situ* repair, instead of wasting hundreds of hours of processing time. This conference intends to provide a forum for research and development efforts for *in situ* diagnostics.

Which photonics technologies are key to 3D manufacturing?

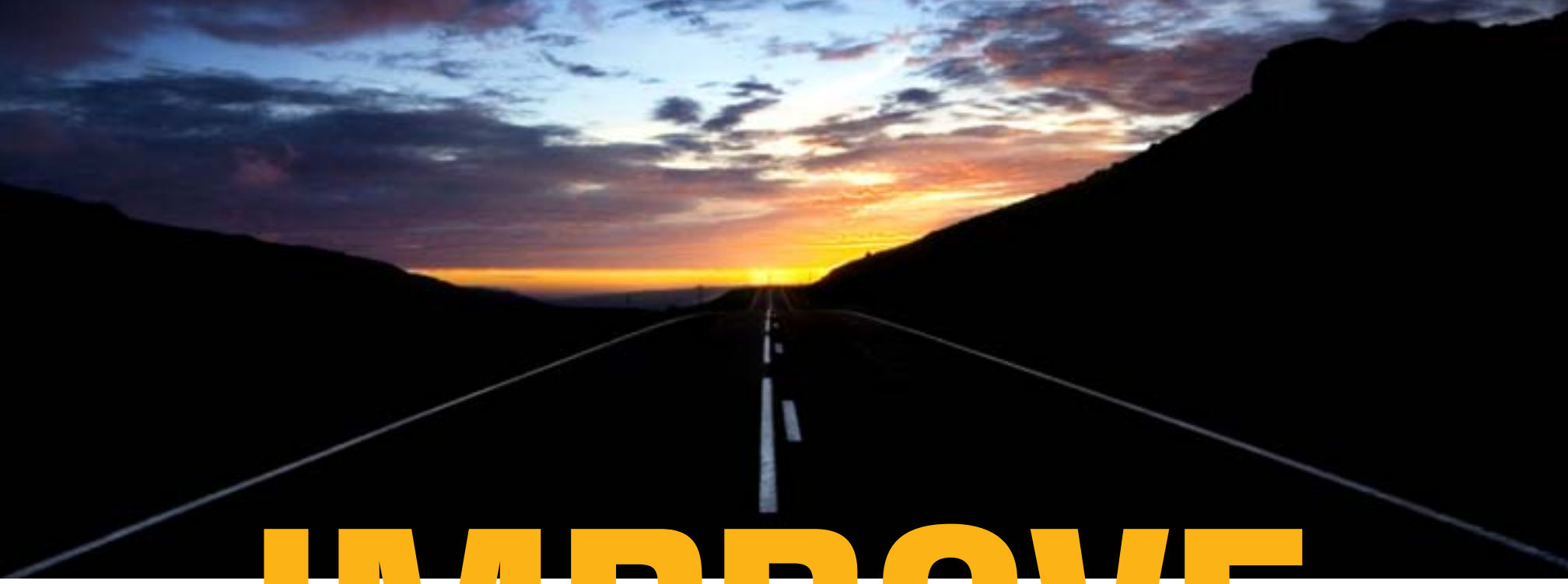
Because laser 3D manufacturing is ultimately a serial process, laser power stability is particularly relevant. For example, the need for compact and stable femtosecond lasers with some 10 mW of average power is necessary for high-precision processing. Also relevant is the need for developing feedback loops between the motion control system and the laser so that the exact amount of energy is delivered per unit volume. The need for laser power stability is ultimately the need for a stable laser-material interaction process. That means not only the laser, but also the reaction of a stock material to laser radiation. So it is important that key properties of the tools and materials are kept consistent.

This laser-sintered headdress is just one example of what is possible with additive manufacturing. Designed by the Chicago-based artist and longtime proponent of 3D-printed art and sculpture, Joshua Harker, it is set to appear at the 3D Printshow in New York this month. The all-plastic headgear, said to pay homage to traditional ceremonial headdresses of Native American and African tribes, consists of a variety of interwoven and suspended components. Harker spent more than 100 hours designing it, but German laser additive manufacturing specialist EOS was able to print the entire piece in less than 26 hours. Credit: 3D Printshow.

Which key problems still need to be solved?

We need to improve spatial resolution, further increase writing speed, introduce novel functional materials (such as photoresists), develop probes to monitor defects, as well as new processes to repair defects (either "on the fly" or soon thereafter), and devices or components that have graded functionalities.

MATTHEW PEACH



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UK presents largest ever industry grouping at Photonics West 2014

Optics and photonics seen as one of the sectors that will help to rebalance the UK economy.

Cranfield's EPSRC Centre for Innovative Manufacturing in Ultra-Precision has the capability to produce large optical structure such as this solar concentrator, as well as for large telescopes. It hosts a diamond drum-turning facility. Credit: EPSRC/University of Cranfield.

This year, the Photonics West exhibition will witness its largest ever contingent of UK companies. Numbering more than 40 altogether, many will be housed by two pavilions — one representing Scotland and another the rest of the UK — while several others are participating as standalone exhibitors. There is a feeling among the UK community that the strong showing reflects the increasing prominence of photonics-related businesses in the country, coming at a time when although economic growth remains nascent, the extended period of slump following the banking crisis of 2008 does appear to be over.

Historically strong in manufacturing, the UK economy had in recent decades shifted starkly in favor of banking and the service sector. The current government is hoping to foster a "rebalancing" towards the manufacturing sector — and high-tech manufacturing in particular — which it recognizes as imperative for job creation and real, sustained economic growth.

An example of Power Photonics' micro-optics for laser and laser diode applications. A direct-write manufacturing process creates custom optics without the usual costs of masking and molding. Credit: Power Photonic.

Laser Beam Products makes chemically polished, super-smooth metal optics for industrial and scientific applications. Credit: Laser Beam Products.

At last year's Photonex conference, Carlos Lee, director general of the European Photonics Industry Consortium, said, "Photonics is expected to play an important role in the UK's manufacturing renaissance." The same, of course, could be said of continental Europe and the US, as evidenced through support mechanisms like Horizon 2020 and — perhaps — the US National Photonics Initiative.

As of today, the UK claims to have at least 1500 companies active in photonics, equating to direct employment of some 70,000 people and an annual production output worth some £10.5 billion ($17.2 billion). That represents close to 20% of Europe's total — estimated at around €60 billion in the Multiannual Strategic Roadmap published by the Photonics21 organization last year. UK expertise is well balanced, says Lee, and distributed across the development of optical systems (20%), medical (19%), production (15%) and defense (10%).

Fields where recent government backing has been forthcoming include space, life sciences, sensing (in food, security and gas sectors), and advanced manufacturing. All are areas where photonics plays a key role.

Example acquisitions of UK optics and photonics companies in recent years include SPI Lasers by Trumpf, CIP Technologies by Huawei, and Barr & Stroud by Thales, while perhaps the most notable development in terms of commercial photonics applications was the decision by the Fraunhofer organization to establish its Centre for Applied Photonics (known as F-CAP) in Glasgow, one of the country's undoubted hotbeds of photonics expertise. It aims to provide laser research and development for applications in security, healthcare, energy and transport.

F-CAP, which officially opened in April 2013, will be among the new UK exhibitors at this year's Photonics West show — alongside twin centers for innovative manufacturing that have been backed by central funding via the Engineering and Physical Sciences Research Council (EPSRC). One, dedicated to photonics, is based at the University of Southampton — another hotbed of optics expertise and home to the world-renowned Optoelectronics Research Centre (ORC) — while the second is focused on ultra-precision technologies and hosted by Cranfield University in Bedfordshire. Both EPSRC centers will be represented on the UK pavilion, while F-CAP will be hosted by the Scotland tent.

John Lincoln, CEO of the re-established UK Photonics Leadership Group, welcomed the bumper UK participation in San Francisco, telling *Show Daily*, "We are very happy to have a much stronger UK pavilion than has been seen for years with a higher profile and better image. The key issues have been developing critical mass and constructing a good-looking booth. We have been criticized before for not being flashy enough, considering that we are number two in European photonics."

He added, "This year is a particularly good year I think because the UK economy is now growing faster than any other European or developed world economy. This provides a great foundation for the strong growth in UK photonics. It is also a good and positive reflection on the large number of [the UK Government's] Technology Strategy Board-supported projects that have involved photonics technologies. The TSB has been well-focused on bridging the innovation gap between industry and academia."

MATTHEW PEACH

The British are coming!

UK-based companies appearing at Photonics West on the UK pavilion (booth 5311/5319). This includes companies from England, Wales and Northern Ireland, while a separate pavilion (booth 1023) will host much of the Scotland photonics industry base (see page 14).

ADVANCED FIBEROPTICS ENGINEERING specializes in the development and manufacture of bespoke optic solutions. Offering subcontract assembly services, AFE also develops high-performance precision products ranging from packaging active components to designing and integrating electronic sub-assemblies to complete integrated modular units. Recent product introductions are fiber-coupled visible lasers and receivers.

ARTEMIS OPTICAL employs more than 30 staff, working on the design and application of optical thin film coatings. Clients include OEMs in the defense, aerospace, security, space, medical and analytical instrumentation markets. The company has added DLC to complement its infrared coating capability, so can offer a complete lens coating service for the thermal imaging market.

CRANFIELD UNIVERSITY: The CIM in Ultra Precision is showcasing its capabilities in optical applications, such as its large-area diamond drum-turning facility for embossing optical structures in films, ultra-precision grinding of large telescope optics, concentrated solar power optics and collectors.

CYMTEC specializes in LED multiplexing and works with customers to develop bespoke products. The LED Multiplexer is designed to collimate, color-mix and homogenize high-brightness LEDs in etendue-restrictive systems. It is possible to create a color-changeable light source with a small emission area and uniform spread of light. This technology is tailored for specific applications ensuring optimal performance.

FIBERLOGIX develops specialty fiber and all-fiber passive devices. It has a special focus on customized solutions, including techniques and knowledge for harsh environmental applications over a wide temperature range. Products include polarization-maintaining active aligned patchcords, passive devices and fiber Bragg gratings.

GLOBAL LASER TECH specializes in a wide range of OEM laser diode module products for use within niche applications including machine vision, alignment, medicine, defense and metrology. Standard products include red, green, blue and infrared laser diode modules with powers up to 200mW. Optical outputs include lines, crosses, circular and elliptical spots.

KNIGHT OPTICAL will be exhibiting its custom optical solutions, sub-assemblies, and a range of IR materials and coatings, including include UV-VIS-NIR components Market sectors thermal imaging systems, medical instrumentation, engineering, defense and aerospace.

LASERMET is a developer and installer of certified laser safety systems and equipment. The Laser Castle is Lasermet's new rapid-build, modular laser safety cabin, and protects personnel from multi-kW laser beams used by laser welding robots. This passive enclosure can be upgraded to an active laser guarding system called Laser Jailer.

LEIN APPLIED DIAGNOSTICS offers measurement devices for the healthcare and industrial markets. Its core technology is based around a low-cost scanning confocal system that can make accurate, non-contact positional and thickness measurements with sub-micron precision.

LOGITECH is introducing what it calls "materials processing advances" with its Akribis-air: intelligent sample preparation system. The single station system is suitable for processing silicon, sapphire, silicon carbide, gallium nitride and other optical and semiconductor materials.

POWERLASE PHOTONICS has accelerated the introduction of high-power lasers into a variety of industrial applications worldwide, primarily in materials processing, marking, annealing, and cleaning. In December 2013, the company announced the installation of a 1.6kW, high-energy infrared laser for a Japanese client working on EUV applications.

POWER PHOTONIC designs and manufactures precision micro-optics for laser and laser diode applications. Its direct write manufacturing process to create custom optics removes masking and molding costs. Based on a laser system that shapes the refractive surface of fused silica glass, Power Photonic has the flexibility to create a complete range of standard products including telecom lens arrays, beam shapers, homogenizers, transformers and correctors, and a custom freeform micro-optics fabrication service called LightForge.

REDWAVE LABS offers affordable, high-performance photoreceivers that are suited to general optoelectronic measurements, spectroscopy and OEM applications. The company also supplies OEM subsystems for commercial instruments. Its photoreceivers and subsystems are designed for commercial equipment used in environmental monitoring, process control and the automotive industry.

SCITEC Instruments makes high-stability variable frequency optical choppers and analog lock-in amplifiers. Its optical choppers include a small OEM product based on a 30mm diameter disc, a large aperture version based on a 200mm diameter disc and a high frequency version offering chopping frequencies of up to 120 kHz. Its standard optical chopper, based on a 100mm disc, is available with options to provide chopping frequencies over the range 0.015 Hz up to 40 kHz.

SOUTHAMPTON UNIVERSITY: the EPSRC Centre for Innovative Manufacturing in Photonics will be showcasing some of the core capabilities of the renowned Optoelectronics Research Centre (ORC), including novel structured fiber fabrication, silicon photonics and high purity soft glass development. It will also be introducing the new Zepler Institute, which combines Southampton's capability in electronics, photonics, nanoscience and quantum technologies into a multidisciplinary research center with over 300 researchers.

TERAVIEW'S equipment enables terahertz imaging, which can be applied to a range of 3D terahertz imaging and spectroscopy applications. Typical market sectors are in semiconductors, solar, pharmaceuticals, medicine, homeland security, non-destructive testing and material characterization.

ULO OPTICS has been designing, manufacturing and supplying CO_2 laser optics, and mid-IR optics for thermal imaging and sensing since 1982. It manufactures a wide range of laser components including lenses, mirrors, cavity optics, and scanner optics all for CO_2 laser systems.

continued on p.14

The British are coming continued from p.13

UQG makes both custom and stock optical components and technical glasses. The company produces the majority of its components in-house, and offers a diverse range of machines for optical fabrication and glass machining. It supplies prototypes or small quantities through to volume production, and its custom range includes optical windows, technical glasses, substrates, discs and glasses.

VORTEX OPTICAL COATINGS supplies optical coatings and filters. Offering design and manufacture of optical components from the visible to the far-infrared spectrum, the company runs what it calls a 'Fast Prototype' shop for rapid problem-solving.

YELO, based in Carrickfergus, Northern Ireland, develops automated test equipment for electronics and opto-electronics markets. A three-year expansion project includes a £241,000 investment in R&D to expand its products and boost exports. Invest NI has offered Yelo more than £230,000 of support, part-funded by the European Regional Development Fund, towards the project. Yelo recently secured new contracts worth more than £500,000 for its laser diode test systems in the US.

Scotland

CHROMACITY's founding team has 40 years' experience in solid-state and fiber-laser development, and nonlinear frequency conversion. Chromacity's "Spark" femtosecond oscillator, based on robust fiber-laser technology, delivers the average power of a solid-state laser without the maintenance overhead or cost, with no water cooling or separate pump laser.

CONJUNCT supplies optical sub-assemblies (OSAs) for a range of datacoms applications. Conjunct's own OSA is the Fibre-Lyte, which combines all optical functions onto a single glass substrate with embedded lenses that eliminate the need for any active alignment. The Fibre-Lyte approach provides the smallest OSA for deployment in active optical cables, transceivers, chip-to-chip and on-board optical connection and Lightpeak applications.

CST is a III-V opto-device foundry with a unique library of processes configured into device platforms allowing pre-qualification to market requirements (e.g. Telcordia), reducing risk and time to market. Operating for more than ten years it has a track record of providing solutions in volume.

EDINBURGH INSTRUMENTS will be giving a live demonstration of its new FS5 Spectrofluorometer, a fully integrated, steady state fluorescence spectrometer designed to meet the needs of the research and analytical markets. Ultimate sensitivity, coupled with high-speed data acquisition and ease of use, makes the FS5 a suitable plug-and-play analytical tool.

FORTH DIMENSION DISPLAYS develops high-resolution spatial light modulators for industrial applications in addition to its range of full color, Near-To-Eye (NTE) microdisplays for government and healthcare markets. The company will be focusing on inline, fast-throughput 3D measurement using SLM-based structured light projection. A key market for this technology is PCB inspection by both 3D solder paste inspection and 3D automated inspection of populated PCBs.

FRAUNHOFER CENTRE FOR APPLIED PHOTONICS offers industry a flexible and practical R&D resource that responds to companies' needs in the development of photonic technologies. Main areas of work are: novel laser sources, laser-based systems for sensing, imaging, manufacturing and materials processing.

GILDEN PHOTONICS designs, manufacture and supplies optical spectroscopy solutions as components, turnkey instruments, OEM components, or customer configuration of optical solutions. It has its own manufacturing base and also acts as value-added reseller for a range of key optical spectroscopy companies. Products include: fluorimeter systems and accessories, fluorescence lifetime imaging systems, hyperspectral imaging systems, scientific CCD cameras and InGaAs array detectors.

HELIA PHOTONICS specializes in developing thin-film optical coatings for bulk/micro-optics and photonic devices such as high-power lasers and anti-reflection coatings for external cavity lasers. Helia uses a range of vacuum optical coating deposition technologies and the company is interested in reinvestment and research, with plans to ensure a strong foothold at the forefront of high power diode laser facet coatings.

INTELLEMETRICS GLOBAL designs and manufactures a range of optical and crystal monitoring and control systems. These systems are integrated onto vacuum coating and plasma etch systems around the world. These monitors are used across a wide range of thin-film coating and plasma etching applications to analyze and control the growth or removal of material, measuring in situ real-time thickness variations during complex fabrication processes.

OPTOCAP provides contract package design and assembly services for microelectronic and optoelectronic devices. Its turn-key packaging services enable customers to reduce development and manufacturing costs, accelerate time to market and reduce risk with new product developments. Optocap's expertise in packaging solutions spans the full product life-cycle: from design through prototyping, process optimization, product qualification, failure analysis and manufacture.

PHOTONIC SOLUTIONS provides world-leading photonic products and services. It is the exclusive distributor for over 20 of the world's premier manufacturers of lasers, spectrometers, detectors and related systems and is regarded as a leading supplier of optoelectronic components to the photonics market. Its portfolio includes a wide range of laser systems.

PYREOS was formed in 2007 to take advantage of the growing opportunity for advanced infrared sensor array technology in gas detection, motion sensing and spectroscopy analysis. The company acquired patents based around a unique thin film pyroelectric infrared sensor technology developed by Siemens over many years at its corporate research facilities in Munich.

UNIKLASERS develops and produces single-frequency DPSS lasers for applications in: leading-edge research; life sciences, biomed; semiconductor manufacture; and environmental metrology. Its lasers uniquely offer spectral coverage at any wavelength within the range from NIR to UV from just a single technology platform, using its patented BRaMMS DPSS Laser technology.

the business of photonics
optics.org
product focus

2014 Photonics West®

Welcome to the optics.org Product Focus which we have published specifically for Photonics West 2014 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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ID Quantique SA

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ID120 series consists of compact and affordable single-photon detector modules

ID Quantique's ID120 series consists of compact and affordable single-photon detector modules, based on reliable silicon avalanche photodiodes that are sensitive in the visible spectral range.
Key advantages of the ID120 modules are high quantum efficiency up to 80% at 800nm *(60% at 650nm)*, a 500 microns large active area and adjustable settings like temperature, excess bias voltage and deadtime. Thus, the customer has a complete control on dark count rate, quantum efficiency and afterpulsing rate, through an USB connection *(Labview)*.

Contact Details: Michaël Désert, ID Quantique SA, Ch, de la Marbrerie, 3, 1227 Carouge/Geneva, Suisse/Switzerland
www.idquantique.com info@idquantique.com Tel: +41 22 301 83 71 Fax: +41 22 301 83 79

Diverse Optics Inc.

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Custom Precision Polymer Optics

When you're looking for precision polymer optics to reduce cost, trim weight, simplify design, and improve performance, come to Diverse Optics.
We specialize in diamond turning (SPDT) and precision injection molding of custom polymer optics.
Prototype to series production of spheres, aspheres, domes, convex/concave, plano/convex, bi-convex, free-forms, diffractives, Fresnels, prisms, light-pipes, cylinders, lens arrays, collimators, combiners, toroids, CPC's, TIR's, micro-optics, mirrors, parabolics, off-axis, ellipticals, cylinders, and more!
Whether it's diamond turned prototypes or thousands of molded optics, we'll show you how polymer optics are perfected.

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www.diverseoptics.com info@diverseoptics.com Tel: +1 (909) 593-9330 Fax: +1 (909) 596-1452

Logitech Limited

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Akribis-air: The Intelligent Sample Preparation System

Logitech is proud to launch Akribis-air. A highly automated lapping and polishing system, designed for the processing of materials used within photonics based applications.
Akribis-air delivers key benefits such as;
• The highest degree of geometric precision, flatness and parallelism. • Exceptional quality, accuracy and reliability of samples. • Real time data feedback. • Faster removal rates and higher throughput. • More efficient use of consumable products. • Minimal set-up and clean-up time. • Increased user safety.

Contact Details: Logitech Limited, Erskine Ferry Road, Old Kilpatrick, Glasgow G60 5EU Scotland
www.logitech.uk.com enquiries@logitech.uk.com Tel: +44 (0) 1389 875444

Navitar

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New Bi-Telecentric Lenses by Navitar

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Magnifications include 0.128X, 0.528X, 0.05X, 0.243X, 1X and 2X.
The lenses offer high telecentricity, excellent MTF performance, no parallax error and less than 0.1% image distortion.
www.navitar.com/product/magnistar-bi-telecentric.aspx
Stop by Booth #502 for more information.

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www.navitar.com info@navitar.com Tel: +1 (585) 359-4000 Toll-free: 800-828-6778

ALTECHNA

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ULTRAFAST LASER MIRRORS

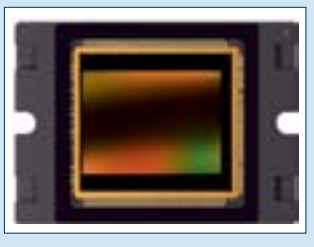
Ultrafast mirrors are designed for femtosecond applications to provide an optimized performance at certain wavelength and angle of incidence (AOI). This is achieved by careful selection of coating stacks to combine high reflectivity and low GDD value. Such coatings are used for external beam manipulation applications where pulse broadening effect is undesirable. Ultrafast mirrors are intended for Ti:Sapphire, Yb:KGW, Yb:KYW or other lasers working in femtosecond regime.
Characteristics:
• High reflectivity: R>99.8 % @ designed wavelengths • High damage threshold • Ultra-low group velocity dispersion

Contact Details: UAB ALTECHNA, Mokslininku st. 6A, 08412 Vilnius, Lithuania
www.altechna.com info@altechna.com Tel: +370 5 2725738 US Tel: +1 408 372 1513 Fax: +370 5 2723704

CMOSIS

Visit us at Booth #109

12-Megapixel/300 fps CMOS image sensor CMV12000



CMOSIS, the leading European supplier of advanced CMOS image sensors, is demonstrating its 12-Megapixel/300 fps CMOS image sensor CMV12000, which is now available in sample quantities. High volume production will ramp up from June 2014 onwards.
The CMV12000 excels current market solutions with a combination of excellent global shuttering with a stunning 300 fps at full resolution serving a broad range of applications like broadcasting, intelligent traffic solutions, machine vision and motion capture.
At Photonics West 2014, CMOSIS exhibits at the Moscone Center, Booth 109.

Contact Details: CMOSIS, Coveliersstraat 15, Antwerp, Belgium
www.cmosis.com info@cmosis.com Tel: +32 3 260 17 30

CILAS

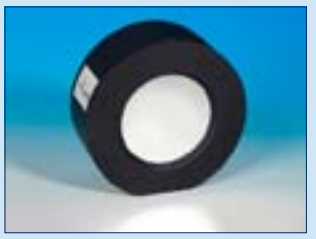
Visit us at Booth #1223 -A

Deformable Mirrors for the largest telescopes in the world

CILAS has developed Deformable Mirrors for the largest telescopes in the world, and continually improved the Adaptive Optics technology to serve Astronomy, High Power Lasers and Space applications.

"Monomorph" mirrors allow the correction of the optical aberrations induced in a high power laser chain, while avoiding both "print through" effect and energy distribution modulations.

Standard Monomorph Mirrors are available for diameters from 30 to 85 mm and are supplied with their Electronic Driver. Larger diameters, as well as specific electrode patterns, are available upon request.



Contact Details: CILAS, 8 avenue Buffon, BP6319, 45063 Orléans Cedex 2 - France
www.cilas.com optics@cilas.com Tel: +33 (0)2 38 64 15 55

ALPhANOV

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ALPhANOV's Cool & Control Modules drive laser diodes to new heights

With the new Cool & Control (CC) diode driver modules from ALPhANOV, single-mode and multimode diodes can now be reliably and securely driven with compact devices.

The single-mode CC Module (CC-S) drives and cools external standard butterfly laser diodes.

Its nsec pulses are generated internally or on-demand from a TTL signal.

The multimode CC Module (CC-M) drives and cools external single or multiple elements laser diodes up to 80W.

Contact Details: Ludovic LESCIEUX, ALPhANOV, Rue François Mitterrand, 33400 Talence, France
www.alphanov.com ludovic.lescieux@aphanov.com Tel: +33 (0)5 24 54 52 00

Ibsen Photonics

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Pulse Compression Gratings 120 mm long

As femtosecond laser systems advance to ever-increasing energy levels, demands to the energy/power handling capabilities of pulse compression gratings increase.

Ibsen manufactures 100% fused silica, transmission, Pulse Compression Gratings that offer unbeatable energy/power handling capacity, combined with high-efficiency, low wavefront distortion performance.

Now, production advances allow Ibsen to supply pulse compression gratings up to 120 mm in length.

Come visit us at booth #743 to tell us about your requirements.

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www.ibsenphotonics.com inquiry@ibsen.dk Tel: +45 44 34 70 00 Fax: +45 44 34 70 01

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FREEDOM UV-NIR 190 -1100 nm

This new spectrometer for integrators of analytical instruments offers high efficiency across the complete 190 – 1100 nm range, ultra-compact size (50 x 50 x 15 mm), robust and athermal performance, and flexibility in choice of detector and electronics.

It is ideal for process control in out-of-the-lab environments as well as handheld and portable instruments. The high broadband efficiency is obtained with a new innovative transmission grating from Ibsen.

Contrary to typical blazed gratings, this new grating provides nearly constant diffraction efficiency over the 190 – 1100 nm range for both polarizations.

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www.ibsenphotonics.com inquiry@ibsen.dk Tel: +45 44 34 70 00 Fax: +45 44 34 70 01

MÖLLER-WEDEL OPTICAL GmbH

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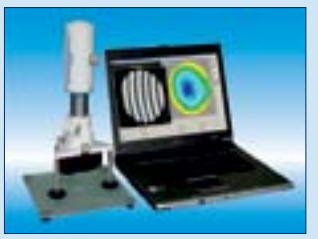
Interferometer VI

The Interferometer VI direct family is mainly intended for use in optical workshops. It is specifically designed for the following measurement tasks:

• Measurement of flatness/sphericity of optical surfaces • Radius measurement • Measurement of wavefront deformation

The main features are:

• Fizeau-type interferometer, modular design • Usable in vertical, horizontal or under oblique directions • Use of high resolution USB-based digital camera • Connection to computer via USB 2.0 port • Upgradeable with phase shifting unit and evaluation software • Easy service and handling • Cost effective alternative to conventional interferometers



Contact Details: MOELLER-WEDEL OPTICAL GmbH Rosengarten 10, 22880 Wedel, Germany
www.moeller-wedel-optical.com info@moeller-wedel-optical.com Tel: +49 4103 937 7617

PI (Physik Instrumente) LP

Visit us at Booth #4801/4901

Fiber Optic Alignment Engines: 3 & 6 Axis

PI provides leading edge photonics alignment engines. For rapid XYZ alignment, the compact F-131 CyberAligner system is the gold standard when it comes to speed and versatility. It combines a piezo scanner (100µm, 1nm resolution, millisecond response) for quick device characterization and precise tracking with motorized long-range positioning stages.

Hexapod-based, 6-axis alignment engines are available for complex fiber-optic components. The H-206, for example, is a unique, parallel-kinematics system including a specialized controller running a variety of user-selectable alignment routines. Get the whitepaper at www.pi-usa.us/products/Photonics_Alignment_Solutions.

Contact Details: PI (Physik Instrumente) LP USA: 16 Albert St, Auburn, MA
www.pi-usa.us info@pi-usa.us Tel: +1 508 832 3456 Fax: +1 508 832 0506

AdlOptica GmbH

Visit us at Booth #6028

Focal-πShaper 9_532q for square flattop laser spots

New Focal-πShaper 9_532q transforms *round* Gaussian 532 nm laser radiation to square shaped *flat-top* focused spot of several microns or tens of microns size with nearly 100% efficiency.

Versions for near-IR, visible, UV spectrum and CO2 lasers are available as well.

Increased quality and productivity of material processing, compactness, easy adjustability and simplicity of integration in already existing equipment, capability to work with scanning heads and F-theta lenses make the **Focal-πShaper** an indispensable tool in various micromachining applications.

Contact Details: AdlOptica GmbH, Rudower Chaussee 29, 12489 Berlin, Germany
www.adloptica.com; www.pishaper.com info@adloptica.com Tel: +49 (30) 56 59 08 880

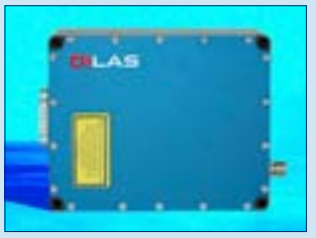
DILAS Diodenlaser GmbH

Visit us at Booth #4737

Blue Fiber-Coupled, Multi-Single Emitter Module

DILAS displays its blue multi-single emitter based, fiber-coupled module, nominated as a finalist for the 2014 Prism Awards for Photonics Innovation. This module is capable of delivering high output power and brightness in the 450nm spectral range and, due to its scalable approach, allows for powers from 10W to 100W, with 10W and 25W currently released as a product.

The product can be used for displacing arc lamps in display applications like cinema or large venue projectors by lasers and extends the current capabilities of blue light therapy and photodynamic therapy (PDT). **Product Page Link:** http://www.dilas.com/pages/products.php?category=9&series=66



Contact Details: DILAS Diodenlaser GmbH, Galileo-Galilei-Straße 10, 55129 Mainz-Hechtsheim, Germany
www.DILAS.com sales@DILAS.de Tel: +49 (0) 6131-9226-0 Fax: +49 (0) 6131-9226-257

MÖLLER-WEDEL OPTICAL GmbH

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GONIOMAT A series

The GONIOMAT A is a high accurate fully automatic goniometer with electronic image evaluation that is essential for measurement and testing of angles of optical components, such as prisms, polygons and wedges. Furthermore it can be used for measuring of angle gauges.

Advantages of the GONIOMAT A series: • High accuracy, even when measuring micro-prisms • Short measurement times • Elimination of the subjective error by electronic image evaluation • Logging of measurement results

Two levels of accuracy: • GONIOMAT A class: 0.7 arcsec • GONIOMAT A HR class: 0.4 arcsec

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DRS Technologies, Inc.

Visit us at Booth #2417

ADVANCED THERMAL IMAGERS FROM DRS TECHNOLOGIES

DRS Technologies provides high-performance thermal camera modules and detectors with flexible configurations to meet a broad range of application requirements.

Leveraging decades of infrared detector development, DRS' Tamarisk® (LWIR) and Zafiro® (MWIR) lines of advanced thermal imagers provide the ideal balance of size, weight, power and performance.

Contact Details: DRS Technologies, Inc., Commercial Infrared Systems, 100 N. Babcock St., Melbourne, FL 32935
www.drsinfrared.com sales@drs-rsta.com Tel: +1 (855) 230 2372

Diamond SA

Visit us at Booth #4240

DiaLink F.O. Connector for OCT applications

DIAMOND's revolutionary Fiber Optic DiaLink connector is a small coupling device based on a 1.25mm ferrule. Thanks to its very small diameter and a balanced design, this connector is an ideal solution for applications requiring high speed rotation, *(e.g. medical OCT)* or any other application where footprint is critical. The push-pull design allows easy mating and de-mating while both fiber end-faces remain protected to minimize damage and to protect against contamination.

The DiaLink is also an excellent alternative to fusion and mechanical splices. The DiaLink is available for all MM and SM fibers, and for cables up to 2.1mm OD. *(Customized solutions upon request.)*

Contact Details: Diamond SA, Via dei Patrizi 5, CH-6616 Losone, Switzerland
www.diamond-fo.com Tel: +41 91 785 45 45 Fax: +41 91 785 45 00

Pixelteq

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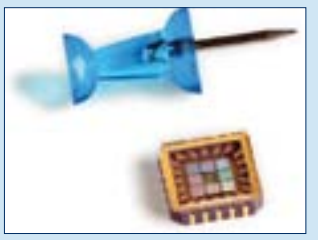
NEW Spectral Sensors | 8-band Spectroscopy

PixelSensor multispectral sensors use exclusive on-chip filtering to pack up to eight wavelength-selective photodiodes into a compact array < 1 cm2 for simpler and smaller optical devices. One PixelSensor replaces several components, delivering more signal and shrinking multispectral instruments from portable spectroscopy to fluorescence detection.

PixelSensor VIS splits the visible spectrum into eight discrete color bands. Customized OEM versions are available with user-defined spectral bands. PixelSensor's unique wafer-level optical filters suppress background light and enhance passband transmission. Find out how PixelSensor can support your application. Destination URL: http://www.pixelteq.com/product/pixelsensor/



Contact Details: www.pixelteq.com info@pixelteq.com Tel: +1 727 545 0741

Iridian Spectral Technologies

Visit us at Booth #5504

Global leader in custom optical filter and coating solutions

Iridian is the global leader in custom optical filter and coating solutions addressing needs in markets including telecom *(GFF, dual-band, dispersion compensation filters)*, bio-analytical *(Raman spectroscopy, fluorescence microscopy, flow cytometry filters)*, consumer optics *(3D glasses and projector wheels, surface enhancement display coatings)*, space and satellite *(multi-spectral, multi-band, multi-zone filters)*, among others.

Our durable optical coatings address needs from the UV to LWIR.

Iridian partners with our customers from design and prototypes through to high-volume production providing filters optimized to meet both technical and commercial requirements.

Contact Details: Iridian Spectral Technologies, 2700 Swansea Cres., Ottawa, Ontario, Canada K1G 6R8
www.iridian.ca inquiries@iridian.ca Tel: +1 (613) 741 4513 Fax: +1 (613) 741 9986

Varioptic

Visit us at Booth #5419

Caspian C-39N0-16

The Caspian C-39N0-16 is an electronically focus controllable C-Mount lens, based on Varioptic's breakthrough liquid lens technology, which incorporates all necessary electronic components to drive the liquid lens.

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Contact Details: Varioptic - a BU of Parrot SA, 24B rue Jean Baldassini, 69007 Lyon, France
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Contact Details: Voltage Multipliers, Inc., Karen Spano, Sales Administration Manager
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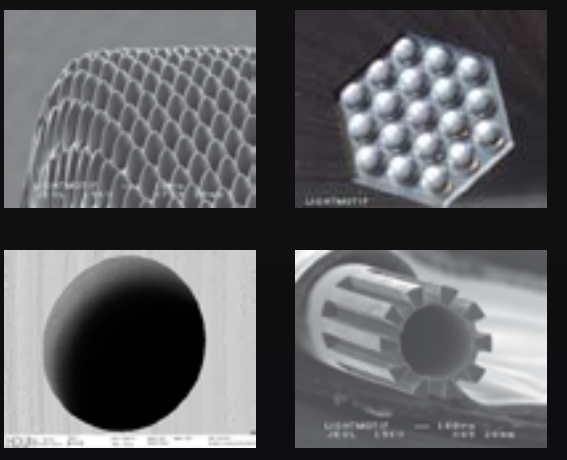

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Arizona's OSC: lighting up optics for 50 years

The University of Arizona's famed optics college celebrates its golden anniversary this year.

In its first 50 years, the College of Optical Sciences at the University of Arizona has garnered a spot atop just about anybody's list of premier centers for study, research and engineering in photonics.

"Nobody has the breadth and depth that we have in the field," said Dean Thomas Koch. "We have a history spanning outstanding fundamental physics and Nobel Prize winners to remarkable innovations in optical design and optical engineering."

Some colleges do the physics, some make things that impact the world. "We do both," Koch said. "Only a few places in the country can say that."

The OSC has awarded more than 2,300 degrees since its launch.

Arizona's scientists and engineers make huge things, like giant 8.4 meter mirrors accurate to 20 nanometers, and also fabricate tiny objects as small as a few nanometers. "When we make telescope mirrors, we mold the glass right on campus," Koch said. "Optics is not just an academic exercise. We make real systems and deploy them. That's one of our hallmarks — it's an amazing training ground for students."

For example, one faculty member is making the cameras that will allow a spacecraft to travel to a distant asteroid in 2018, determine a landing site with high-resolution photos, grab a sample and return it to earth in 2023, all part of the UA's $1 billion OSIRIS-Rex project for NASA. "The University of Arizona does real stuff, big science," Koch said.

Looking ahead, Koch is hoping to put the college's powerful infrastructure and engineering teams to work as the "go-to partner" around the world, in new partnerships involving large-scale optical systems, engineering and fabrication.

Up to 2005, the college was known as the OSC, for the Optical Sciences Center started in 1964, and it retains that distinguished OSC abbreviation. In addition to its prominence in global research, OSC has played a central role in establishing Tucson and southern Arizona as America's Optics Valley and in spurring the area's high-tech economy.

In the 1960s, leaders in the US optics industry and the Air Force sensed a national crisis in the lack of training and research in optics. In 1964, they worked with the UA to form the original OSC as an independent university unit, with Aden Meinel, director of Steward Observatory, in the lead. Meinel recruited the most innovative optical scientists he could find, and doors opened to students in 1968.

Today, OSC teaches more than 100 graduate and undergraduate courses and educates the largest number of students anywhere in the field of optics. The OSC has awarded more than 2,300 degrees since its launch.

About 100 students are enrolled in the undergraduate Bachelor of Science in Optical Sciences and Engineering degree, but most students are in the graduate program. That includes about 200 Ph.D.-level students and about 125 others in masters programs. Five students are pursuing the new Master of Science in Photonic Communications Engineering, and another five are seeking the new Professional Graduate Certificate in Optical Sciences, which can be completed on campus or as distance learning.

Many faculty members engage with top industrial researchers and scientists in partnership programs. Principal partners include Ball Aerospace, Edmund Optics, Johnson & Johnson Vision Care and Radiant Zemax. Others include Raytheon, Canon, Lockheed Martin, Nikon Research Corporation, and Sandia National Laboratories. The OSC generates about $30 million per year in research contract revenue, or nearly $1 million per year for each tenure-track faculty member.

The OSC has four core research groups, some of which are illustrated by the work of these faculty members:

Measuring and making giant telescopes

Jim Burge, a professor of optics and astronomy, leads a team of researchers who are pushing the envelope in technology for measuring telescope mirrors.

Tom Koch, Dean of the College of Optical Sciences at the University of Arizona, hails the breadth and depth of optics research at the venerable institution. Credit: Lehigh University.

This group has developed new classes of computer-generated hologram techniques and scanning laser measurement systems that have enabled fabrication of some of the world's most challenging mirrors, including the asymmetrical 8.4 meter mirrors being fabricated by UA's Steward Observatory Mirror Laboratory for the Giant Magellan Telescope.

A new scanning infrared system was also recently demonstrated at UA for the measurement of the 4-meter primary mirror for the Advanced Technology Solar Telescope. The ATST will become the largest scope ever pointed at the sun.

"The UA is the pre-eminent place to take on very difficult projects like this mirror," Burge said. "Our excellence in optical engineering allows us to attract the best students and the best faculty."

continued on p.20

Arizona's OSC

continued from p.19

The project, led by Burge and carried out in UA's Optical Fabrication and Engineering Facility, applies advanced technologies developed at the UA for polishing large ultra-precise mirrors and for measuring shape errors of complex mirrors with high precision.

Like the Giant Magellan Telescope, the ATST primary fits into the decades of OSC innovations with immense world-class mirrors. With its asymmetric shape, it will form the centerpiece of the ATST in Hawaii for detailed study of the sun starting in 2018. The telescope is being built on Mount Haleakalā, Maui, Hawaii, under a UA multimillion dollar contract with the Association of Universities for Research in Astronomy, or AURA.

The glass mirror will be the primary focusing element to create high-resolution images of the fine scale structure of the sun. The telescope will address basic questions of solar magnetism and how its changing outputs affect the Earth.

http://www.loft.optics.arizona.edu

Lasers, turbulence, Bose and Einstein

Brian P. Anderson is following in the footsteps of Bose and Einstein, pushing the frontiers on their eponymous condensates (BECs).

His team uses lasers and magnetic fields to study some of the coldest things on earth. They trap the clouds of rubidium atoms and cool them to temperatures of about 50 billionths of a degree Kelvin above absolute zero — about as close as scientists have ever been to reaching absolute zero.

These ultracold microscopic droplets were first produced in Nobel Prize-winning experiments in 1995. They behave according to the laws of quantum physics, displaying the wave properties of matter on a macroscopic scale, and are valuable tools for exploring a wide range of topics of fundamental interest in physics.

"Someday soon, the marriage of these experimental

Brian P. Anderson's group is focused on laser-cooled Bose-Einstein condensates. From left: Joe Lowney, Kali Wilson, Jessica Doehrmann, Zach Newman and Anderson. Credit: University of Arizona College of Optical Sciences.

techniques will permit novel approaches to probing, measuring, and even manipulating the characteristics of quantum turbulence," Anderson said.

The Arizona researchers, along with collaborators at the University of Otago, are expanding their experimental abilities by combining real-time imaging and tracking of vortices, developing new methods for creating vortices on-demand and manipulating their positions with lasers.

"Physicists have long speculated that research on fluid dynamics and turbulence in quantum fluids may lead to new insights into the behavior of more familiar fluids, such as water, or the universality of turbulence,"

The new Meinel building in Tucson, named after Aden Meinel, director of the Steward Observatory in the 1960s and a prime mover behind the establishment of today's college. Credit: F.J. Gaylor Photography.

Anderson said. "For now, however, we are still very excited about all of the new things we are discovering and that are left to learn regarding vortex dynamics and two-dimensional quantum turbulence in BECs.

"It is fascinating to see how vortices move about in a quantum fluid, how they can be generated and manipulated with laser beams, how they interact with each other, how they seem to display dynamics in ways that are analogous to vastly larger classical fluids, and to really nail down why all of these dynamics occur." http://bec.optics.arizona.edu/

High-speed "rack-on-a-chip"

Arizona is at the heart of a mighty engineering research effort to deliver end-user data rates at up to 10 gigabits per second at low cost. Nasser Peyghambarian, an OSC professor, heads up the Center for Integrated Access Networks (CIAN), created at the UA with a five-year $18.5 million NSF grant.

"These transformative systems are of critical importance to the foundation of our national information infrastructure," Peyghambarian said.

Data centers now have racks of 20 to 40 discrete servers with 8 to 16 CPU cores, hundreds of gigabytes of memory, and potentially tens of terabytes of storage. New designs to meet CIAN's cost and energy goals may employ a rack of multiple, discrete servers, including the top-of-rack network switch, integrated into a single chip.

The integrated "rack-on-a-chip" will be networked, internally and externally, with both optical circuit switching (to support large flows of data), and electronic packet switching (to support high-priority data flows).

Since 2008, the University of Arizona has worked with eight CIAN partner institutions -- UC San Diego, USC, Cal Tech, UC Berkeley, Columbia, UCLA, Norfolk State University and Tuskegee University.

CIAN focuses on removing one of the last bottlenecks in the Internet by developing optoelectronic technologies for high-bandwidth, widespread access and aggregation networks. It seeks to create optical access networks where virtually any application requiring any resource can be seamlessly and efficiently aggregated and interfaced with existing and future core networks. The solution will employ optoelectronic integration to enable affordable and flexible access to any type of service, regardless of the "last-mile" technology.

"Attainment of these goals will enable affordable, flexible access to any type of service to anybody, anywhere, at any time," Peyghambarian said.

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ALIO's Hybrid Hexapod

ALIO Industries proudly announces their latest 6-DOP (6 degrees of precision) product line, the patent pending Hybrid Hexapod®. This new type of motion solution eliminates the weaknesses of the conventional hexapod with two orders of magnitude more accuracy while providing a much more robust solution for applications requiring high lateral loading.

This product will change the way you think about hexapod applications. Application examples include laser machining, cutting, drilling that allows for smooth cut "zero kerf" features. Ideal for applications such as medical devices (stent cutting), 3D printer movement from 3D to "6D" printing to enable higher throughput and higher accuracy of printed prototype parts. Laser drilling applications can provide a more perfectly round hole without kerf for such applications as fuel injectors.

ALIO Industries was founded in 2001 with the focus of building precision products with unmatched quality and reliability by implementing unique designs for precision manufacturing. This in-depth focus on current and future industry needs of nano-precision has led to the development of another ALIO innovation; the Hybrid Hexapod®

Edmund Optics in 2014: expansion and innovation

Rapid optical prototyping and product modification are on the agenda as one of the Photonics West show's largest exhibitors continues to grow.

After five years of solid growth since 2009, during which time its workforce has grown by 100 to reach 750, Edmund Optics (EO) heads into 2014 in confident mood. Investment is set to continue, especially in its production facilities in Singapore and Akita, Japan, while growth opportunities in Europe, where activity complements the firm's well-known expertise in precision optics, are also anticipated (see sidebar).

Those manufacturing sites in Asia make products for customers using designs devised at EO's central design facility overlooking the Catalina Mountains in Tucson, Arizona, and at a sister site in Shenzhen, China.

Jeremy Govier, the principal engineer at EO's Tucson design facility, says the Singapore site will focus on aspheres, while the recently expanded Akita site will produce mainly spherical optics. Govier, trained at the University of Rochester, adds that the 72-year-old company will continue to leverage its two main strengths, as both a catalog optics supplier with the world's largest inventory of off-the-shelf optical components — now numbering 26,500 items — and as a manufacturer of optics.

Custom optics production at EO's facility in Barrington, New Jersey. Credit: Edmund Optics.

One of Edmund's high-performance microdisplay eyepieces. Credit: Edmund Optics.

"We are unique in the market by doing both things," Govier said. The blend will let EO offer some new advantages in 2014, as it increases its ability to quickly modify its existing products, allowing customers to easily transition from design to prototype to volume production.

Building up

The company began to build up its US manufacturing in Barrington, New Jersey, last year, and has big plans to expand its optical prototyping capabilities there. That effort will allow increased small-run fabrication. "It's internal manufacturing," Govier said, "used for both our own development work and optical prototyping for customers."

Jeremy Govier, principal engineer at EO's Tucson design facility. Credit: Edmund Optics.

What happens in Barrington, also the corporate headquarters, reflects the distinctive nature of EO. "We offer modified standard items, leveraging stock optics and our in-house manufacturing equipment," Govier said. "We can take components out of inventory and make semi-custom items, doing edge-downs, cuts in parts and even making aspheres out of spherical lenses."

For example, a customer might like the performance of EO's 25 mm diameter Achromat lens, used typically in microscopy, inspection, and spectroscopy applications, but they might want to make it fit into a machine a little differently. "They may need it a bit smaller, say, at 23 mm," Govier explained. "We can take an off-the-shelf 25 mm Achromat and grind down the edge, and make a 23 mm part, keeping all its optical properties, and do it very quickly. By starting with an off-the-shelf product, we can turn it around in a matter of days, rather than months."

Alternatively, the modifications might involve custom coatings or other changes. "This is one of our more exciting new things," Govier said. "We have taken an off-the-shelf PCX (PlanoConvex) lens, used it as a base part, and polished an asphere into it. There was no waiting for glass. We can do it economically since we are starting with a polished part, and add a lot of customization in a very little time. This is the ideal solution for a customer looking for 25 custom aspheres in order to test proof-of-concept and prototypes."

Growing range

EO also continues to ramp up its vision and imaging lines. "We are designing many more new catalog products for that area, along with custom work," Govier said. "We'll [also] have more diversity in anti-reflection coatings. We are investing heavily in coating technology."

The company also produces multi-edge fluorescence dichroic filters that are designed to work in conjunction with multi-bandpass filters to create high-contrast, multicolor images. That technology will allow users to enhance their fluorescence microscopy systems. "When you want to use multiple dyes at the same time, you would use a multi-edge filter that uses precise filter coatings," Govier said.

In the past year, EO has added several new products to its already vast range, including for SWIR (shortwave infrared) sensing. "We've been offering more off-the-shelf complete vision lenses, with more focal lengths and fields of view as standard products," Govier said. "And we are making some custom products as well."

Another focus is the design of eyepieces for use in industrial applications using color microdisplays. They are used to magnify small images on the LCD so that a user can view them much more easily with the naked eye. Catalog versions, called high-performance microdisplay eyepieces, are intended for very high-resolution displays showing the output from a thermal camera. "A firefighter could use these new products to identify hotspots at the scene of a fire," Govier suggested. "The eyepieces could attach to [a firefighter's] helmet."

Several new products aimed at bio-imaging and inspection applications are expected at the Moscone Center this week, alongside new hard coated fluorescence filters. Bio-imaging in particular has proved to be a growing sector in recent years. "A trend we are seeing in the market is a need for greater flexibility in complex systems with a desire for customers to maximize the lifetime of any existing equipment," Govier said. "By building a fluorescence microscope from off-the-shelf products, we can show customers how easy it is to have a custom solution at one-fourth of the cost of a traditional fluorescence microscope."

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European outlook

In Europe, as around the world, photonics is seen as an enabler for applications in a wide range of fields, such as:

- Information & communication technology
- Life sciences, healthcare, agriculture & food
- Energy & environment
- Safety & mobility
- Lighting & displays
- Factory automation & logistics

All these sectors present current and future challenges — challenges that can only be met successfully with advances in photonics — and Edmund Optics supports many partners and customers who are addressing those challenges.

In Europe we see steady growth in most photonics markets, but particularly in the fields of machine vision and life sciences. We fulfill our customers' requests by continuously enhancing our capabilities. Besides offering more than 26,500 stock products in our catalog, we continue to strengthen relationships with OEM customers and support them at all project levels. Customers are demanding traceability in the marketplace, leading to growth in high-volume requests and serial production. Customers are also looking to speed up their prototyping and shorten time to market, leading to increased demand for rapidly modifying standard optical components.

Edmund Optics is committed to supporting tomorrow's innovations. As a components supplier we fill a crucial role at an early stage of the value chain. We maximize customer success by listening to our partners and adjusting our capabilities, not just in manufacturing, but also in service and supply chain. We demonstrate our dedication to customer success with, for example, free technical support, simple and quick shopping options, and continuously adding new product offerings to improve product performance, address emerging market applications, and when needed, to update (replace) or discontinue products.

We will have about 1000 new products in our 2014 catalog, many of which we are proud to launch at Photonics West 2014.

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CDA – We inspire and manufacture value!

Optoelectronic components and microfunctional optofluidic devices in plastic

CDA GmbH (Suhl, Germany) is an established manufacturer of custom components and solutions in plastic. CDA's technology portfolio includes polymer optical elements and arrays for use in optoelectronics, automotive and other high-tech fields, as well as additional high-end microfabrication technologies such as printed electronics components and microfluidic structures. All of these can be flexibly and individually combined in order to realize complex miniature devices for clinical point-of-care, diagnostics, environmental monitoring and biochemical/forensic screening applications.

A multifunctional optofluidic demonstrator chip. Blue fluid is pulled left by pillars in a channel on-chip to complete a circuit (electrodes, left) with an external light source, thus illuminating a DOE (green spot right) and projecting an image. The additional fabrication features necessary included printed electronics and component bonding.

Optical elements

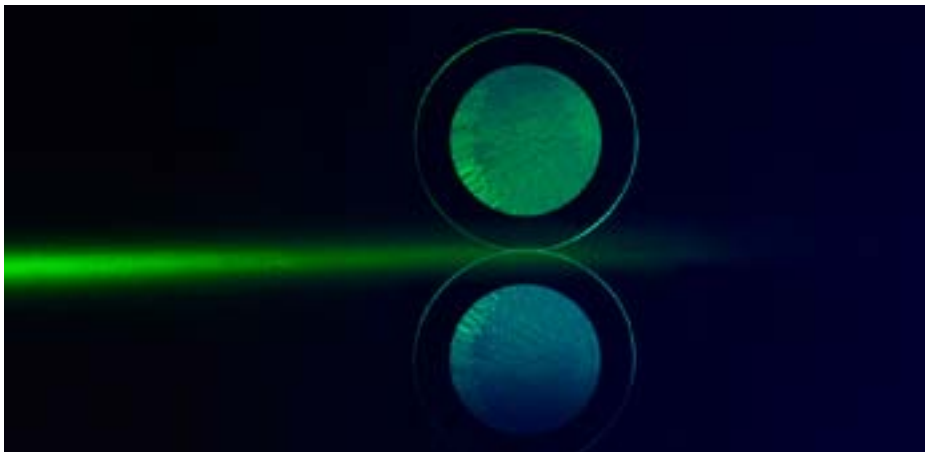
Individual elements can comprise diffraction-limited refractive structures or diffractive structures optimized to provide the best efficiency for the intended application. Current products include:

- DOEs (binary and multilevel, see photo)
- gratings, line generators, etc.
- collimators, Fresnel lenses, custom lens arrays
- diffusors and mirrors
- optical encoders

A recent development is the ability to stack multiple optical layers in order to further customize performance.

Microfluidic structures for ›lab-on-a-chip‹

CDA additionally provides the integration of high-tech microfluidic structures into sophisticated, compact and sensitive devices, (›lab-on-a-chip‹). Such devices are becoming increasingly important where physical chemistry, electrical and/or optical properties need to be tested on a small scale. Tried and tested structures and options include:



A polymer DOE lens

- channels for separation and mixing
- hydrophobic and hydrophilic surfaces
- combining these with microoptics and printed electronics (see photo)

Appropriate devices lend themselves well to high levels of parallelization, thus reducing costs, but their manufacture does require a fully integrated process chain and command of several cutting-edge microfabrication technologies.

Manufacturing services

According to Pia Harju, Business Development Manager at CDA, "The opportunities for both microoptical elements and for integrated devices are truly global. Our manufacturing services – prototyping, assembly and volume mass production – are designed to benefit our customers' global strategy."

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CDA µFunctional Solutions

Advancement to the Core

DRS Technologies provides high-performance thermal camera modules and detectors for a broad range of applications. With a wide assortment of pixel pitch options, resolutions, and fields of view, DRS has flexible modules and detectors that provide superior detection for the most vital requirements.

The **Tamarisk®** family of 17µm Vanadium Oxide (VOx) uncooled thermal modules provide exceptional thermal imagery in a miniature package while maintaining industry low power consumption rates. Utilizing DRS' patented microbolometer Absorber Superstructure, Tamarisk® thermal imagers are designed for greater sensitivity and image quality at an affordable price. Ideal for applications constrained by aggressive size, weight and power requirements, Tamarisk® is offered in modules weighing as little as 33 grams and drawing as little as 850 mW. Tamarisk® is available in resolutions of 320x240 and 640x480 with multiple lens options for greater flexibility in integration. All Tamarisk® modules now tout DRS' proprietary Image Contrast Enhancement (ICE™) for superior edge enhancement, dynamic contrast thresholding and adaptive rescaling.

The **Zafiro®** family of cooled thermal modules employ DRS' advanced Mercury Cadmium Telluride (MCT) detector and patented Stirling cryogenic cooler to produce unparalleled infrared imagery operating in the mid-wave infrared (MWIR) spectrum. The rugged, compact Zafiro® design and 12 µm pixel pitch detector provide a long-range surveillance solution that is widely deployed on Unmanned Aerial Vehicles (UAV) and other demanding situational analysis requirements. Zafiro® modules are available in 640x480 resolutions and a 1280x720 High-Definition model.

Continuous Innovation

DRS Technologies has been a leader in the evolution of the next generation of low power, compact sized, high reliability and high performance thermal imaging components and sensor systems. With nearly half a century of infrared innovation, DRS Technologies is exceptionally well-positioned to meet the needs of rapidly growing thermal imaging applications world-wide.

Expansion into high-volume, low-cost manufacturing and ground-breaking technological advances have allowed for the development of powerful, yet affordable infrared imaging modules and camera systems to address emerging infrared imaging and detection markets. Underlying these advances is DRS' commitment to collaborate, both internally and externally, to develop the best possible solutions; to help Customers achieve operational advantages; and to transform military and commercial capabilities through superior product offerings.

DRS Technologies, Inc.

DRS Technologies is a leading supplier of integrated products, services and support to military forces, intelligence agencies, commercial partners and prime contractors worldwide. The company is a wholly owned subsidiary of Finmeccanica SpA (FNC.MI), which employs approximately 70,000 people worldwide. DRS is proud to produce the Commercial Infrared Systems (CIS) line of advanced electro-optical sensor systems to include thermal surveillance systems, cooled and uncooled infrared camera modules, and thermal detectors.

Visit DRS Technologies at Booth #2417 or online at **www.drsinfrared.com**.

Logitech's highly automated sample preparation system delivers new levels of performance in material processing capabilities.

Material processing is a time consuming task and takes many years to develop the knowledge and skill required to achieve repeatable results. With over 50 years of experience in material processing, system design and knowledge transfer the team at Logitech fully understand how to achieve the accuracy and repeatability required for a wide range of applications, such as; Silicon, Silicon Carbide, Gallium Arsenide, Gallium Nitride, Sapphire, Diamond, Germanium and Indium Phosphide.

Driven by client demand to reduce the level of user expertise , guesswork and time spent on their application processes, whilst maximising surface finish and repeatability. Logitech created a working group to consider how we incorporate solutions to these issues within our systems. The outcome from this was a number of key technology changes, increased controllability and software driven automation. These features are showcased in Logitech's new lapping and polishing machine, Akibis-air: Intelligent Sample Preparation System.

Basic Lapping and Polishing Concepts

To ensure these new features did not compromise the high level of surface finishing expected from a Logitech system. the team setup a process matrix to establish the stability and repeatability of a number of processes, to guarantee conformance with Preston's Law. The basic formula for predicting the amount of material that will be removed in a given time in both a Lapping and Polishing Process is:

PRESTON'S LAW

M = α * p * v * t + C (y = mx + c)			
Material = Constant * Processing * Plate * Processing + Constant			
Removed	Pressure	Speed	Time
(um)	(g/cm2)	(rpm)	(mins)

We can analyse the Prestonian behaviour of removal rate in a process to confirm process stability.

Preston's equation states that the removal rate is proportional to the product of the processing pressure and plate speed.

The results achieved from these trials confirm that Akribis-air offers the accuracy, repeatability and control to confidently deliver the optimum in surface finish to precise geometric tolerances.

However this was only one stage in the development process as Logitech endevoured to remove the "black magic" from application processing and decrease the processing time.

Removing the black magic from sample preparation

It is a very skilled job to achieve the accuracy and surface finish that many of these demanding applications require, particularly due to the high levels of manual set-up and control. The increasing cost of materials and lose of expert staff adds additional pressure to these departments.

With this in mind the design team at Logitech developed a software platform and a number of automated controls that significantly reduces the amount of manual input required during set-up, processing and clean-up operations. These new features have been so successful that they can reduce processing time by as much as 40%. Features include:

- Automatic wafer thickness control for the highest degree of geometric precision, flatness and parallelism.
- Software driven set-up for faster processing times and more reliable results.
- Extensive parameter control for the processing of highly complex and fragile materials or devices.
- Increased plate speed for faster removal rates and higher throughput.
- Plate flatness control for higher quality and accurate of the samples.
- Metered abrasive feed supply for optimal processing and reduced consumable waste.
- Auto-wash feature for minimal clean-up time and increased user safety.

Air Jig Technology

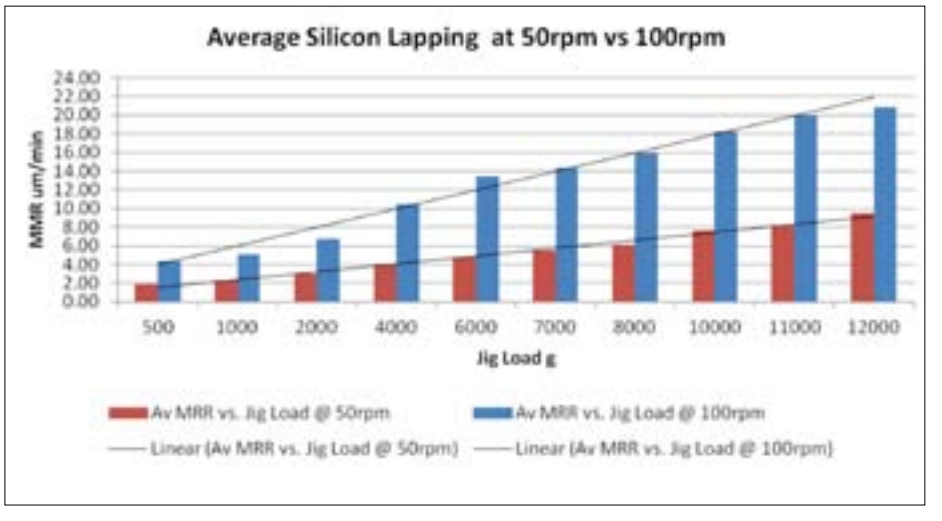
A key aspect of the system success is the introduction of an air driven jig. The jig ensures that the sample or substrate is held in place during the lapping and polishing processes. Key advances in this jig includes;

- Dynamic load control for faster, more responsive processing across single and multi stage processes.
- Bluetooth connectivity for real time data and higher levels of control.
- Increased load range for higher Material Removal Rates (MRR) while maintaining low Total Thickness Value (TTV).
- Integrated jig cleaning station for minimum handling, safety and time saving.

Superior results

The exceptional results achieveable with all Logitech equipment is respected across the world. With the introduction of easier, faster and more reliable results, Logitech is ever increasing the competitive gap and client confidence.

Lapping trials using a silicon substrate with an Akribis-air system and a standard Logitech lapping and polishing machine can be seen below.



This shows a material removal rate of 18-22 microns per minute with the Akribis-air compared to 7-9 microns per minute with a standard system. When added to the substantial time savings and accuracy provided with the automated set-up and control platform and the internal clean up facility, it is easy to see why the Akribis-air offers time savings of up to 40%.

You will find Akribis-air and our team in the North Hall, Booth #5319.

About Logitech

Logitech are recognised as world leaders in many aspects of materials processing, shaping and surface finishing technology.

This position has been reached through many years expertise in materials processing and in the design and manufacturing of precision equipment.

Application areas where Logitech provide solutions and advance processing technologies include:

✓ Semiconductor materials processing

✓ Opto-electronics surface finishing

✓ Optical materials processing

✓ Geological science thin section preparation

✓ Test & measurement of materials

✓ Materials processing consumables

Cutting Edge Materials Processing Solutions

Logitech's core business is in the design and manufacture of precision sawing, lapping, polishing and CMP equipment. This equipment is aimed at research based applications with the need for high specification surface finishes, prepared with precise geometric accuracy.

For further information please go to **www.logitech.uk.com**

LOGITECH
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Sponsored Editorial

NKT Photonics introduces the World's most affordable supercontinuum fiber laser

SuperK COMPACT

NKT Photonics has just released their new SuperK COMPACT – the World's most affordable supercontinuum fiber laser. The laser provides single mode, fiber delivered light in the entire 450-2400nm range and, unlike most supercontinuum sources on the market, the COMPACT can be triggered externally and synced with low jitter from single shot up to 20 kHz.

The previous generation COMPACT can be found in laboratories around the World where it is the daily driver within applications such as component characterization, test & measurement and spectroscopy, or simply as a general purpose white light source. However, the extremely low price point and the external trigger function of the new model bring supercontinuum sources into volume applications that were previously dominated by single-line lasers, lamps and SLEDs. Now you can replace several of these sources with only one SuperK COMPACT and significantly reduce system complexity and cost. Add to that a maintenance-free lifetime of thousands of hours and the cost of ownership for this broadband system is the lowest we have seen in the industry.

The SuperK COMPACT is powered by NKT Photonics patented photonic crystal fiber technology pioneered more than a decade ago and which have since then been licensed to several partners. Constructed on the same platform as the popular SuperK EXTREME sources, the COMPACT is compatible with the existing range of plug & play supercontinuum accessories from NKT Photonics.

You can see the new SuperK COMPACT running live at NKT Photonics booth #711.

NKT Photonics
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SPIE Career Center

Toptica's Marion Lang with the FemtoFiber dichro. Credit: Matthew Peach/SPIE.

Controlling light speed with Toptica

Toptica Photonics is presenting a wide range of diode and ultrafast fiber lasers, and the Munich, Germany, company showcased applications in three of its key markets: test and measurement, quantum optics and spectroscopy, and biophotonics and microscopy. Marketing chief Thomas Renner told *Show Daily* that the firm is particularly proud of its digital laser controller, the DLC Pro, which he described as, "the future of tunable laser control".

"With the new DLC Pro, high-end laser control has now entered the digital world," Renner said. "The digital laser controller is designed for Toptica's tunable diode laser, the DL Pro, and it is achieving new benchmarks for low noise and low drift levels. It provides intuitive touch control to operate and frequency-stabilize the DL Pro. It also lowers the laser's spectral linewidth down to 10 kHz."

Applications requiring a narrow linewidth, such as optical clocks or quantum computation experiments based on "cold" atoms and ions, as well as applications needing remote laser control should benefit from the DLC Pro. Designed in collaboration with Professor Robert Boyd (Universities of Rochester and Ottawa), the "slow light" experiment being demonstrated on Toptica's booth shows the interplay between the new DLC Pro laser controller and the DL Pro. Renner explained: "This setup allows the user to control the speed of light — with their finger tip."

Toptica is also showing the prototype of its new ultrafast fiber laser platform, called the FemtoFiber dichro. This complements the company's established ultrafast fiber laser series FemtoFiber Pro and FemtoFiber smart. The first model of the new platform will provide femtosecond pulses at 780nm and 1030nm for multiphoton applications. Both wavelengths are emitted from same aperture, while the laser also offers a virtual intermediate wavelength of 888nm.

Toptica's Marion Lang said, "For many biophotonics and life sciences applications the workhorse laser source for these wavelengths has been the Ti:sapphire laser, which is generally quite large and has a large power demand. But our FemtoFiber dichro laser is more compact and has a conversion efficiency of at least 50%, so it uses much less power."

Toptica is at booth #723

Block's cascade lasers chosen by military

Block Engineering from Marlborough, Massachusetts, a developer of quantum cascade laser (QCL) instrumentation, launched two ultra-miniaturized QCL products at this year's show: the Mini-QCL Module and the LaserTune infrared source. The Mini-QCL is a widely tunable QCL module designed for OEM customers that weighs only 75g. The LaserTune has been miniaturized to a compact (165×127×110mm), wirelessly-controllable system said to offer the widest contiguous tuning range available on the market — more than 1000 cm^{-1}.

Block's Tim Osbourn told *Show Daily*, "We believe this is the world's most compact, fully-functional QCL source and with the widest contiguous spectral tuning range. We are receiving tremendous interest in these new products from universities, corporate R&D labs, and a wide range of OEMs. Demand for these devices in gas sensing, metrology, and academic and corporate R&D applications is significant."

"These devices are now enabling new applications, which were not available in the past generations of QCLs, due to their size, ruggedness and performance limitations."

Block Engineering's Mini-QCL Module is available in spectral ranges greater than 250 cm^{-1} per module, and multiple modules can be combined to cover a wider range. They should find use in a variety of real-time gas analysis applications requiring a mid-infrared laser source, including greenhouse gas monitoring, automotive combustion analysis, oil and gas exploration, and air-quality monitoring. The module is designed for integration into spectroscopic instruments.

The LaserTune infrared source has a 2x4 mm collimated beam that can be programmed to operate in several modes with a manual step, programmable step, and programmable sweep. It offers a rapid scan capability at 25 cm^{-1} per ms, and the tablet-controllable source can be programmed to emit pulses from 20 to 500 ns.

Osbourn said both of Block's developments were already finding customer applications, with the US military choosing the mini QCL for chemical threat and explosives detection, and chemical giant 3M buying the LaserTune for product development applications.

See Block at booth #5333.

Xenics shrinks infrared cameras

Xenics presented its full family of remarkably compact Bobcat 2-D cameras for the first time at the weekend's BiOS expo. These "imagining the invisible" cameras, made in Leuven, Belgium, can image through a chunk of silicon to measure electroluminescence and photoluminescence. That lets the cameras inspect for defects in, for example, solar panels, to spot flaws as small as a micron or two that impact photovoltaic conversion efficiency.

At the Xenics booth, a Bobcat 640 camera looked right through a DVD-sized silicon panel, and imaged writing on the far side as well as a small model train hidden by the panel.

Luc DeBrouckere, CEO of Xenics USA in Beverly, Massachusetts. Credit: Ford Burkhart/SPIE.

In a BiOS demo on Sunday, Luc DeBrouckere, the CEO of Xenics USA in Beverly, Massachusetts, said the high-resolution cameras use indium gallium arsenide (InGaAs) sensors for the short-wave infrared spectrum. The mid and long-wave regions use indium antimonide (InSb) or QWIP semiconductor material.

The infrared cameras are as small as 2 x 2 x 1.25 inches, making them one of the smallest of their kind on the market. "They are really very tiny," DeBrouckere said. A camera with its lens runs $17,000 to $27,000.

Fianium ramps supercontinuum brightness

UK-based fiber laser firm Fianium unveiled its new high-brightness supercontinuum light source at the weekend's BiOS expo. It delivers 20 Watts total power across the spectrum from 480 nm to 2400 nm, including 4.5 Watts over the extended visible range (350-850 nm). Combined with picosecond pulses at a repetition rate of 80 MHz, it is expected to find applications in steady-state and lifetime metrology studies.

Sales manager for scientific applications Ross Hodder says that the power is three times brighter than its closest rival, and maintained across the full range of wavelengths. The kit features photonic crystal fiber (PCF) designed by Fianium and produced in collaboration with the UK's University of Bath.

Fianium also showed off its new shoebox-sized Hylase-25 picosecond laser for industrial micromachining, which offers 25 Watts power and a maximum pulse energy of 125 microJ. Designed for 24/7 industrial applications, Fianium is currently shipping the first few Hylase sources to early customers including UK-based TWI, Summit Photonics and Laser Zentrum Hannover. The company is expecting the laser to eventually find applications in micromachining of sapphire, strengthened glass and photovoltaic films.

Summit Photonics' owner Brian Baird, who contributed to the Hylase design, suggests that the new source will be a "game-changer" in ultrafast laser processing.

See Fianium at booth #729

JenLab kit tests astronauts' skin

Skin-cancer labs around the world are using JenLab's multiphoton, label-free imager to check for danger signs without biopsies.

The proof? As the company showed its device, the MPTflex CARS, at the BiOS exhibition, up walked a customer.

Michael Roberts, professor of clinical therapeutics at the University of Queensland, pronounced his JenLab device "fantastic. It even lets us look at internal organs without surgery."

Karsten König, JenLab's CEO in Jena, Germany, introduced the new instrument at the BiOS Expo. "It allows the best resolution of all imaging technology for biopsies, 1000 times better than ultrasound, to see single cells," König said. "Resolution is 300 times lower than the thickness of a human hair. We see the nucleus, the mitochondria."

The device can look into skin to a depth of two-tenths of a millimeter and show images in minutes or seconds.

JenLab is using the device to look for skin problems in five astronauts who spent six months in space. He said cosmetic companies testing anti-aging products are using it to measure the collagen and elastin networks as factors in skin aging. Cancer labs use it to look for dendritic cells and melanocytes in upper layers of skin.

"You can make a diagnosis within seconds, without an invasive cut," König said. "You can even look for brain cancer and let the doctor know to cut further or not."

Labs are also testing the safety of sunscreens, seeing if nanoparticles can end up in the liver and lead to liver cancer. The MPTflex has undergone clinical tests in Australia, the UK, Italy, and the US.

FORD BURKHART

Gooch & Housego develops space EDFA

UK-based exhibitor Gooch & Housego has developed a proof-of-concept erbium-doped-fiber amplifier (EDFA) with an eye on future deployment in satellite communications.

The company believes that operators are looking for innovative ways to provide high data-rate downloads from micro-satellites, and that this will open up a whole new market for optical communications faster than the microwave links currently used in space.

But while EDFAs have been deployed in terrestrial communications for several years and are therefore subject to stringent Telcordia standards, G&H says that designing versions for the much more demanding environment in space presents some unique challenges. The main one is passing radiation-hardness requirements, an area in which the active fiber is particularly susceptible to degradation, as well as eliminating out-gassing and minimizing power consumption, size and weight.

G&H's prototype two-channel EDFA, designed by its systems technology group, is said to have exceeded all specifications, delivering optical output power of almost twice the required target. The next stage of the project will be to produce a fully space-qualified EDFA to be flight-tested by the European Space Agency.

Work on the latest phase is about to begin and, if successful, the space EDFA could be launched as early as 2016.

MIKE HATCHER

Accelerating continued from p.1

They recommended asking some key questions early on to determine whether you have a commercially viable idea or product — questions that at first glance may seem to have little to do with that idea or product.

"You have a concept and an idea, but you have to look at it as being a business," said Schaefer, who has a number of clients involved in technology startups. "You have to be solving a problem with a product or idea that is unique and has a big enough market and that you have the resources to handle.

"You have to ask yourself: Am I a scientist/engineer, or am I businessperson who is going to make this work?"

Itrato, a lawyer, agreed. "The idea is important, but there are a lot of great ideas out there," he said. "It is more about how you go about executing it — who is on the team, what strategies they have, etc. There are many other things you have to think about in terms of whether or not your business succeeds."

One of the first goals for any startup is to figure out who the potential customers are. Then determine what your product offers them that the competition doesn't.

"You need to identify your core customers and what overall problem you are solving," said McGuirk, who specializes in corporate marketing strategies. "How are you going to take your product all the way through execution to reach those customers? You need to plot out a course or you can get off track quickly."

Building a strong team

As part of this process, they recommend bringing in a marketing person early on.

Nevis, a lawyer who previously worked as an engineer in the laser industry, concurred. "I have seen a lot of great ideas languish because they didn't have the right person who could go out and speak in the language that the right people could understand."

It is important to be just as diligent putting together the rest of your management team, the panelists noted.

"You need to think about what you are really good at and what you aren't really good at and then decide who to surround yourself with to help get you there," Itrato said.

Schaefer agreed. "You want to get the right people who can complement you and help you take the company where you want it to go."

"The people part is the hardest part of all," Belz said. "There is a big difference between a group and a team."

Show me the money!

Putting together a strong management team is also key to attracting working capital, Schaefer noted.

"Investors are looking more at the management team than the product/idea," he said. "If you are head of that team, you have to be able to present yourself to the investors so that they are confident you can make this idea/company work. They want to know how they can make their money back with minimal risk."

An exit strategy is also important, he added. "Within a five-year period, you will need to have sold your company or gone public to ensure their return on investment."

A number of factors go into deciding when and where to look for investors, the panelists emphasized.

"The view of the investors has changed a lot," Schaefer said. "Ten years ago, if you had a great idea they would invest it. Now they like to see something more developed, at least a beta test. And if you have customers, even better."

Many startups look to family and friends for initial investments before reaching out to angel investors and venture capitalists, he added.

You want to think about why you want to bring in an investor, Itrato said. "I've talked to many entrepreneurs who picked the wrong investor group or angel investors, and their companies didn't work out very well."

KATHY KINCADE

Real-world challenges for microfluidic devices and systems

The materials and technologies available to manufacturers of microfluidic devices and systems continue to pose challenges for successful commercialization, but a panel of experts discussing the future of microfluidics on Monday agreed that those who have found the right need in the marketplace have been very successful.

The panel discussion on prospects in and the future of microfluidics was moderated by Bonnie Gray of Simon Fraser University in Canada and included Holger Becker, of microfluidic ChipShop in Germany, Emanuel Delamarache from IBM, Giacomo Vacca of Kinetic River, Albert van de Berg from University of Twente and Peter Hesketh from Georgia Institute of Technology.

Discussion ranged from the make-up of the personnel in start-ups (Should the technologist lead the company or should s/he be an outsider?) to a 5- to 10-year outlook for microfluidics commercialization.

The technology idea is not the right place to start a company, the panelists said. Instead, time should be spent in the field understanding the needs of potential customers.

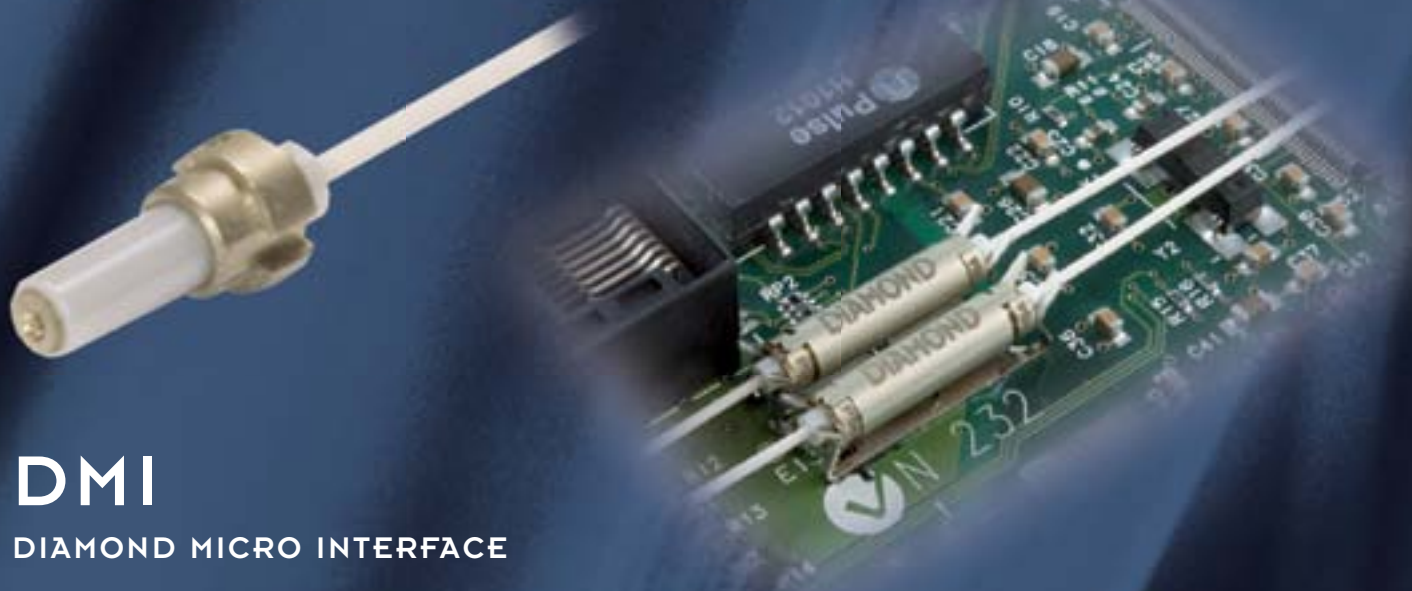
For example, the idea of a lab on a chip sounds appealing, and there have been many technical examples of how to do this. However, in the real world, the product needs to be cost effective, robust and probably disposable; so you don't want the expensive element to be the chip you design to be thrown away.

Another discussion focused on the development platform not being in the correct material base for the final product. The use of 3D printing to make devices seems convenient, but the materials used in the process are usually not stable in water because they swell or they do not have sufficient lifetime before they begin to degrade.

One prediction for the future is a consolidation of the current multiple platforms for the development of microfluidic devices.

RONALD E. SCOTTI

THE LEADER IN FIBER OPTIC CONNECTOR TECHNOLOGY



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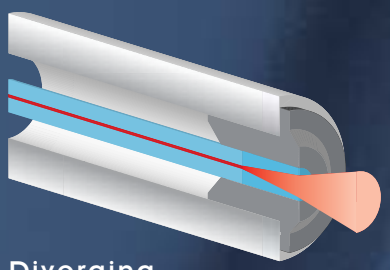

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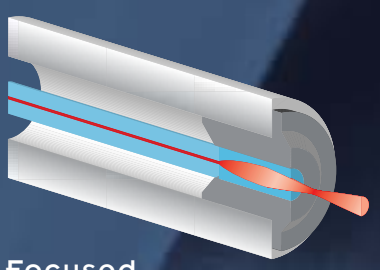

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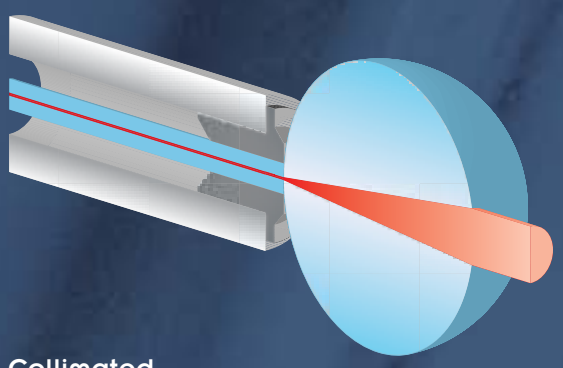

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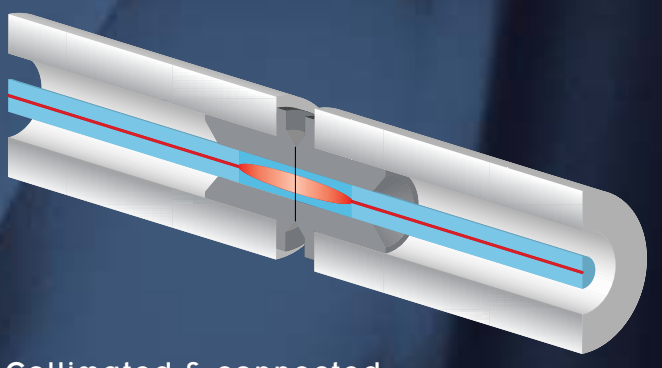

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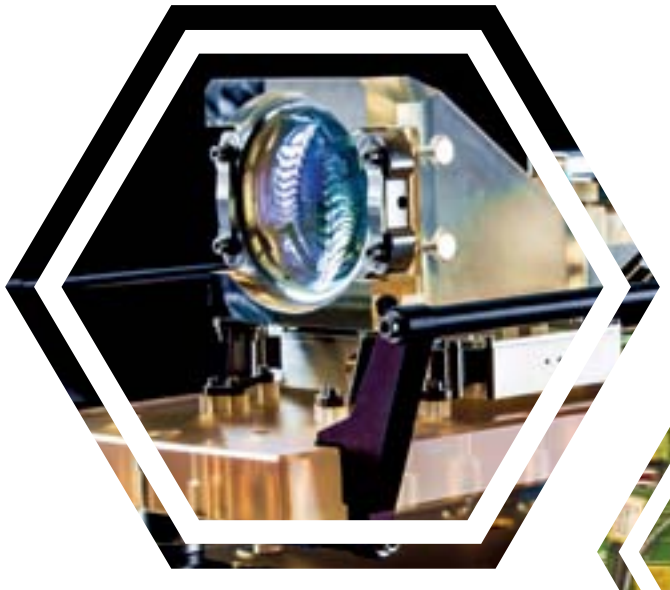

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