PHOTONICS spectra

February / 2010

Fighting Lab Fraud

New Uses for Holography

Prism Awards – Winners Inside!

OLEDs: Lighting the Way

Inside this issue, starting opposite page 82

NEW
www.Photonics.com

Easily analyze solids, liquids, gels and gases on a single FT-IR platform

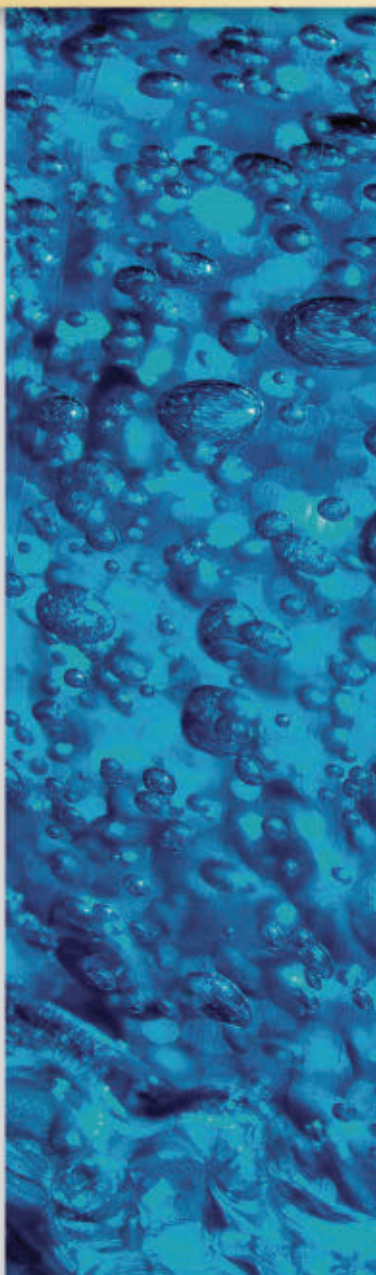
Varian's FT-IR spectrometers:

Robust systems simplify QA/QC of raw and processed goods in the demanding industrial environment

If you are seeking a reliable solution for applications such as quality control of raw materials, verification analysis of finished goods and dedicated oil analysis, the Varian 600-IR series is the ideal solution for you.

With easy-to-use analyzer software, plug and play accessories and superior signal-to-noise performance, Varian's range of FT-IR spectrometers and microscopes will exceed your expectations – saving you time and money!

Learn more about Varian's complete line of FT-IR instrumentation at www.thevarianexperience.com/ftir/



North America 1.800.926.3000
Europe 31.118.67.1000
Asia Pacific 61.3.9560.7133
Latin America 55.11.3238.0400

VARIAN

300 MHz Laboratory Amplifier ...

... in the SIM900 series platform

- **Two independent amplifier channels**
- **±10 V output voltage**
- **±500 mA output current**
- **Drives resistive and reactive loads**
- **4000 V/µs slew rate**

« SIM900 Mainframe loaded with various modules

The SIM954 Amplifier is the latest addition to the *Small Instrumentation Module* (SIM) platform from SRS. With 300 MHz of bandwidth and 5 W of output power, this dual-channel inverting amplifier can be used in a variety of laboratory applications.

The SIM954 drives resistive, inductive or capacitive loads, has an input offset of <1 mV, and doesn't carry the high price tag of typical RF power amplifiers.

SIM954s are housed in the SIM900 Mainframe which provides power and computer interfacing (RS-232 and GPIB) to the SIM modules.

SIM954 Amplifier ... $975 *(U.S. list)*

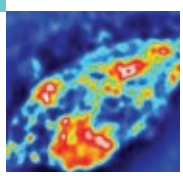
SRS **Stanford Research Systems**
1290-D Reamwood Avenue, Sunnyvale, CA 94089

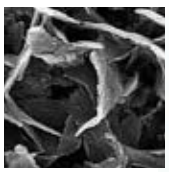
Phone: (408) 744-9040
www.thinkSRS.com

PHOTONICS spectra

February | 2010

TABLE OF CONTENTS






NEWS & ANALYSIS

16 | VIEWPOINT
by Blair Patacairk
Ottawa Centre for Research and Innovation
Cement not included: 10:1 return on federal infrastructure investment in photonics?

18 | TECH NEWS
New system lets world monitor California forest fires
QCL peak power record smashed
Cold atoms + lasers = synthetic magnetic field
Terahertz laser tuning comes down to the wire
The ins and outs of adjustable microlenses
NIR spectroscopy to predict pill quality
Graphene: the rising star in Raman spectroscopy

29 | FASTTRACK
Business and Markets
Optical coatings: designs for growth

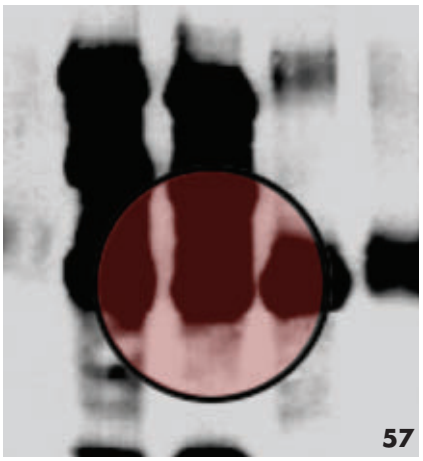
32 | THE PRISM AWARDS WINNERS
Recognizing innovation in photonics

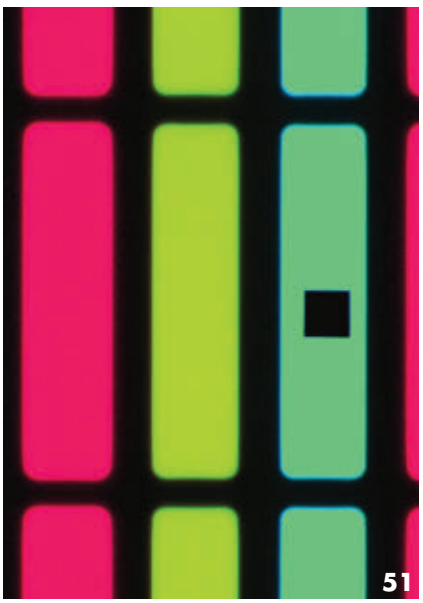
37 | GREENLIGHT
by Anne L. Fischer, Senior Editor
US PV market watch
Solar-heated bridges, roads
by Doug Malchow, Sensors Unlimited
Imaging PV cells

DEPARTMENTS

10 | EDITORIAL
62 | BRIGHT IDEAS
79 | HAPPENINGS
82 | PEREGRINATIONS
Depending on the kindness of strangers

THE COVER
This month's cover was inspired by the feature article on OLEDs for lighting applications. Lumiblade Glow image courtesy of Philips. Cover design by Senior Art Director Lisa N. Comstock.





PHOTONICS SPECTRA (USPS 448870) IS PUBLISHED MONTHLY BY Laurin Publishing Co. Inc., Berkshire Common, PO Box 4949, Pittsfield, MA 01202, +1 (413) 499-0514; fax: +1 (413) 442-3180; e-mail: photonics@laurin.com. ISSN-0731-1230. TITLE reg. in US Library of Congress. POSTMASTER: Send form 3579 to Photonics Spectra, Berkshire Common, PO Box 4949, Pittsfield, MA 01202. Periodicals postage paid at Pittsfield, MA, and at additional mailing offices. **CIRCULATION POLICY:** Photonics Spectra is distributed without charge to qualified scientists, engineers, technicians, and management personnel. Eligibility requests must be returned with your business card or organization's letterhead. Rates for others as follows: $122 per year, prepaid. Overseas postage: $28 surface mail, $108 airmail per year. Inquire for multiyear subscription rates. Publisher reserves the right to refuse non-qualified subscriptions. **ARTICLES FOR PUBLICATION:** Scientists, engineers, educators, technical executives and technical writers are invited to contribute articles on the optical, laser, fiber optic, electro-optical, imaging, optoelectronics and related fields. Communications regarding the editorial content of Photonics Spectra should be addressed to the managing editor. Contributed statements and opinions expressed in Photonics Spectra are those of the contributors – the publisher assumes no responsibility for them.

FEATURES

42 | LIGHTING THE WAY: DEVELOPING OLEDS FOR THE GENERAL ILLUMINATION MARKET
by Gary Boas, Contributing Editor
Organic LEDs have created a stir, mainly because of improvements in power efficiency.

47 | MAKING ELECTRO-OPTICAL SENSE WITH ZINC OXIDE
by Lynn Savage, Features Editor
Because it is environmentally benign, ZnO is finding increased use in photonics applications.

51 | THE ART OF MICROSPECTROSCOPY
by Caren B. Les, News Editor
Microspectroscopy is primarily used to acquire spectra rather than images.

54 | BEAMING THROUGH TO NOVEL USES FOR HOLOGRAPHY
by Lynn Savage, Features Editor
Holography has found several niches in which important work can be done.

57 | THE STRUGGLE TO KEEP RESEARCH REAL
by Hank Hogan, Contributing Editor
The amount of scientific misconduct that goes on is hard to pin down.

Special EuroPhotonics Supplement

E 4 | EURO NEWS
White light supercontinuum: power struggle
The 3-D way to slice it
It's a terascale world after all
Germany: managing the downswing
Let it shine the easy way: laser polishing

E 10 | PUTTING IMAGING IN THE PICTURE
by Marie Freebody, Contributing Editor
Images today are produced in myriad ways – using infrared, fluorescence, bioluminescence, x-ray machines, optical coherence tomography, lidar – for use in a variety of industries.

E 14 | PATENT ISSUES IN SYNTHETIC BIOLOGY RESEARCH
by Jörg Schwartz, Contributing Editor
The roles patents play in this emerging biophotonics application.

E 16 | ECOPHOTONICS
by Krista D. Zanolli, Contributing Editor
Spectroscopy detects toxins in veggies.

E 18 | PRODUCT PREVIEW

E 23 | ADVERTISER INDEX

THE EUROPHOTONICS COVER

The intellectual property issues surrounding synthetic biology research inspired this month's cover. Some say granting ownership to someone who "discovers" something created by nature is equivalent to allowing someone who catches a butterfly to patent the creature. See related article on page E14. This month's cover was designed by EuroPhotonics Art Director Juliana T. Willey.

PHOTONICS spectra

Editorial Offices

2 South Street, PO Box 4949, Pittsfield, MA 01202-4949
+1 (413) 499-0514; fax: +1 (413) 442-3180; www.photonics.com

Laurin Publishing has additional editorial offices throughout the world. News releases should be directed to our main office. If you would like an editor to contact you, please notify us at the main office and we will put you in touch with the editorial office nearest you.

Editorial E-mail: editorial@laurin.com
Ad Sales E-mail: advertising@photonics.com

More Than 100,000 Distributed Internationally

BPA WORLDWIDE
ABP Association of Business Publishers

www.photonics.com

We've got the perfect fit down cold.

Thermo Scientific ThermoFlex recirculating chillers combine a highly configurable design with a wide range of cooling capacities and a variety of options that are a perfect fit for your application.

- Enhanced reliability: the latest technology in refrigeration design combined with pumping system protection maximizes uptime
- Ease-of-use and maintenance: an integrated ramp for simple unpacking, and a quick start guide will let you be up and running in minutes, plus filters that can be changed while the unit is running
- Total peace of mind: each system is backed by our global support and service for worry-free operation

To learn more about the complete family of Thermo Scientific NESLAB ThermoFlex recirculating chillers, visit **www.thermo.com/tflexa**

Thermo Scientific NESLAB ThermoFlex recirculating chillers
The perfect fit for a wide range of applications within a variety of markets.

Moving science forward

Thermo SCIENTIFIC

Part of Thermo Fisher Scientific

PHOTONICS spectra

Corporate Staff

Chairman/CEO	Teddi C. Laurin
President	Thomas F. Laurin
Director of Sales	Robert J. Briere
Controller	Mollie M. Armstrong
Accounting Manager	Lynne M. Lemanski
Accounts Receivable Manager	Mary C. Gniadek
Business Manager	Elaine M. Filiault
Human Resources Coordinator	Carol J. Atwater

Business Staff

Marketing & Research Manager	William Hoelzel
Advertising Production Coordinator	Tracy L. Reynolds
Trade Show Coordinator	Allison M. Mikaniewicz
Computer Systems Manager	Deborah J. Lindsey
Computer Assistant	Angel L. Martinez
Circulation Manager	Heidi L. Miller
Assistant Circulation Manager	Melissa J. Liebenow
Circulation Assistants	Alice M. White, Kimberly M. LaFleur, Theresa A. Horn
Subscriptions	Janice L. Butler
Distribution Manager	George A. Houghtlin
Traffic Manager	Daniel P. Weslowski

Advertising Offices

Main Office
Robert J. Briere
2 South Street, PO Box 4949
Pittsfield, MA 01202-4949
+1 (413) 499-0514, Ext. 101
Fax: +1 (413) 443-0472
bob.briere@photonics.com

United Kingdom
Penny Pretty
Whitehouse, 134 Templewood, Walters Ash
High Wycombe, Bucks HP14 4UF UK
+44 1494 564411
Fax: +44 1494 461198
penny.pretty@photonics.com

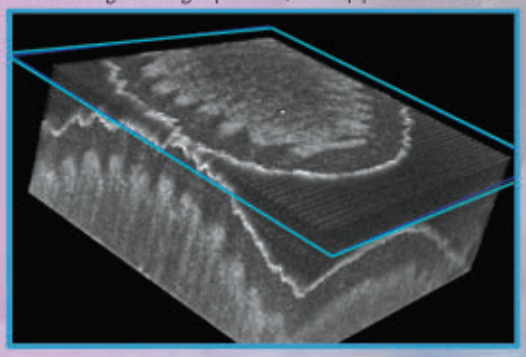
Japan
Scott Shibasaki
The Optronics Co. Ltd.
Sanken Bldg., 5-5 Shin Ogawamachi
Shinjuku-ku, Tokyo 162-0814, Japan
+81 3 5225 6614
Fax: +81 3 5229 7253
s_shiba@optronics.co.jp

China
Hans Zhong/Hai Yan Qin
Shenzhen Fortune Technologies Ltd.
3-7E, Di Jing Feng, Moi City, Buji
Shenzhen, China 518112
+ 86 755 2157 3066
Fax: +86 755 2872 6973
hans.zhong@yahoo.com.cn

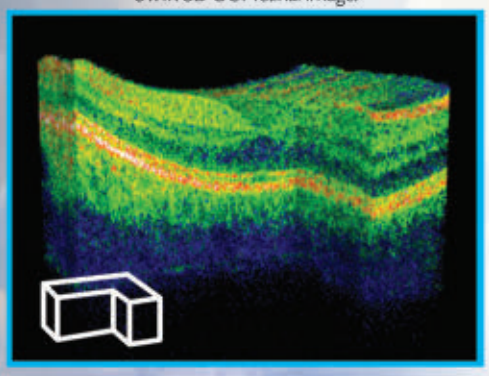
For individual advertising contacts' information, view listings next to advertiser index.

www.photonics.com

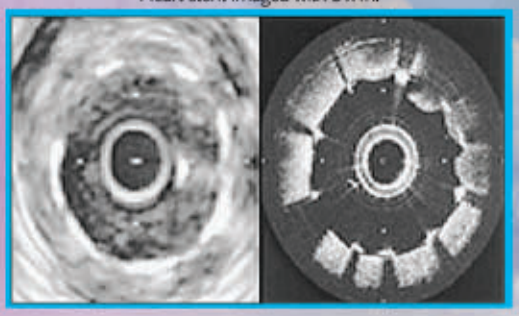
SWIR image of a fingertip section, with top portion removed.



SWIR SD-OCT retinal image.



Heart stent imaged with SWIR.



LIVE TISSUE IMAGING GOES DEEPER WITH SWIR.

Sensors Unlimited - Goodrich ISR Systems introduces the fastest shortwave infrared camera for SD-OCT systems – providing the deepest live tissue imaging available. Our SU-LDH camera has no moving parts and produces highly stable, highly repeatable and highly accurate results. SWIR technology enables unparalleled imaging of numerous non-invasive OCT applications.

The SU-LDH is shipping in production quantities right now. So call today for more information. No one goes to greater depths than we do – SWIR for SD-OCT imaging.

phone: 609-520-0610
email: sui_sales@goodrich.com
www.sensorsinc.com

Features:

- Images at >46,000 lines per second
- High resolution – 1024 pixel arrays
- High sensitivity from 960 nm-1600 nm
- Wavelength response 800 nm-1700 nm
- Room temperature operation
- No moving parts for greater reliability
- Sees deeper into living tissue

seeing beyond™

right attitude/right approach/right alongside
www.goodrich.com

GOODRICH

Finding falsification – and fighting it

Allegations of fraud can take a long time to show up and can take even longer to investigate and prove. But the process is worth it: Innovation will falter without integrity.

On page 57 of this issue, editor Hank Hogan takes an in-depth look at research misconduct, from the difficulties associated with identifying it, to how scientists in our industry can educate themselves (and others) on how to fight it. The article also looks at policies and procedures currently in place that can help deter and uncover future falsification, fabrication and plagiarism in scientific research.

Remember the bubble fusion scandal? That particular case certainly took a long time to develop. In autumn 2008, Purdue University in West Lafayette, Ind., stripped nuclear engineering professor Rusi P. Taleyarkhan of his named professorship after a university appeals committee upheld findings that he had falsified research records not once but twice in reporting his work on sonofusion.

In the March 2002 issue of *Science*, Taleyarkhan reported that he was the first to demonstrate sonofusion in a beaker. The technique, also known as bubble fusion, involves using sound waves to compress bubbles in deuterated liquids to the point of collapse, producing fusion normally only possible with enormous, expensive machinery.

Creating cheap, unlimited energy using this technique would have been a wonderful thing – if the technique had worked. But other scientists were unsuccessful in their attempts to duplicate the results he had reported, and allegations of falsification began to swirl.

The first time the university officially looked into the matter, it issued a statement in February 2007 that the evidence "does not support the allegations of research misconduct" and closed the investigation.

And then the US Congress got involved. The chairman of the Subcommittee on Investigations and Oversight for the House Committee on Science and Technology sent a letter to Purdue's president in May 2007, chastising the school for failing to follow its own rules about research misconduct investigations and for failing to review the research in question to see whether it was indeed valid.

After another inquiry, which concluded in July 2008 with findings of misconduct, Taleyarkhan was sanctioned by the university through the removal of his title and discretionary funds.

The outcome of this case serves to underscore not only the importance of integrity in the research process but also the vital role that government can take in addressing lab fraud when internal investigations into alleged misconduct are flawed.

Tom Lawton

Small Power Meter. Big Features.

NEW PowerMax-USB/RS Sensors—At Your Fingertips.

Coherent's new PowerMax™ USB/RS sensors are the first laser power sensors that utilize state-of-the-art miniaturization techniques, integrating an entire instrument within a USB 2.0 or RS-232 cable connector. These new sensors have all the signal processing and power measurement electronics normally contained in a LabMax™ meter, and connects directly to a PC with plug and play functionality.

Ideally suited for low and high volume embedded sensor applications, this new family of sensors eliminates the need for a separate meter box, thus delivering a significant savings in cost and space, but with no reduction whatsoever in performance.

To find out more information about PowerMax-USB/RS sensors, visit us on the web at www.Coherent.com/lmc or call 1-800-343-4912.

COHERENT®

LMC.sales@Coherent.com
www.Coherent.com
toll free: (800) 343-4912
phone: (408) 764-4042

Benelux +31 (30) 280 6060
China +86 (10) 6280 0209
France +33 (0)1 6985 5145
Germany +49 (6071) 968 204

Italy +39 (02) 34 530 214
Japan +81 (3) 5635 8700
Korea +82 (2) 460 7900
UK +44 (1353) 658 833

Superior Reliability & Performance

PHOTONICS MEDIA

Welcome to the New

photonics.com

Photonics Media has enhanced its industry-leading site to showcase specific areas of interest, such as optics, and imaging and lasers, as well as videos, white papers and blogs.

Features

- News & Analysis
- Explore by Subject
- Product Page
- Industry Event Coverage
- Videos & Photo Galleries
- Monthly Web Exclusives

Join the Discussion

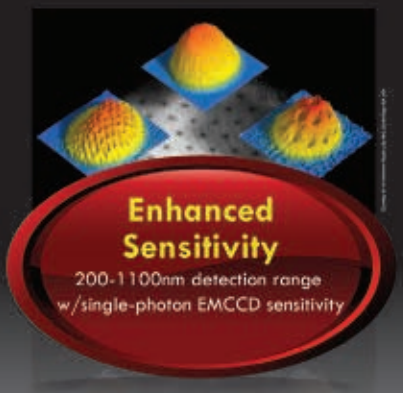
- Post Article Comments
- Contribute to our Forum
- Read our Industry Blogs
- Follow Photonics Media on Twitter

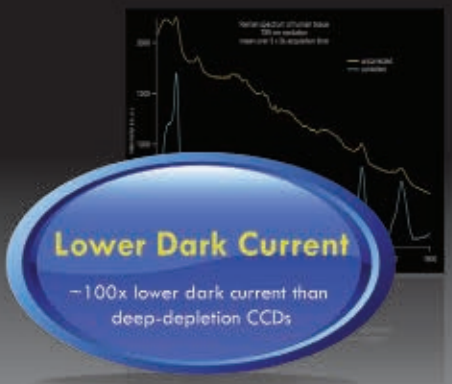
Princeton Instruments

NEW Breakthrough Technology

eXcelon™

...CCD and EMCCD sensitivity *redefined*





Jointly developed with e2v, our new eXcelon™ back-illuminated CCD and EMCCD sensor technology is ready to revolutionize scientific imaging and spectroscopy!

Princeton Instruments' eXcelon-enabled cameras enhance a wide variety of applications, including:

- Astronomy
- Raman spectroscopy
- Bose-Einstein Condensate (BEC) imaging
- Confocal imaging
- Live-cell imaging
- Solar cell inspection

Visit www.excelonccd.com to find out how this new breakthrough technology will improve your research results!

Global Sales & Support

www.princetoninstruments.com | info@princetoninstruments.com | Tel: +1 609.587.9797

PHOTONICS MEDIA

In the March issue of Photonics Spectra ...

Silicon Photonics:
The future of computing needs a light touch – literally. As chips route more and more data around, the standard electronic wiring on and between chips can't keep up. Enter silicon photonics, which aims to marry a photonic layer atop the existing circuitry.

Advancing Fiber:
Enablence Technologies Inc. reviews ways in which modern planar lightwave circuit technology is being leveraged to enable very high performance in next-generation 40G/100G networks.

Stimulus Funding Follow-Up:
A look at some of the work that has been funded by the American Recovery and Reinvestment Act, and whether it has affected growth and helped to create new jobs in the optics and photonics industries.

GreenLight:
Solar cells implanted in the retina may help restore vision to blind people or those with macular degeneration. A team of researchers at Stanford University is working on a system in which the patient wears a video camera, a pair of goggles, an LCD screen and solar cells.

AsiaPhotonics:
This new special supplement will cover all aspects of the Asian photonics industry. The March issue will feature reports on photonics in China, the East Asian solar technology market, machine vision, laser diodes and more.

Check out a sample of the new digital version of *Photonics Spectra* magazine at www.photonics.com/DigitalSample. It's a whole new world of information for people in the global photonics industry.

You'll also find all the news that affects your industry, from tech trends and market reports to the latest products and media.

You can't afford to miss this issue.

maximize the moment

pco.dimax digital high speed 12 bit CMOS camera system

Features

- 1279 fps @ 2016 x 2016
- 4502 fps @ 1008 x 1000
- 12 bit dynamic range
- pixel size 11µm x 11µm
- imaging memory up to 36GB
- GigE Vision & USB2.0
- multiple trigger options

Applications

- short time physics
- plasma imaging
- PIV
- ballistics
- biomechanics research
- automotive crash tests
- combustion imaging

the cooke corporation

www.cookecorp.com

In Europe contact: www.pco.de

Cement not included:
10:1 return on federal infrastructure investment in photonics?

BY BLAIR PATACAIRK
OTTAWA CENTRE OF RESEARCH AND INNOVATION

Responding to the credit crisis and resulting global recession, national governments around the world are furiously pumping cement-truck loads of money into infrastructure projects. Some of these economic stimulus initiatives will work, and some will fail; few will offer a specific return on investment (ROI).

Roads, bridges, buildings and last-generation manufacturing jobs are important – and easy to justify in a political context. Yet building a next generation of successful "cement not included" innovation companies will generate long-term jobs, exports and tax bases, and ultimately pay the tab on the short-term stimulus spending.

The Canadian photonics industry, employing an estimated 20,000 people in 400 companies, currently offers an innovation infrastructure ROI example that shows a nearly $10 return for every dollar invested. This is based on a $52 million federal government investment in the National Research Council Canadian Photonics Fabrication Centre (NRC-CPFC).

KMPG LLP estimates in a recently released report, *Impact Analysis of the Canadian Photonics Fabrication Centre*, that the NRC-CPFC, a unique resource created in 2002, will generate $500 million in economic benefits over the next five years.

Canada's photonics industry generates close to $4.5 billion annually, with approximately 85 percent from exports, including 50 percent to the US. The industry has its roots in the telecommunications sector, but with active diversification in the past decade, only 20 percent of today's companies now address telecom, with the rest creating exciting new applications in defense and security, health and medical, consumer electronics, remote sensing and measurement, green energy and manufacturing. (For more on photonics in Canada, see "Northern Lights" on page 80 of the September 2009 issue of *Photonics Spectra*.)

In keeping with the government's sustained commitment to building a stronger economy through science and technology, the NRC-CPFC presents an excellent case study for what happens when you combine public and private funds to assist Canadian companies in commercializing their research and development.

NRC-CPFC is a world-leading photonics prototyping and training facility that provides commercial-grade fabrication services dedicated to the creation of photonic device prototypes. It supports the growth of the Canadian photonics sector by offering clients and partners cutting-edge photonics fabrication services, and simulation, design, fabrication, testing and prototyping services that help move innovative photonic devices to market.

Its role is to work with startup companies across the nation and photonics industry clients worldwide to explore new technological possibilities, and then to help demonstrate their technology and raise capital. The facility, containing a 40,000-sq-ft industrial-grade semiconductor foundry, is a commercialization partnership between the federally funded National Research Council (NRC) Canada and the province of Ontario, which has contributed $10 million in additional funding. It is located on NRC's Ottawa campus.

After working with NRC-CPFC, OneChip Photonics, an Ottawa-based company with products aimed at the integrated fiber-to-the-home (FTTH) transceiver market, closed a second round of venture capital financing last March, raising a total of $19.5 million from Canadian and US investors.

"OneChip is well positioned to help system providers and carriers deploy FTTH more cost-effectively than ever before, and to meet consumer and business demand for high-bandwidth voice, data and video services," said Jim Hjartarson, OneChip's CEO, after his company announced its venture capital deal earlier this year. "OneChip is one of only a few companies with new core intellectual property and advanced technology in the optical transceiver business that can sustain a competitive advantage over other optical component providers, which rely on conventional technology and assembly processes."

OneChip believes that its approach and technology will strengthen the business case for broader deployment of FTTH worldwide, enabling the company to claim a significant share of the FTTx (fiber-to-the-x) optical transceiver market – one that market analyst and consulting firm Ovum Ltd. of London estimates will grow from $419 million by the end of 2009 to $456 million by the end of 2013.

Infrastructure projects such as NRC-CPFC substantially reduce startup and product development costs, de-risk technology for entrepreneurs and encourage investment by the venture capital community. With more of this type of enlightened stimulus spending, we can park a few cement trucks and build more 21st-century jobs and companies that boost long-term prosperity.

Meet the author

Blair Patacairk is senior investment consultant for Ottawa Centre of Research and Innovation; e-mail: bpatacairk@ocri.ca.

Better Together

LABSPHERE and SPHEREOPTICS, long time photonics industry leaders have reunited to bring you innovative products, world-class technical expertise and unequalled customer service. Our goal is to provide easy-to-use products of exceptional quality that will meet your light measurement requirements at the performance and price levels you demand.

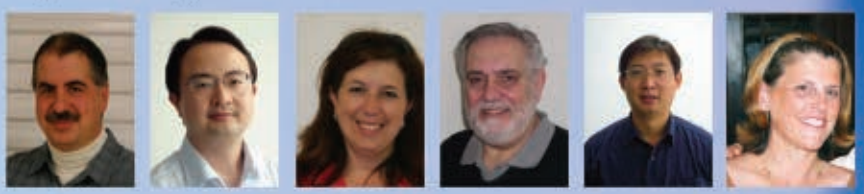
- LAMP MEASUREMENT SYSTEMS
- LED MEASUREMENT SYSTEMS
- LASER POWER MEASUREMENT
- LUMINANCE/RADIANCE STANDARDS
- UNIFORM CALIBRATION SOURCES
- REMOTE SENSING SYSTEMS
- SOLAR SIMULATORS
- LOW-LIGHT LEVEL SYSTEMS
- SPECTRAL MEASUREMENT SYSTEMS
- INTEGRATING SPHERES & COMPONENTS
- REFLECTANCE/TRANSMITTANCE SPHERES
- REFLECTANCE STANDARDS & TARGETS
- SPECTRALON REFLECTANCE MATERIALS
- ALUCORE™ REFLECTANCE TARGETS

Innovative Technical Expertise

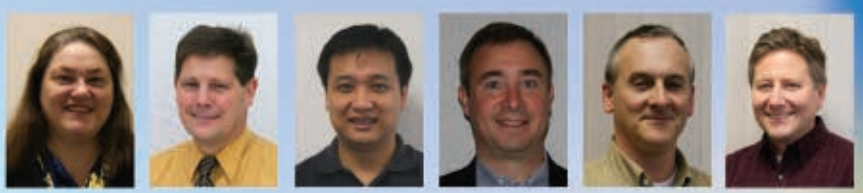
Unequalled Customer Service & Support

Exceptional Manufacturing Quality

Visionary Management



World Class Sales Team



labsphere®
A HALMA COMPANY

www.labsphere.com

SphereOptics

www.sphereoptics.com

New system lets world monitor California forest fires

Nevada Seismological Laboratory director Graham Kent presents the new solar-powered Wi-Fi Forest Eye camera system to the Northern California students who developed the novel idea for early detection of forest fires. Photo by Mike Wolterbeek; courtesy of University of Nevada, Reno.

RENO, Nev. – When wildfires forced a group of Northern California students from their homes last year, they decided to work to keep the same thing from happening to others.

Ranging in age from 10 to 13 years old, the grade-schoolers came up with the idea for Forest Guard, an early detection system for forest fires that relies on a new 360° solar-powered camera and Wi-Fi technology. The idea won the global First LEGO League Climate Actions competition in Copenhagen, Denmark, in May 2009.

Impressed by the idea, European executives from Sony offered to help the team develop the system, and a prototype was installed at Tahoe City, Calif., for an Internet debut in December 2009 from Copenhagen during the United Nations Climate Change Conference.

Forest Guard will use a closed-circuit television system to send pictures live from the forest to the desktops or screen savers of Internet users all over the world. Both professional firefighters and citizen fire-watchers will be able to monitor areas where the potential for fire is high; if they spot a fire, the Internet users can let the pros know right where it is. The intention is to cut down significantly on response time and, in so doing, to save lives and property by warning residents who live in the path of a fire and by deploying resources more wisely. Cutting down on forest-fire carbon emissions is another potential plus for the system.

Graham Kent, director of the University of Nevada's Seismological Laboratory, has led Forest Guard's installation, testing and maintenance.

"We've been working on a similar system for several years, for scientific research purposes, and are grateful to be able to work with Sony on this prototype and get a system installed in the Tahoe-Reno area," Kent said. "The network is ideal for real-time data collection and optimizes the use and expense of the system."

Kent's team includes Ken Smith of the Nevada Seismological Laboratory, Frank Vernon of the University of California, San Diego, and Geoff Schladow of the UC Davis Tahoe Environmental Research Center. They also will use the network's real-time capacity to monitor other environmental systems such as climate, forest fuel moisture, evapo-transpiration, seismic activity and air quality. Research and data collection are high on their list as well.

"This camera has serial number 001," Kent said. "We'll be testing and debugging it over the winter in Tahoe City while also doing some interesting science. It's great to have been able to integrate some design features and functions into the system based on our experiences with the 10-year-old system in San Diego."

A camera network has been used successfully in Southern California for many years to monitor forest fire areas, but without the social network of citizen fire-watchers. Kent pointed out that the cost of the system is approximately the same as that of one or two homes that could be lost in a catastrophic fire, and that the maintenance of the system for 10 years is equal to about one lost home.

Next summer, a network of the solar-powered Wi-Fi cameras will be placed on mountaintops surrounding Lake Tahoe.

Laura S. Marshall
laura.marshall@photonics.com

QCL peak power record smashed

EVANSTON, Ill. – Only a year ago, the peak output power of a quantum cascade laser (QCL) was 34 W. Today, thanks to researchers at the Center for Quantum Devices at Northwestern University, peak power of 120 W from a single device at room temperature has been achieved. However, this extremely high peak power is only the first step in making such lasers ready for system integration.

The research was led by Manijeh Razeghi, Walter P. Murphy professor of electrical engineering and computer science at the university's McCormick School of Engineering and Applied Science, and the director and founder of the center.

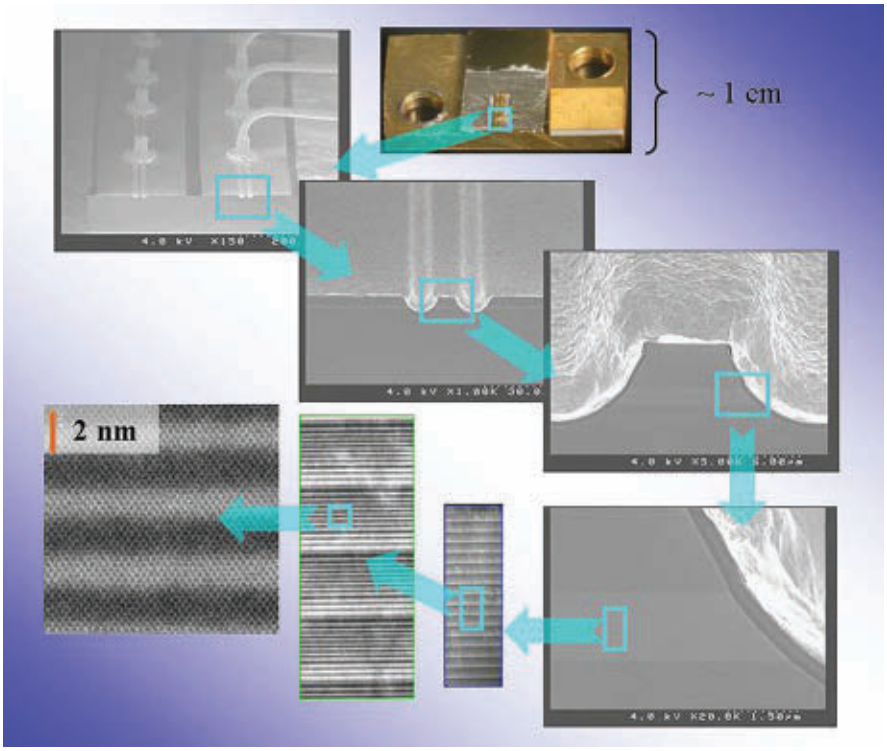
"The breakthrough is particularly attractive for sensing chemicals at a distance and for infrared countermeasures," Razeghi said, "because power is a luxury that defines range, speed and sensitivity for targeting remote applications such as misguiding incoming missiles."

The same research into high peak power also confirmed that the QCL is resistant to filamentation, which limits the beam quality of conventional broad-area semiconductor lasers as they get wider.

The researchers demonstrated that the ridge width of a broad-area QCL can be increased up to 400 µm without suffering from filamentation effects, as evidenced by a stable, well-defined output beam profile, nearly identical for all widths tested. Currently, although stable, the laser is not operating in the highest-quality mode.

"One future direction is to improve the beam quality," Razeghi said. "The current demonstration has a broad output beam, which makes the light harder to utilize fully. Some research into spatial mode filtering is warranted to combat this problem."

Unlike diode lasers, the QCL requires only electrons to operate, giving it unique properties that a conventional laser lacks.



Shown are size scales relevant to the quantum cascade laser. At the top is a packaged device. In the middle is the waveguide cross section as imaged by a scanning electron microscope. On the lower left are some of the individual layers of the injector region as imaged by a transmission electron microscope. Courtesy of Manijeh Razeghi/McCormick School of Engineering and Applied Science at Northwestern University.

One feature is that its linewidth enhancement factor is close to zero, compared with two to five for a conventional laser. The researchers believe that this difference has serious implications for power scaling with broad-area devices.

"Other wavelengths also need to be developed. Besides the 120 watts at shorter wavelengths, we have demonstrated up to 25 watts at a wavelength of 10.3 microns," she explained. "At present, this work is also unfunded, but we have confidence that similar power levels can be demonstrated throughout the three- to 12-micron wavelength range."

Razeghi said that, once this is achieved, another direction will be to improve the spectral characteristics.

"The current laser, like most broad-area lasers, shows many emission lines which span approximately 100 nanometers around a wavelength of 4.4 microns. For remote chemical sensing, a much narrower, single-mode emission is desired, which would require spectrally selective feedback. In addition, some moderate tunability of this wavelength would also be advantageous," she explained.

"A final research area is to scale average power delivery. While peak power is useful when fast detectors are available, use of these lasers for infrared countermeasures requires a more sustained power delivery. Thermal management makes this a significant challenge, limited by the overall power conversion efficiency of the laser. As such, both are subjects of current and future research."

Krista D. Zanolli
krista.zanolli@photonics.com

Cold atoms + lasers = synthetic magnetic field

GAITHERSBURG, Md. – Thanks to lasers, researchers have persuaded ultracold, neutral atoms to do something new: respond as if they were charged particles to a magnetic field that isn't there. This synthetic magnetic field will help scientists create new states of matter and probe their fundamental properties. The findings also could lead someday to new types of computers.

Research team leader Ian B. Spielman, a physicist at the National Institute of Standards and Technology (NIST), said that the experiment required new scientific concepts and was technically challenging to pull off. However, it did not demand breakthroughs in instrumentation or equipment. "We use established laser techniques, but with a lot of finesse."

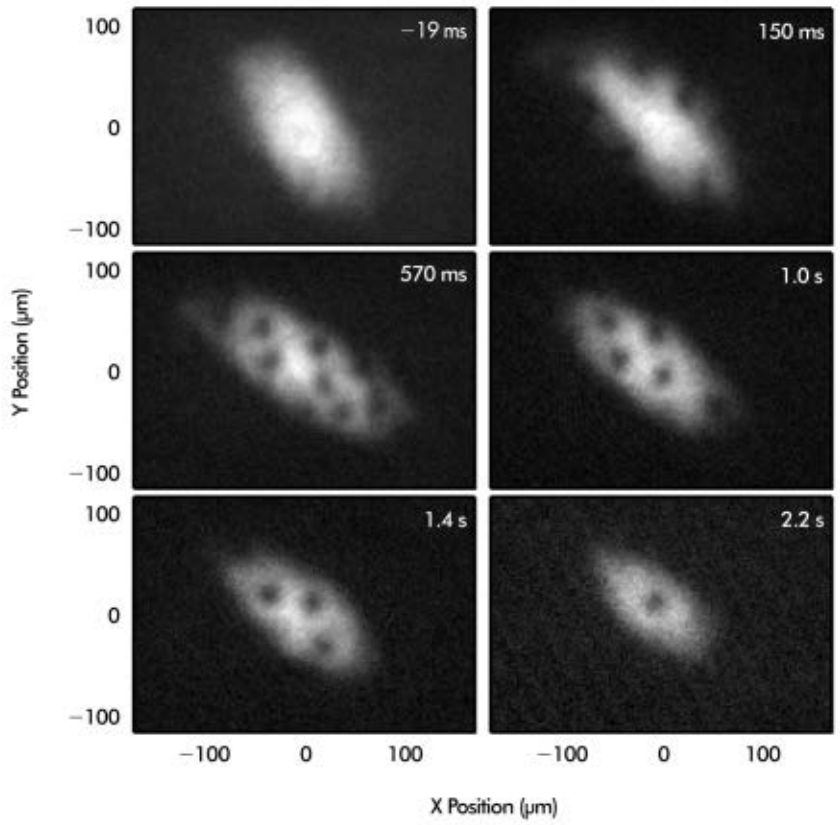
In the Dec. 3, 2009, issue of *Nature*, the team described how it achieved synthetic magnetism. It began by cooling a cloud of rubidium atoms, using optical and other methods to trap them and then chill them to 100 nK. Hovering just above absolute zero, the atoms formed a Bose-Einstein condensate, with all of them residing in the lowest energy quantum mechanical state. Such a condensate has been described as a superatom because its constituents behave identically.

After creating the condensate, the researchers applied a small, real magnetic field across the ensemble that varied along a single direction. At the same time, they illuminated the atoms with two near-infrared (801.7 nm) laser beams at right angles to each other. The two beams differed in frequency by about 3 MHz, or about one part in a billion. The beams coupled to the internal spin-state of the atoms through the Raman effect.

The result of the laser beams and magnetic field was that the neutral particles moved as though they were charged particles traveling through a uniform real magnetic field. The synthetic magnetic field caused the atoms to spiral as they moved. The researchers created vortices in the condensate by varying parameters. Imaging the rubidium cloud captured these vortices.

Spielman noted that synthetic magnetic fields could help reveal some of the fundamentals of matter and its interactions with magnetic fields. Researchers, for instance, will be able to investigate more completely the energy spectrum of particles, such as electrons, in a crystal lattice when a magnetic field is applied. One possible outcome of this research could be novel materials with unusual properties.

New states of matter also could help resolve a problem: Quantum computers can solve some problems impossible to tackle with current technology. However, actually building these new machines involves



Vortices, the dark spots in these images, are the result of synthetic magnetism acting on an ultracold condensate of rubidium atoms. The vortices are not present before two laser beams are switched on (−19 ms in upper left) but are there afterward (rest of images). Courtesy of Ian Spielman, NIST.

practical issues, one of which is the loss of quantum coherence.

Bosons, as with the condensate, might theoretically eliminate some of these problems, Spielman explained. "These quasiparticles are important for a proposed method of quantum computation, known as topological quantum computation, that is naturally robust against the decoherence that plagues current implementations."

Hank Hogan
hank.hogan@photonics.com

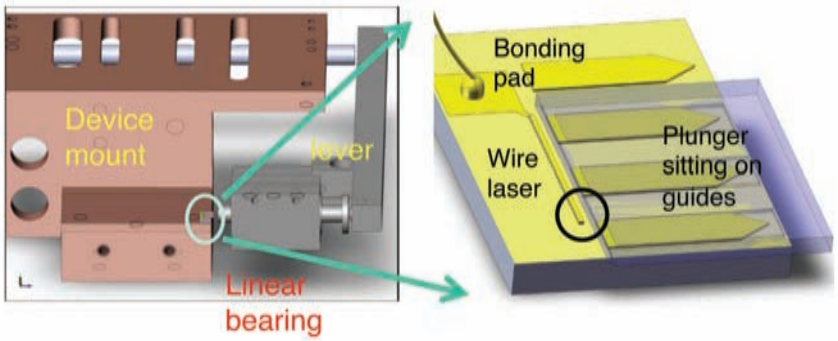
Terahertz laser tuning comes down to the wire

CAMBRIDGE, Mass. – The progress of terahertz technology continues its steady march with news of a tunable terahertz laser developed by a group at MIT.

Tunable terahertz lasers are particularly useful for sensing and spectroscopy applications because many biochemical species have strong spectral fingerprints at terahertz frequencies. Despite this, the terahertz range is among the most underdeveloped in the electromagnetic spectrum. This is largely a result of the "terahertz gap" between solid-state electronic devices and photonic devices.

Qing Hu and colleagues have managed to overcome some of the technological hurdles facing terahertz research to develop a terahertz quantum cascade laser with a frequency tuning of ~0.14 THz.

Conventionally, the frequency of a laser is tuned in a manner similar to a stringed musical instrument, such as a violin. The pitch of the instrument is varied by changing the length – the longitudinal component of the wave vector – and the tension – the refractive index – of a string. However, this method is difficult to implement at terahertz frequencies because of the rel-



An enlarged view of the laser (right) shows the plunger (transparent blue) lying on top of guide rails, ready to be actuated by the shaft of the linear bearing (left). Courtesy of professor Qing Hu.

atively long wavelength of a semiconductor laser compared with its cross section.

Instead of fighting the battle with brute force, the group developed an approach to tuning that actually takes advantage of the laser's tiny cross section. The new line of attack is based on manipulating the evanescent propagating mode of a device known as a "wire laser"; i.e., any laser with a cross section that is much smaller than the wavelength it produces.

"In a typical wire laser, a large fraction of the mode propagates outside of the solid core," Hu said. "By placing a movable object close to the wire laser, we can manipulate the laser's transverse mode profile, thereby tuning its resonant frequency."

In the researchers' experiments, which were described in the November 2009 issue of *Nature Photonics*, a movable metallic or dielectric object is placed at a distance of ~1 to 15 µm from a wire laser with a 13-µm-wide ridge. Using a gold object next to the wire laser resulted in a blueshift in frequency, and, conversely, a silicon object produced a redshift.

Hu now hopes to develop broadly tunable terahertz lasers based on microelectromechanical systems technology.

"The aim is to integrate the tunable wire lasers with power amplifiers to create high-power frequency-tunable sources for sensing, spectroscopy and imaging applications," he said. "Furthermore, the concept of tuning a wire laser by manipulating the transverse mode profile applies to other frequency ranges. For wire lasers at visible frequencies, one can envision using a scanning probe to tune its frequency for sensing and spectroscopy at nanometer scales."

Marie Freebody
marie.freebody@photonics.com

The ins and outs of adjustable microlenses

CHANGCHUN, China – Adjustable microlenses now have a new knob that can be turned, courtesy of a research team led by Yanchun Han of Changchun Institute of Applied Chemistry. The group demonstrated two new types of variable-focus liquid microlenses, one constructed with sidewalls that curve in and the other with sidewalls that curve out.

The slope of the sidewalls is adjustable during fabrication, while the curve of the lens can be changed during operation. Thus, any application requiring adjustable optics could have new tools to bring things into focus.

A variable-focus liquid microlens exploits the flexible nature of a liquid-air interface. As pressure changes, this boundary moves, bending from concave to flat to convex. Because of refractive index differences between the liquid and air, the interface acts like an optical surface. The result is an adjustable lens with a variable focus, with its optical performance determined by the characteristics of the liquid and the lens housing.

The researchers' innovation involves that housing. They fabricated microlenses with curved sidewalls, using a housing made of polydimethylsiloxane (PDMS), a transparent rubber.

In one case, they molded the PDMS

Unique Applications... "Custom" Solutions.

You might have noticed that Power Technology, Inc. uses the phrase "putting the 'custom' back in customer" in tandem with our company logo. That phrase is not only an integral part of our corporate identity, but is an undeniable factor of our almost 40 years of success within the photonics industry. With wavelengths ranging from 370 – 1600nm, output powers from 1mW – 7W, and both CW and pulsed power offerings, thousands of laser solutions are made available to our customers. Let Power Technology, Inc. produce a custom laser solution for your unique application.

Fiber Coupled for Clean Beam Output

Microprocessor Controlled for Maximum Control and Monitoring

Compact Units for Space-Constrained Applications

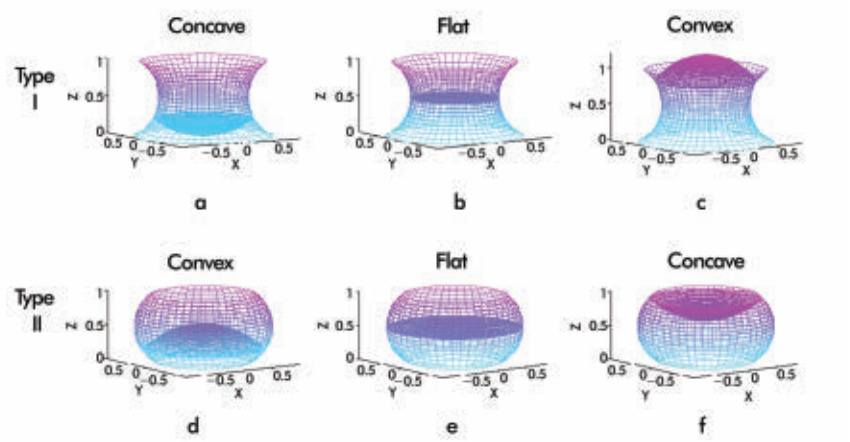
Temperature Control for Ultimate Wavelength and Power Stability

Dual Beam Combining for Added Wavelength and Power Flexibility

Power Technology Incorporated

Putting the "custom" back in "customer"

P.O. Box 191117
Little Rock, AR 72219-1117
Phone: 501.407.0712
Fax: 501.407.0036
www.PowerTechnology.com
Email: sales@PowerTechnology.com



Researchers in China have developed two new types of variable-focus liquid microlenses. The first (a-c) has sidewalls that curve in, while the second (d-f) has sidewalls that curve out. Changes in pressure move the meniscus from concave (a, f) to convex (c, d), changing the focal length. Reprinted with permission from *Langmuir*.

around a water droplet sandwiched between two plates with identical wettability. Bridging the gap between the plates, the droplet narrowed toward the center and flared at either end. The curvature of the resulting PDMS sidewall depended upon the surface wettability of the plates.

In the second case, they molded the PDMS around a solid microsphere. This housing had sidewalls that curved out, with the curvature determined by the radius of the microsphere.

When they put a liquid, such as water, in the microlenses, they could flex the interface, or meniscus, between it and the air from concave to flat to convex by changing the pressure. The slope of the sidewall, along with the pressure, determined the curvature of the meniscus and the focal length of the lens.

The two kinds of microlenses, the group reported in a Dec. 9, 2009, *Langmuir* online paper, have opposite tuning tendencies. The focal length of the first type – the one with sidewalls that curve in – goes more negative as pressure is increased. In contrast, the focal length of the second type, with sidewalls that curve out, goes more positive as pressure is increased.

The researchers showed good agreement between simulations and demonstrations for both types. They noted that the lenses can be adjusted over a wide dynamic range, with focal lengths spanning from ±2 mm to ±∞ for each type in their demonstration microlenses.

They also noted that the lenses' sensitivity to pressure changes depends on the curvature of the sidewalls, which can be set as needed, within limits, during fabrication. Thus, a lens can be made so that it covers the required focal range for an application.

Hank Hogan
hank.hogan@photonics.com

NIR spectroscopy to predict pill quality

BALTIMORE – The quality-testing process for pharmaceuticals raises drug costs, according to pharmacy professor Stephen Hoag, but he says that evaluation with near-infrared spectroscopy could help lower those costs.

"The drug industry used to test a pill for dissolution, then send a sample for analysis to a wet lab," said Hoag, who works at the University of Maryland School of Pharmacy. "Now – with near-infrared high-speed computers and software – you can get information in real time. So instead of evaluating each step and waiting three days for samples to come back, [testing] is instant.

"It impacts inventory, materials and space for storage, and shortens the manufacturing time – all things that have financial implications. And you know industry

is under a lot of pressure to cut costs in health care."

Hoag and his team found in 2008 that the technology worked for testing of coated tablets, and now they have demonstrated the use of NIR to predict the dissolution rate of a pill – specifically, a matrix-type controlled-release tablet that releases medication from the inside. With this kind of tablet, the process is controlled by physical polymers that slow it down. The new study was published in the *International Journal of Pharmaceutics* in December 2009.

Hoag reported that the technology predicted accurately the dissolution rate of the drug thiophylline in matrix pill form and added that this gives an indication of how quickly it would dissolve in the human body.

"This may be a very narrow topic, but I think it will someday have huge implications for pharmacy, as [NIR] can also do ID testing," he said. "That is, it would relieve pharmacists of the need to routinely inspect every prescription."

NIR is already commonly used in quality measurements in crop production, forage, fruits, food processing baking products, timber, meats and nonfood agriculture. The pharmaceutical industry began to use it in the 1990s because it responds to both chemical and physical properties of a given substance.

Drug regulators also could use the NIR technique to determine the ingredients in pills. "For identification testing," Hoag said, "anytime you bring in a material in the drug-making process, the FDA wants real data proving that the material really is that material."

He added that the new technology possibly could avert disasters with consumer drugs, such as the 2006 tainting of cough medications that killed more than 40 people in Panama and 80 children in Haiti.

Hoag believes that the cost savings associated with NIR testing could trickle down to the patient, as a slightly reduced production expense could be increasingly significant for companies as they produce more complex biology-based therapies.

The "fundamental change" Hoag expects the technique to afford the pharmaceutical industry may not come tomorrow, he said. "We still have a long way to go before you have this complete system where [pills] flow in one side and information flows out the other side." But he emphasized that his team's experiments could lead to lower expenditures for drugmakers and more consistency in the quality of pills.

Laura S. Marshall
laura.marshall@photonics.com

Graphene: The rising star in Raman spectroscopy

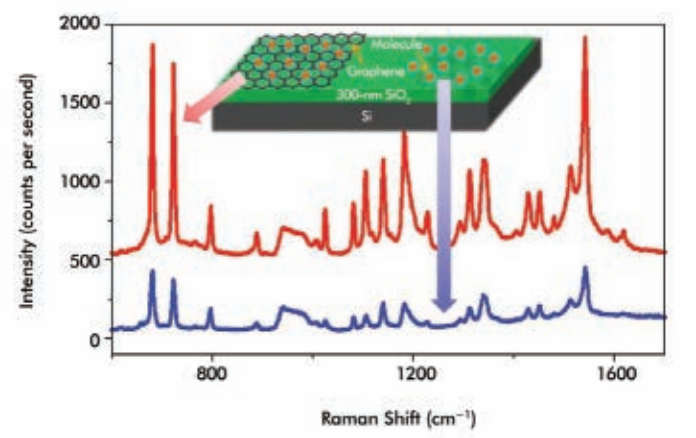
BEIJING – With its numerous appealing qualities, including biocompatibility, chemical inertness and abundance, graphene has long been a popular metal among chemists and physicists alike. Thanks to these properties, it has found its way into new applications ranging from chemical sensors to transistors. Until now, however, its potential as a substrate for Raman enhancement had not been investigated.

The challenge was taken up by Zhang Jin and colleagues at Beijing National Laboratory for Molecular Sciences. They found that graphene-based probes did indeed enhance the Raman signal compared with conventional noble metal-based probes. The discovery could expand the application of graphene to microanalysis and help to better explain the basic properties of both graphene and surface-enhanced Raman scattering (SERS).

Raman spectroscopy is an important and powerful tool used for characterizing the structure of materials. However, the weak intensity of Raman signals results in low sensitivity and prompts many scientists to seek out alternatives. Although SERS provides better results, thanks to surface plasmon-related enhancements that boost the Raman signal, it is not without its difficulties.

For SERS, the key to strong enhancement is the substrate, traditionally a rough surface of a noble metal such as silver, gold or copper. However, fabricating a rough metal surface is not easy, and the biological incompatibility of the metals makes them difficult to work with.

Graphene, on the other hand, poses none of these issues and is cheap and easy to obtain and can be used directly. In the Beijing team's experiments, detailed online in the December 2009 issue of *Nano Letters*, some common molecules used for Raman probes were deposited equally on graphene and on a conventional silicon dioxide/silicon substrate. The Raman signals of the molecule on graphene and the silicon dioxide/silicon substrate were then compared.



This illustration of the experimental flow and typical result shows stronger Raman signals from phthalocyanine on graphene than on the silicon dioxide/silicon substrate. Courtesy of Zhang Jin.

"We found the Raman enhancement effect exists on graphene and is, in fact, much stronger than on the silicon dioxide/silicon substrate," Jin said. "While the precise origin of this enhancement is not clear, we believe this discovery will expand the application of graphene and will also help us to understand the charge transfer of graphene as well as chemical enhancement mechanisms."

More research is needed to determine the origin of the enhancement and to prepare the path toward using graphene-based Raman probes in real applications.

"The most important thing is to investigate the phenomenon and optimize it," he said. "We then plan to adjust the enhancement efficiency using various methods, such as combining our system with the classical SERS system."

Marie Freebody
marie.freebody@photonics.com

Aging infrastructure.
Convert ideas to light.
Speed human communication.
NuSil Technology.

People are communicating at the speed of light thanks to the most-advanced silicone technology pioneered by NuSil.

Our Lightspan brand of transparent optical silicones forms an impenetrable shield around sensitive fiber-optic lines, protecting them from heat, dust, vibration and radiation. At the same time, refractive index matching increases signal efficiency and light output.

As a result, words, ideas and emotions come through. Loud and clear, with no drop-offs. To computers and mobile phones across the country and around the world.

NuSil scientists are dedicated to helping innovators innovate. From fiber optics and display technology, to LED packaging. Whether your need is for large batches or small, we deliver precise, custom formulations backed by 30 years of engineering and synthesis expertise.

What? When? Where? If it's NuSil, it's no problem.

NuSil SILICONE TECHNOLOGY

What's your challenge?
www.nusil.com/phosp
USA +1-805-684-8780
Europe +33 (0)4 92 96 93 31

Optical coatings: Designs for growth

WELLESLEY, Mass. – Innovation is critical for revenue growth in the optical coatings industry, according to the market analysis firm BCC Research. New applications, where coatings have a new advantage, represent the fastest growth markets for the industry, according to the company, which published the report *Optical Coatings: Technologies and Global Markets* in October 2009. The total global market for optical coatings is estimated to rise from 4.6 billion in 2010 to 5.7 billion in 2015, with a compound annual growth rate of 4.3 percent, according to the report.

Electronics, the largest market segment for the coatings, is projected to increase from 2.6 billion in 2010 to 2.8 billion in 2015, with a compound annual growth rate of 2.1 percent. Defense/security and architecture, the second- and third-largest segments, are expected to have compound annual growth rates of 3 and 4.5 percent, respectively.

In descending order, the smaller solar, medical, telecommunications, transportation and "other" segments are projected to have compound annual growth rates of 10, 12, 7, 12.8 and 4.3 percent, respectively, during the five-year period, according to the company.

"Lighting technology is on the verge of a significant technological transition as incandescent lighting is replaced," said Lori Weisenbach, author of the report. "Optical coatings and filters will play a role in producing new lighting options. Flat screens on televisions, cell phones, computers and other displays are becoming ubiquitous, and optical coating technology can extend their usefulness in various lighting settings."

She noted a trend in patents and patent applications for coating designs that enhance the light efficiency of flat panel displays.

"Coatings are usually deployed to improve a device; thus, cost is a limiting factor," she said. "Most common are antireflection coatings, which are typically low-margin high-volume-produced for lenses and other optical components. These standard coatings are manufactured mostly in Asia because of price. The number of coating manufacturers in China is growing rapidly. This trend will continue." The higher-margin coatings are filters for high-end cameras and flat screens.

Consolidation is still a factor in the industry, she noted. The tough economic conditions have made it difficult for smaller coating houses to survive. "New uses for optical coatings favor coating houses with strong design teams that can innovate," she said.

Optical systems, including coatings, will continue to be important in the military, which now emphasizes remote sensing and observation in warfare tactics. The higher price for optical technology, relative to electronic alternatives, is less of an obstacle in the defense segment, which also supports innovation in optics to meet stringent requirements, Weisenbach said.

"In terms of architecture, most coatings are applied to windows. As the economy and construction industry recover, revenues will rise. Growth in 'green' window coating is expected to increase. Solar energy is another green revenue opportunity for coatings. We believe that growth in the solar sector – really still in its infancy – will be robust in the long term. Optical coatings can help slow the deterioration of solar panels as they age," she said.

Anthony Pirera, president of Spectrum Thin Films Inc. of Hauppauge, N.Y., said that, although offshore competition and the economic downturn have negatively affected many optical coatings businesses, the worst may be over, and there is a likelihood of gradual growth. "Optical coatings businesses need to understand and work with the global business trends and opportunities that have resulted from the Internet – and to work on improving their technology and increasing their quality control."

To stay competitive in the world market, Pirera suggests that businesses should continue to upgrade their equipment; for example, there is a need for optical monitoring systems that have logic and that can measure rate and automate the coating process. "Ion beam sources are advancing, but density, profile and current levels need improvement. Developing a focused higher-current ion source with a denser beam would greatly improve coating technology. Ion beam sputtering is our future, as it can manufacture the most complex of coatings."

A relatively small company, Spectrum Thin Films manufactures optics as well as simple-to-complex coatings ranging from the UV 193 nm to the far-infrared 20 µm using the electron-beam and ion-assisted technologies. It has developed an ultraviolet silver coating that reflects 98 percent from 310 nm to 2.5 µm, making it highly suitable for applications in astronomy.

Pirera said that optical coatings are a key component in lasers, adding that, as lasers evolve, very complex coatings will be in greater demand. Because much funding is going into next-generation telescopes, advances in optics and coatings likely will be needed in these efforts, he noted.

Caren B. Les
caren.les@photonics.com

ESA Offers Contract The European Space Agency has offered Midaz Lasers Ltd. €150,000 for the development of an engineered version of the diode-pumped Alexandrite laser. The performance benefits of the Alexandrite laser include higher wall-plug efficiency and the possibility of tuning the system in the ultraviolet range. Midaz, a spin-out company of Imperial College London, says that the new technology could supersede the conventional Nd:YAG for space-based lidar, which measures a variety of atmospheric parameters.

New Location Mobius Photonics, a producer of short-pulsed fiber laser sources, has moved its corporate headquarters to a facility in Mountain View, Calif., that is larger than its former Santa Clara location. The move is a result of the company's plans to enhance its production capabilities and grow its operation. The 10,000-sq-ft building has both office and manufacturing space, and it includes a 3200-sq-ft cleanroom. Mobius will produce fiber lasers for semiconductor and microelectronics processing, and stimulated emission depletion microscopy.

$10M Venture Funding QD Vision Inc. of Watertown, Mass., has received $10 million in venture funding from North Bridge Venture Partners, Highland Capital Partners and the CIA's investment arm, In-Q-Tel. The company will use the funds to bring its nanotechnology-based LED products to market as solid-state lighting and displays. QD Vision is the developer of the proprietary Quantum Light, which uses quantum dots to produce high-output LEDs.

New US Subsidiary Gera, Germany-based Präzisionsoptik Gera GmbH has formed a US subsidiary, Precision Optics Gera Corp., with sales offices in Florida and Colorado. The custom and standard microstructures manufacturer provides complete in-house processing, including design, photolithography, coating and assembly for serial production and small batch quantities. The company also produces custom optical systems and components for the ultraviolet to infrared spectral range for machine vision, semiconductor, aerospace and defense applications.

LED Installation LED lighting company Cree Inc. of Durham, N.C., has announced that LR24 recessed LED luminaires have been installed in the Smithsonian Institution's National Air and Space Museum in Washington. Designed for the museum's "Moving Beyond Earth" exhibit, the lights replace high-intensity-discharge work lights and provide the high lumen output and efficacy required to work in the gallery. They also weigh less than other fixtures, helping to reduce strain on the ceiling.

Distributor Appointed Diode laser company Dilas of Mainz, Germany, has entered into an exclusive distribution agreement with LxRay Co. Ltd. of Saitama, Japan, to serve the Japanese market. The latter, a technical oriented trading company specializing in laser, optics and optoelectronic products, has offices in Tokyo and Osaka and will provide customers with diode laser services.

NSF Research Grant Vixar of Plymouth, Minn., has received a Phase II Small Business Innovation Research grant from the National Science Foundation for the development of integrated wafer-scale vertical-cavity surface-emitting lasers with heterogeneous lensing. The project is expected to broaden the range of applications for the technology within the industrial, medical, consumer and office product areas.

$11M Grants The Australian Solar Institute (ASI) will provide $11 million to help fund five research and development projects that will support and accelerate the growth of Australia's solar technology sector. ASI is part of the government's $4.5 billion Clean Energy Initiative, which includes the Solar Flagships initiative. The institutions receiving funds are the University of New South Wales, the University of Newcastle, the Australian National University and the University of Queensland.

Unified Subsidiaries Mems Optical Inc. of Huntsville, Ala., and Jenoptik Polymer Systems Inc. of Rochester, N.Y., have merged with Jenoptik Optical Systems Inc. of Jupiter, Fla., to

create a single corporation for the US-based manufacturing operations of Jenoptik | Optical Systems Div. Each location now will benefit from the efficiencies of a larger organization, simplifying marketing efforts, increasing brand recognition and continuing technical development.

Exclusive Distribution Lake Oswego, Ore.-based Spectrum Detector Inc., a manufacturer of standard and custom detectors, is now the exclusive marketing, sales and distribution agent in the US and Canada for Laserpoint srl of Milan, Italy. The latter is a manufacturer of laser diagnostic sensors and instruments. With more than five decades of combined experience designing and building laser sensors, the partnership will provide technical and application support to its clients.

Subsidiary Acquisition Optical and optoelectronic components manufacturer 3S Photonics of Nozay, France, has entered into a share purchase agreement to acquire Avensys Group subsidiaries Avensys Inc. and ITF Laboratories Inc. for a total of €6.5 million. The holding company, Avensys Corp., owns Avensys Inc. and holds a 42% interest in ITF Laboratories, whose majority shareholder is the Canadian state. The assets of Avensys' two divisions, Avensys Technologies and Avensys Solutions, as well as those of ITF Laboratories, have merged with those of 3S Photonics.

Andor Acquires Bitplane Andor Technology plc of Belfast, UK, a digital camera manufacturer, has acquired microscopy image analysis software company Bitplane of Zurich, Switzerland, for £7.46 million in cash and 283,851 shares. An additional consideration in the form of cash and Andor shares of a maximum aggregate value of £0.51 million may be payable under an earn-out provision if the latter company exceeds an agreed-upon "earnings before interest, taxes, depreciation and amortization" target. Guernsey-based Endeavour LP was the majority owner of Bitplane.

Patent Acquisition Optics for Hire (OFH) of Arlington, Mass., an optical product development company, has completed its acquisition of the patent portfolio and other assets developed and owned by Actuality Systems Inc., a 3-D display technology provider. OFH purchased 19 US patents and multiple patent applications, including foreign counterparts. Most notably, it acquired Actuality's Perspecta spatial 3-D display technologies, multiple free-eye 3-D image projection patents, and a suite of software and hardware technologies for cancer treatment.

Photonics Company Established Key Photonics Ltd. of Cambridge, UK, has been formed to service the optics and photonics requirements of UK industrial and research companies. The company, specializing in the design and supply of optics, photonic components, optical systems and design software, also will assist UK product manufacturers to export products overseas. Key Photonics is an agent for Fisba Optik AG of St. Gallen, Switzerland, and the main supplier and local technical support for Littleton, Mass.-based Lambda Research Corp.'s TracePro and OSLO products.

LED Plant Opens Osram Opto Semiconductors of Sunnyvale, Calif., has completed construction and process-testing of its LED chip production plant in Penang, Malaysia. The facility will make InGaN semiconductor chips based on 4-in. wafers for the blue, green and white LEDs used in architectural and general lighting, display backlighting and mobile terminal devices. According to the company, it is the first LED manufacturer with high-volume chip production facilities in both Asia and Europe. Its main plant is in Regensburg, Germany.

License Agreement Varioptic of Lyon, France, a liquid lens provider, and Cognex Corp. of Natick, Mass., a machine vision sensors and systems manufacturer, have announced a partnership and licensing agreement for the use of the former's liquid lens solutions. Cognex will use the solutions to add autofocus capabilities to its line of identification code readers. The lenses are designed to match the requirements of low-footprint systems for ¼- and ⅓-in. formats. They are suitable for camera applications.

The Prism Awards Winners

Photonics West 2010

RECOGNIZING INNOVATION IN PHOTONICS

SAN FRANCISCO – The photonics industry last month took an evening off from the bustle of the show floor to celebrate innovation at the Photonics West 2010 trade show and conference. Ten companies received prestigious Prism Awards for 2009 on Jan. 27 at a gala presentation ceremony attended by industry leaders.

"Photonics technologies affect nearly every aspect of life – energy production and distribution, communications, consumer electronics, medicine, biotechnology, manufacturing, analysis of climate change and security, to mention a few," said Eugene Arthurs, CEO of SPIE, the international society for optics and photonics. "The Prism Awards program is one way we are helping to accelerate innovation and move technology to market. We are pleased to honor and promote the technological creativity and vision represented by these entries."

The awards recognize innovation in photonics technology and are sponsored by Laurin Publishing, which publishes *Photonics Spectra*, and by SPIE.

"These awards are important, as they motivate and encourage excellence and serve to promote the industry and its image," said Thomas Laurin, president of Laurin Publishing. "For the past half-century, photonics technology has progressed from a twinkle in a researcher's eye to real-life applications that touch every aspect of our lives. We congratulate the winners, the finalists and all who submitted applications."

Judges from SPIE and the *Photonics Spectra* advisory board reviewed and ranked applications from more than 100 companies, looking for shining examples of innovation in the field. The judges selected the winners from 29 finalists; there was a tie in the "Analytical, Test and Measurement" category. For more information on the finalists and to view photos from the ceremony, visit www.photonics.com.

Charlie Troy, charlie.troy@photonics.com

OPTICS

Swamp Optics

BOA Pulse Compressor

A pulse compressor for shortening ultrashort pulses. The BOA (Bother-free Optimized Arrangement) uses only one prism, a roof mirror and a precisely manufactured corner cube to reflect the beam back to the prism precisely parallel with the beam entering it. This automatically aligned arrangement avoids all of the problematic beam distortions of two- and four-prism designs (including angular dispersion, spatial chirp and pulse-front tilt).

LASERS

Laser Operations LLC – QPC Lasers

BrightLock Ultra-G

A compact, athermal, multiwatt green laser (532 nm) with near-diffraction-limited beam quality based on on-chip wavelength stabilization of high-brightness laser diodes. Designed for medical applications, the BrightLock® Ultra-G™ MEDICA package features a compact, user-friendly and cost-effective fiber-coupled source delivering >3 W CW at 532 nm in a narrow-core detachable delivery fiber combined with smart medical features such as a low-power aiming beam, a fiber detector and a removable blast shield for applications in dermatology and ophthalmology.

OTHER LIGHT SOURCES

Hamamatsu Corp.

160-kV Open-Type Microfocus X-Ray Source

A microfocus x-ray source (MFX) with 0.25-µm resolution for x-ray nondestructive inspection and computed tomography. Microfocus x-ray sources were specifically developed for x-ray nondestructive inspection. A small focal point prevents blurring of x-ray images and delivers a sharp, enlarged image. An RS-232C interface is provided as standard for external control. These microfocus x-ray sources yield clear, sharp, enlarged x-ray images even during three-dimensional observation.

LIFE SCIENCES

LightLab Imaging Inc.

C7-XR Optical Coherence Tomography System (FD-OCT)

The C7-XR frequency-domain system employs advanced photonic technologies to provide cardiologists with an interior view of coronary arteries. Its ultrafast imaging speed, micron-scale resolution and 3-D visualization capabilities streamline the clinician's work flow and redefine the possibilities of interventional cardiology imaging.

DETECTORS, SENSING AND IMAGING SYSTEMS

This device targets mid-wave-infrared gas analyzer and spectroscopic applications to identify substances by detecting their unique absorption signatures. It is based on a bulk micromachined spectrally tunable Fabry-Perot interferometer with an electrostatically tuned air cavity integrated into an infrared detector.

InfraTec Infrared LLC

MEMS Tunable Fabry-Perot Interferometer Microspectrometer for Infrared Absorption Spectroscopy

ANALYTICAL, TEST AND MEASUREMENT

The scanning microwave microscopy mode from Agilent Technologies is an atomic force microscopy method designed to enable quantitative electromagnetic materials characterization at high resolution.

Agilent Technologies

Scanning Microwave Microscopy

— TIE —

This instrument measures electron mobility, sheet resistance, carrier concentration and density in a noncontact, nondestructive manner, eliminating destruction of expensive wafers for measurement. The 1605 can map the mobility of 2- to 6-in. wafers in minutes and can measure samples smaller than wafer size.

Lehighton Electronics Inc.

1605 Mobility Mapping Unit

PHOTONIC SYSTEMS

This thermal spot curing system provides localized heat via high-intensity infrared radiation in a portable unit that can be integrated into a production line.

IRphotonics

iCure Thermal Spot Curing System

PHOTONIC PROCESSES

Linden Photonics

Strong Tether Fiber Optic Cable

Linden's patented strong tether fiber optic cable (STFOC) uses extruded liquid crystal polymer on commercial-grade optical fibers such as SMF28 and Allwave. STFOC has moisture barrier properties and eliminates the need for metallized fiber in hermetic packaging of optoelectronic components.

SUSTAINABLE/GREEN TECHNOLOGY

The optimizer provides an electronic solution to long-standing challenges with solar arrays, enabling systems to realize their full power-producing potential. Using advanced algorithms and mixed-signal technology, SolarMagic minimizes the negative effects of panel mismatch caused by real-world conditions such as system aging, varied tilts and orientations, and debris or shade.

National Semiconductor

SolarMagic Power Optimizer

Laser Science to Photonic Applications

CLEO/QELS:2010

CLEO/QELS: 2010 Program Features

World Renowned, Peer reviewed Technical Program

- More than 1200 Technical Presentations and 100 invited speakers
- 22 tutorials, 7 symposia, and 3 poster sessions
- 36 Short Courses

Top Forum for Applied Research and Commercial Applications

- **CLEO: Applications** provides the forum to discuss the transition of basic and applied research innovations into products in 4 areas: Biomedical, Energy/Environment, Government Programs, and Industrial Applications.
- **CLEO: Market Focus** presents business and commercialized applications sessions held on the exhibit floor in Industrial Lasers, Photonics for Defense and Security, BioPhotonics, and Photonics for Energy.
- **CLEO: Technology Transfer** provides "One Stop" opportunity to learn about the latest technologies coming out of University and Government Labs and successful licensing of University technologies.

Opportunity to Showcase and View the Latest Industry products

- **CLEO: Expo** features over 300 Exhibitors from around the world to showcase their latest products.

Opportunity for Job Seekers and Employers to Connect

- Free Job Fair and Career Workshop

May 16–21, 2010
San Jose McEnery Convention Center
San Jose, California

Register by April 5, 2010
For SPECIAL SAVINGS

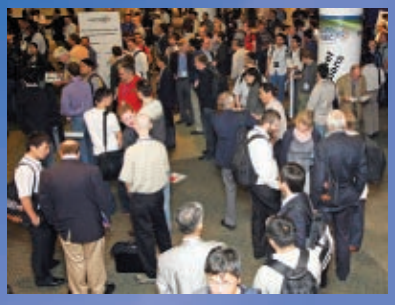
For Program details, Short Course schedule, topics and registration information, Visit www.cleoconference.org

Sponsored By:

APS physics · IEEE photonics SOCIETY · OSA

Collocated with:

CLEO: Expo



GreenLight

US PV market watch

BY ANNE L. FISCHER
SENIOR EDITOR

The US financial world was anything but rosy in 2009, with the possible exception of the solar sector.

According to a December 2009 market report by GTM Research of Cambridge, Mass., grid-connected photovoltaics (PVs) grew from 320 MW in 2008 to 440 MW in 2009 – and could go as high as 545 MW by the end of this year. Titled *The United States PV Market through 2013*, it also states that, from 2000 to 2008, grid-connected capacity in the US grew at an average of 71 percent per year, from 4 to 290 MW, putting the US third in global demand behind Germany and Spain.

Looking a bit farther out, report authors Shayle Kann and Daniel Englander find that the US will experience the most rapid growth of any global PV market over the next four years and will take Spain's place as the second in the world behind Germany. Kann noted that, depending on what happens with Germany's feed-in tariff policy, the US will either remain behind Germany until 2013-2014 or could surpass it as early as 2011.

In the US, electricity is regulated at the local, state and federal levels, with state public utility commissions setting prices and governing renewable energy programs. Therefore, the US market has to be looked at on a state-by-state basis, which is both a blessing and a curse, according to Kann. In countries like Germany and Spain, where one incentive creates the market for the entire country, "it makes things simpler and largely guarantees a good rate of return." However, he said, "The downside is that if one policy is taken away or reduced, it can send shock waves throughout the industry."

He pointed to what happened in Spain last year after the country cut and capped its tariff program, sending the global PV industry into a downward spiral. In the US, on the other hand, not having a single plan means that changes in incentive from state to state won't have a huge effect on the global market. Individual state incentives, however, can boost that individual market. California is a case in point, as it currently accounts for more than 50 percent of the national PV demand, followed by New Jersey, Colorado and Arizona. By 2012, New Mexico, New York, Nevada and Massachusetts will join what Kann calls "second-tier markets," and, along with Arizona and New Jersey, will reach 376 MW of installed PV.

"From 2000 to 2008, grid-connected capacity in the US grew at an average of 71 percent per year, from 4 to 290 MW, putting the US third in global demand behind Germany and Spain."

The holy grid

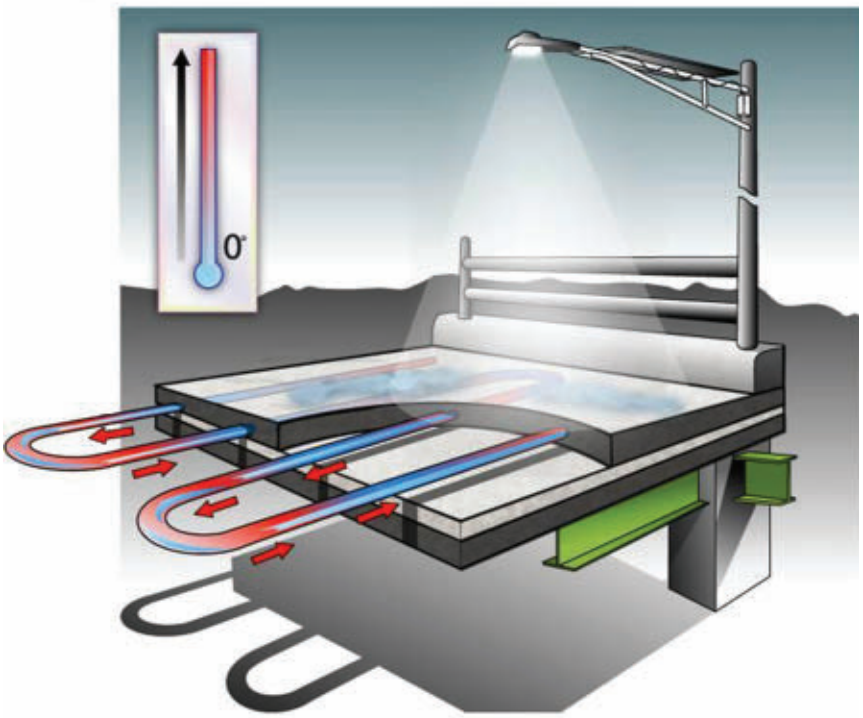
The report analyzes what GTM Research calls "price convergence" – also known as grid parity – the price differences between PV power and electricity from the grid in residential, commercial and utility-scale markets. In locations with high demand, such as New Jersey and California, price convergence has been achieved in some markets, due in large part to strong state incentives. Kann expects that, of the 16 leading solar-producing states in the US, 11 will achieve convergence in the commercial sector by 2012, and 10 will do so in residential. The growth in utility-scale PV will be driven by renewable portfolio standards, along with numerous economic and operational benefits of utility-owned PV. Residential PV installations have been slower because of upfront costs and the time it takes for payback, but new solar financing programs through leases or power purchase agreements will spur this sector.

Kann sees the US as the only country that will be able to sustain a long-term market because the demand for electricity is high, and there is vast open land for development. The strong market will ripple through the entire supply chain, with demand increasing for everything from silicon to panels. Kann noted that Chinese company Suntech, the largest module maker in the world, recently announced a manufacturing facility in Phoenix – initially bringing more than 75 jobs to the US. He indicated that, although US-based PV manufacturing won't dominate the global market, there will be a strong base in the US.

anne.fischer@photonics.com

GreenLight

Solar-heated bridges, roads



A system developed by Pave Guard Technologies Inc. warms the road with a liquid pumped beneath the surface and heated by the sun.

In January, we reported on the Solar Roadways project ("Pushing the envelope: Trends in green research and technology," p. 45), which is working toward using road surfaces as giant electricity generators. But here is another solar-on-the-road project that uses solar to warm roads while sending electricity back to the grid.

Developed by Corey McDonald, founder, president and CEO of Pave Guard Technologies Inc. in Lee's Summit, Mo., the system uses traditional silicon photovoltaic (PV) cells to warm the surfaces of bridges, thus preventing icing. It works much like radiant heating in a floor but uses the sun to heat a glycose liquid and to power a pump that pushes the liquid through pipes embedded under the road. Sensors activate the system when the temperature drops to 40 °F. The rest of the time, the solar arrays are busily generating electricity and sending it back to the grid.

In testing, McDonald calculated the amount of space to be heated and the energy that would be used, then determined what the payback would be. "You only need to thaw roads for maybe five or six weeks out of the year," he said, "which allows payback during the other months."

The Missouri Department of Transportation plans to install the system this year on two bridges in need of upgrading and to repair or replace more than 800 bridges by the winter of 2013. So, if the system holds up to the initial test, it could become more widespread.

McDonald said other advantages to the PV system include lighting, remote monitoring and preventive maintenance. The PV panels have great potential for powering LED lighting on bridges and highways, he noted, adding that many LED highway lighting projects are working very well with solar.

And because the PV system includes monitoring sensors, the transportation department can skip the step of pretreating road surfaces and can monitor conditions remotely.

In terms of preventive maintenance, keeping road surfaces from freezing extends the life of the pavement. Ultimately, however, the greatest advantage is safety, which has the potential for unlimited payback.

anne.fischer@photonics.com

SR830 Lock-In Amplifier

...the industry standard

- **0.001 Hz to 102 kHz frequency range**
- **256 kHz front-end sampling rate**
- **100 dB dynamic reserve (<5 ppm/°C stability)**
- **Auto-gain, -phase and -reserve**
- **Harmonic detection (2F, 3F, ... *n*F)**
- **Time constants from 10 µs to 30 ks (6, 12, 18, 24 dB/oct. rolloff)**

Other lock-in amplifiers
...starting at $2495 *(U.S. list)*

The SR830 is the most widely used lock-in amplifier in the world. It measures signals with greater accuracy, higher stability, and better noise rejection than any other lock-in. With over 100 dB dynamic reserve, 5 ppm stability, and 0.01 degree phase resolution, the SR830 will handle the most demanding applications. It has convenient auto-measurement features, a wide selection of time constants, and a built-in source with 80 dB spectral purity. Best of all, it's affordable.

SR830 ... $4500 *(U.S. list)*

Stanford Research Systems
1290-D Reamwood Ave. Sunnyvale, CA 94089 · **www.thinkSRS.com**
Phone (408) 744-9040 · Fax (408) 744-9049 · info@thinkSRS.com

Imaging PV cells

BY DOUG MALCHOW
SENSORS UNLIMITED

Researchers and manufacturers of concentrated photovoltaic (CPV) cells have recently achieved record solar cell conversion efficiencies of 41 percent by overlaying three semiconductor layers. Careful selection of both the materials and the chemical structures used within the cell will result in matching the absorbance of each layer to the sun's spectrum. When this occurs, each layer contributes equal amounts of electrical current to the cell's output.

Because the layers are photodiode junctions connected in series, the maximum current output of the cell is limited by the output of the lowest-performing layer. It's important to ensure that all three layers work efficiently; otherwise, the current from the strong layers will dissipate power into a weak layer. The multijunction cells are usually assembled at the focal point of light concentrators, which are designed to focus the equivalent of 500 suns onto an area measuring 1 cm^2. This then generates amps of current.

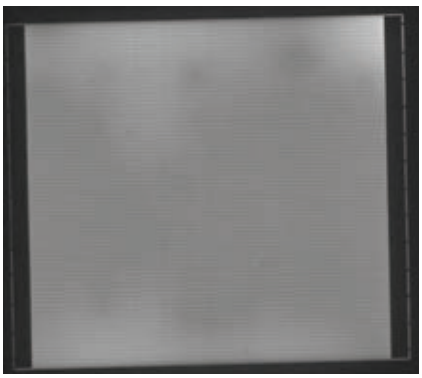


Figure 1. This electroluminescence image of a multijunction cell was acquired with an InGaAs 1024-pixel line-scan camera array without filtering. The image was cropped to 880 columns × 773 rows. The horizontal line pattern consists of 10-µm lines on 100-µm centers.

It is vital for cell fabricators, solar concentrator integrators and solar farm installers to inspect individual cells before incurring the expense of final assembly into large concentrator structures. Fortunately, multispectral electroluminescence imaging can be used to separately inspect each layer's junction uniformity and relative output.

Typical multijunction CPV cells, as indicated above, are small, yet they generate a lot of current, so the collection lines and bus bars must be robust but not so large as to block the sunlight from the cell surface. As shown in Figures 1-3, the collection lines are only 10 µm wide on 100-µm centers.

Dust particles or defects in the various layers also can seriously affect energy collection. Consequently, high-resolution inspection is a requirement for quality control. Current technology for short-wave infrared area cameras provides video graphics array resolution of 640 columns by 512 rows, while short-wave infrared line-scan cameras permit imaging of 1024 pixels.

Thus, the highest-resolution imaging can be obtained by scanning the wider linear array over the small CPV cell. The line-scan camera is mounted on microscope optics, and the line acquisition is synchronized with the motorized stage movement. This permits ultrahigh-resolution imaging by taking several passes, each offset to the side to image a different portion of the cell.

Figures 1-3 show how imaging electroluminescence with several filters is used to find nonuniformities, cracks and defects in the cell layers. These images are of one type of multijunction cell, composed of gallium indium phosphide (GaInP) and gallium indium arsenide (GaInAs) layers on a germanium substrate. ImageXpert of Nashua, N.H., acquired the photos in a single pass using its wafer inspection system with a Goodrich high-speed, indium gallium arsenide (InGaAs) digital line-scan camera.

The black-and-white image (Figure 1) was acquired without a wavelength filter other than the camera's natural response from 700 to 1680 nm. The other three electroluminescence images (Figure 2) were acquired through filters that isolate the emissions of each layer. The top layer (Figure 2a), emitting around 700 nm, shows a number of dark spots that are not

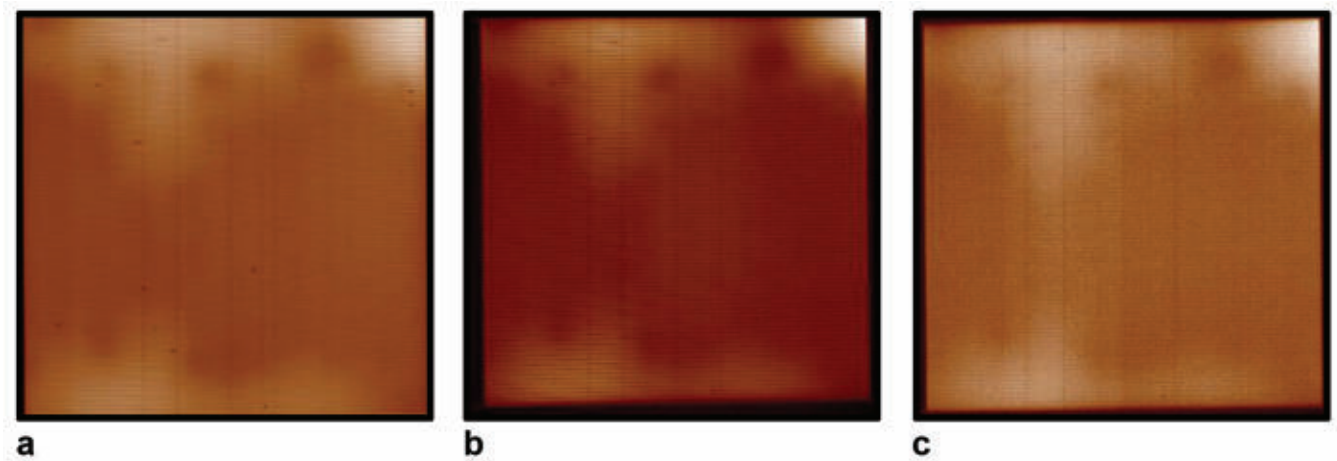


Figure 2. (a) An electroluminescence image of the same cell as in Figure 1 was taken with an 800-nm short-pass filter in front of the lens to capture only the 700-nm emission from the top GaInP layer. Note the number of dark spots apparent. The image is displayed with a warm-scale false color plot generated by the Goodrich Sensors Unlimited Image Analysis program to bring out details within the dynamic range of the image. This helps make the dark spots visible. (b) This electroluminescence image was taken with a combination of 800-nm long-pass and 1250-nm short-pass filters to isolate the electroluminescence emission at 920 nm from the middle layer of the GaInAs film. (c) The same cell is shown in this electroluminescence image taken with a 1250-nm long-pass filter to capture the emissions from the germanium substrate, which are mostly at wavelengths longer than 1550 nm. All electroluminescence images (Figures 1, 2a, 2b and 2c) are courtesy of, and were acquired by, ImageXpert.

visible in the other images, indicating that the defects causing them are relatively transparent to the longer wavelengths. However, some of the dark spots are noticeable in all of the images. These are likely caused by dust or digs on the top surface, which will block all wavelengths from reaching the camera.

As demonstrated, new inspection tools using electroluminescence – and short-wave infrared – imaging systems are helping to meet the increasing demands for efficient and affordable multijunction CPV cell inspection. To replace fossil fuels with solar cells, manufacturers must deliver high quality and optimal output power, and imperfections such as nonuniformity must be detected early in the production process so that costs can be curtailed and the goal of efficient, renewable energy production can be achieved.

Meet the author

Doug Malchow is business development manager of industrial products at Sensors Unlimited (part of Goodrich ISR Systems) in Princeton, N.J.; e-mail: doug.malchow@goodrich.com.

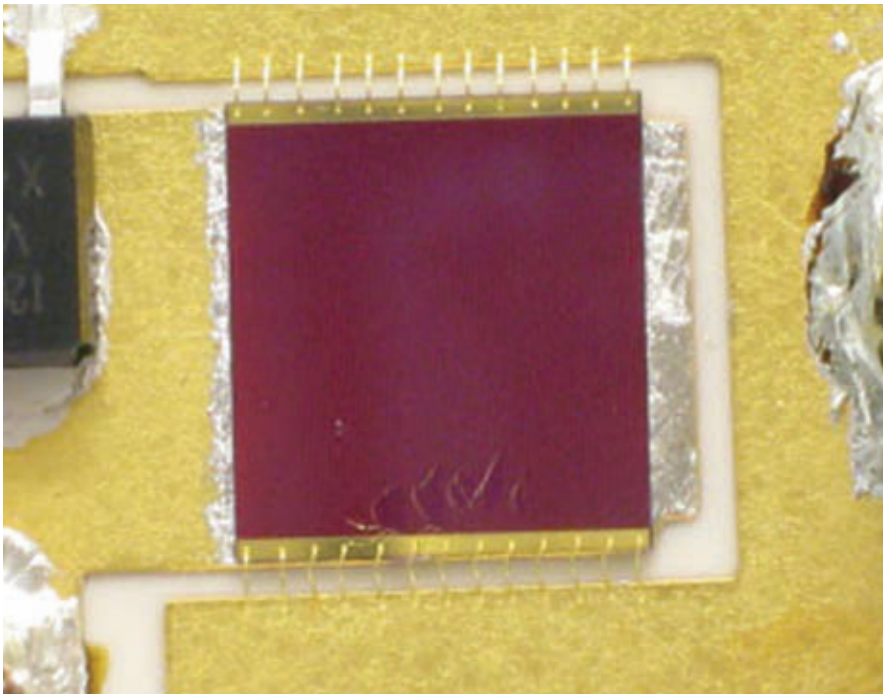
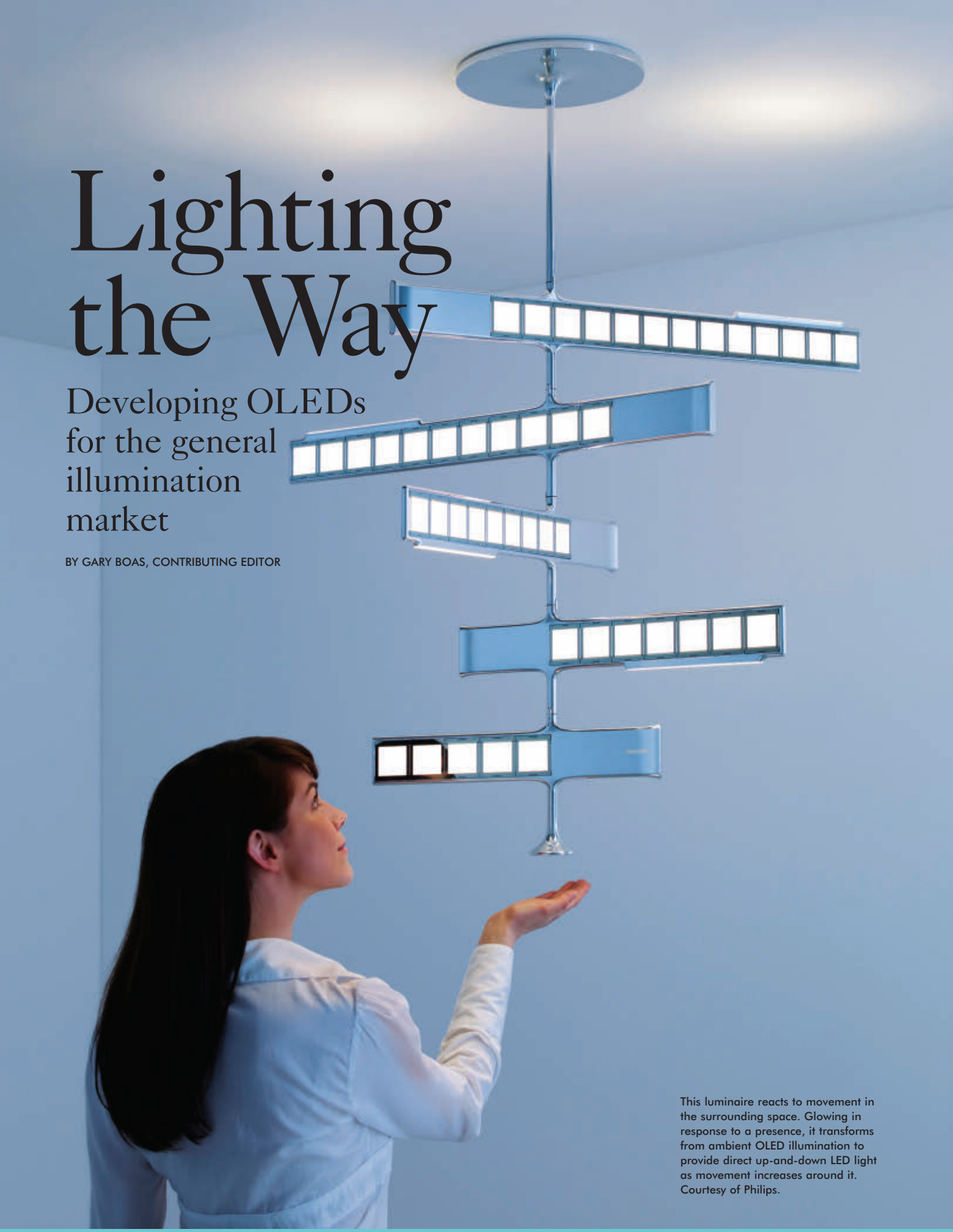


Figure 3. Shown is a color photo of a multijunction CPV device that is glowing red because the forward bias is driving the top layer to emit at 700 nm. This particular cell has physical damage to the fine collector lines in its lower part, but it is otherwise the same type as imaged in Figures 1 and 2.

Lighting the Way

Developing OLEDs for the general illumination market

BY GARY BOAS, CONTRIBUTING EDITOR



This luminaire reacts to movement in the surrounding space. Glowing in response to a presence, it transforms from ambient OLED illumination to provide direct up-and-down LED light as movement increases around it. Courtesy of Philips.

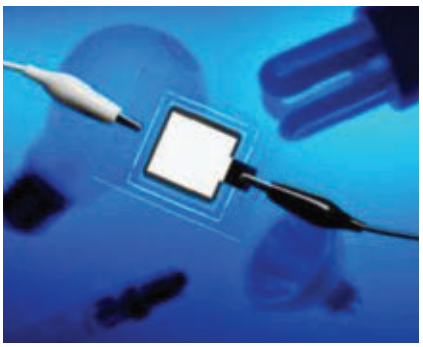
The lighting industry is in transition. The formerly ubiquitous incandescent bulb has already been banned in Europe and will be phased out in the US beginning in 2012, all part of an effort to reduce greenhouse gas emissions by promoting energy efficiency. That leaves a significant portion of the $100 billion global lighting market – more than $20 billion of which is represented by lamps – up for grabs.

Compact fluorescent lamps are often considered the obvious successor to incandescent bulbs, since they use as much as 80 percent less energy and last considerably longer, but they have drawbacks as well. They are more expensive individually and give off a harsher light, dramatically changing the aesthetics of an interior. At the same time, consumer advocates have noted that many people – those who suffer from epilepsy and anxiety, for example – are especially sensitive to this light.

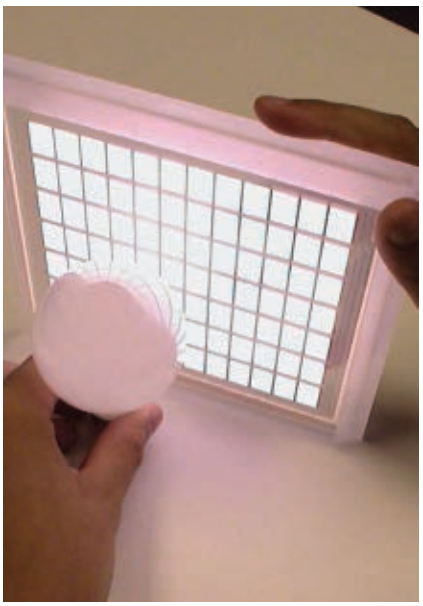
Among the other alternatives, organic LEDs (OLEDs) have lately created a stir, in large part because of improvements in power efficiency. "In the past couple of years, we have seen tremendous advances in OLEDs," said Janice Mahon, vice president of technology commercialization with Ewing, N.J.-based Universal Display. The company licenses technology and sells phosphorescent materials for use in OLED displays and lighting. "These advances have made it clear that, technically, the industry can get to the kinds of performance numbers it needs to make OLEDs a viable lighting source."

Changing the character of light

The fundamental mechanisms of OLEDs are similar to those of LEDs: Applying electricity to a device leads to a recombination of electrons and holes in the conductive layer, resulting in a release of energy in the form of photons – but the emissive materials are organic molecules as opposed to semiconductor diodes. This leads to compelling differences between the two light sources – indeed, between OLEDs and most other forms of lighting. Most significantly, perhaps, OLED panels can be less than 2.5 cm thick.



This white OLED panel from Novaled can be used for lighting applications. Courtesy of Novaled.



For general illumination applications, OLEDs offer a viable alternative to conventional sources. They are relatively energy efficient and provide a uniform diffuse light that can even be tunable. OLED lighting panels are also thin, measuring as little as 2.5 cm. Courtesy of Janice Mahon, vice president, technology commercialization, Universal Display.

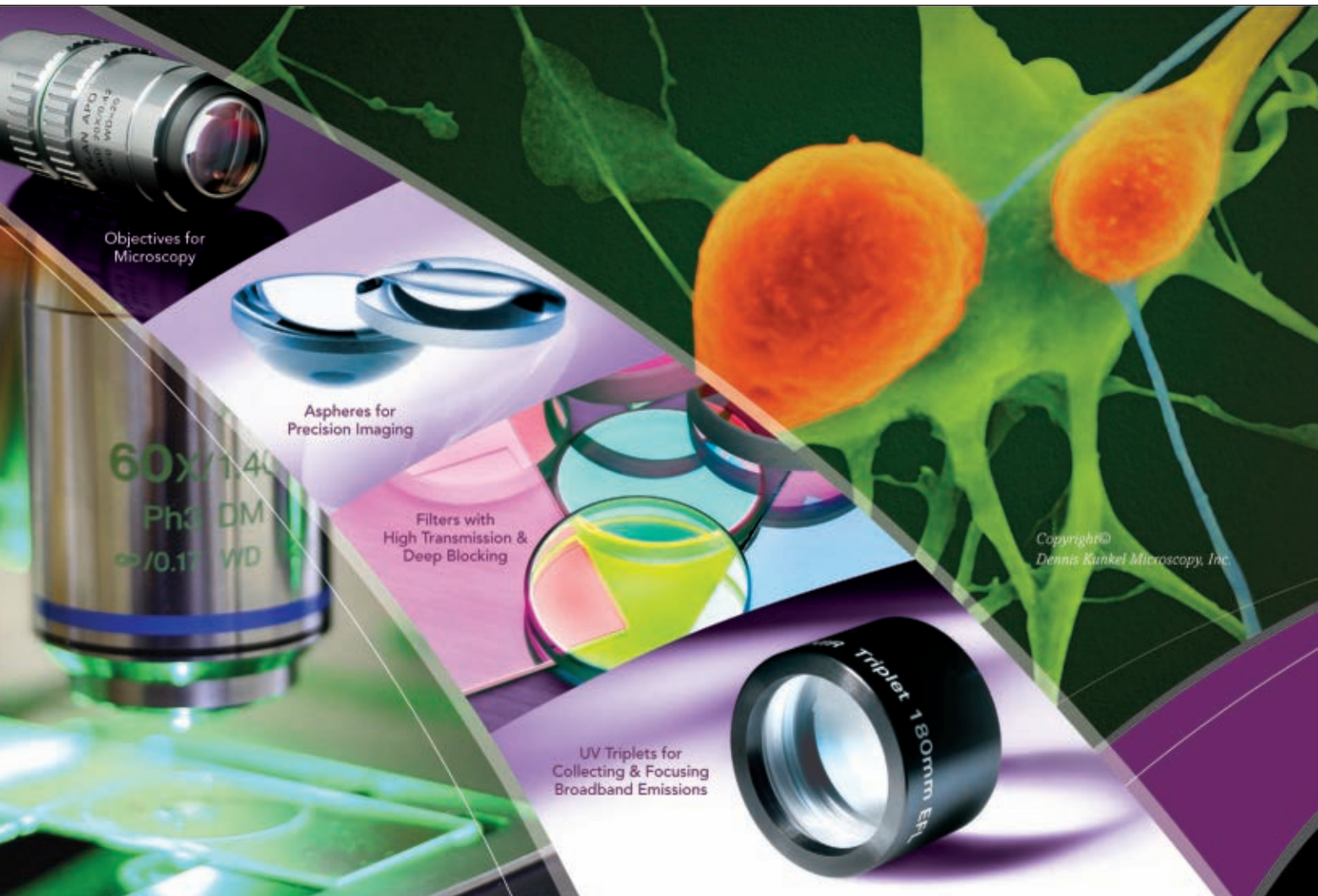
OLEDs can be made in various colors, including warm and cold whites, with a very high color rendering index. Courtesy of the OLLA Project.

Courtesy of Philips.

But also, whereas LEDs and other more conventional sources present distinct points of light, OLEDs offer uniform, diffuse light spread across the sheets of material. This changes the character of the light and allows for a degree of transparency in the panel when the source is switched off. With further development, the sheets could even be made flexible.

OLEDs recommend themselves for a number of specialty or niche applications, including emergency signage, automotive applications – for interior and dashboard uses, for example – and architectural lighting features. With the latter, Mahon said, they offer "all kinds of opportunities to create special lighting effects." A single device could offer either cool or warm light, and even allow tunability so users can design lighting specific to the occasion, be it a business meeting or a dinner party.

The flexibility and transparency of OLED sheets, and the availability of lighting as ultrathin panels, open the door to a world of additional possibilities. Lighting designers are already chattering about making decorative wall dividers with OLED panels, incorporating the panels



into ceiling tiles and venetian blinds, even wrapping them around columns.

Ultimately, though, whether OLEDs can compete in the general lighting market will depend on both efficiency and cost. For example, using its phosphorescent OLED technology, Universal Display has produced OLEDs with an efficiency of 102 lumens per watt in a small area. (A standard 60-W tungsten incandescent bulb offers efficiency of about 15 lumens per watt; fluorescent bulbs, typically in the range of 50 to 75.) “Now we need to demonstrate the same efficiency on a 6 × 6-in. panel,” Mahon said, adding that costs will begin to drop once production is scaled up.

At the same time, Universal Display and others continue to work toward the US Department of Energy’s 2015 target for general illumination: 150 lumens per watt. To this end, the company is evaluating new materials and device structures and seeking to reduce some of the losses that occur over area in larger-area lighting panels, by using better conductors and scalable outcoupling techniques, for instance.

gary.boas@photonics.com

Organic light-emitting diodes, shown here at bottom in three different colors, offer alternatives to other lighting technologies, such as, from left, compact fluorescent bulbs, traditional incandescent lightbulbs and fluorescent tubes. Courtesy of Philips.

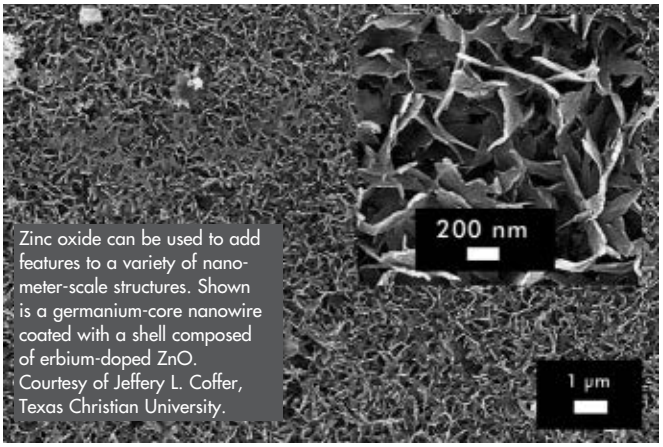
Making electro-optical sense with ZINC OXIDE

PHOTONIC APPLICATIONS USING THE II-VI SEMICONDUCTOR ZINC OXIDE (ZnO) ARE BECOMING INCREASINGLY PREVALENT, AND RESEARCH INTO EVEN MORE USES IS EXPLODING, WITH HUNDREDS OF LABS LOOKING INTO THE MATERIAL'S UNIQUE PROPERTIES.

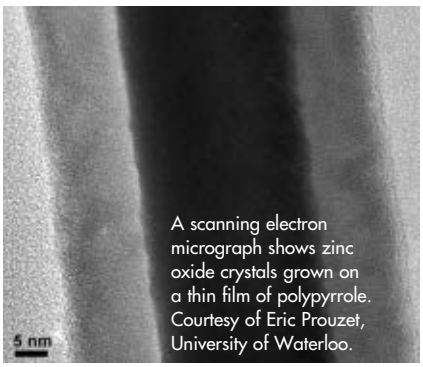
BY LYNN SAVAGE, FEATURES EDITOR

ZnO has many properties that make it attractive for optoelectronic applications. It has a bandgap of 3.37 eV – the same as gallium nitride (GaN) – and an excitation binding energy of about 60 meV. It is transparent under visible wavelengths of light yet opaque under ultraviolet, making it a great UV sensor material. And it offers both piezoelectric and pyroelectric characteristics.

However, what is really attractive about ZnO compared with GaN and other semiconductors, such as cadmium selenide, is that it is environmentally benign. Semiconductor manufacturers are feeling increased pressure to include nontoxic materials in their products.



Zinc oxide can be used to add features to a variety of nanometer-scale structures. Shown is a germanium-core nanowire coated with a shell composed of erbium-doped ZnO. Courtesy of Jeffery L. Coffer, Texas Christian University.



A scanning electron micrograph shows zinc oxide crystals grown on a thin film of polypyrrole. Courtesy of Eric Prouzet, University of Waterloo.

Such materials are easier to recycle, and outright biocompatibility of ZnO makes it a promising candidate for optoelectrical medical devices that can be inserted into the body.

Another intriguing aspect of ZnO crystals is that they readily form specific shapes, depending on the method used to create them. Each shape results in a slightly different set of photonic, piezoelectric and mechanical characteristics.

"ZnO with various shapes, including nanowires, nanorings, nanorods, nanobelts, nanotubules, nanohelixes and so on, have been synthesized by various methods and studied in the past decade," said Wei Zhong of the Nanjing National Laboratory of Microstructures in China. "As a result, the properties of ZnO were found to depend on the shape and corresponding synthesis method."

Thus far, however, bandgap tunability seems to depend more on changing the size of the crystal than on changing its shape.

Crystal formation

Typically, ZnO crystals are fabricated through thermal evaporation, chemical vapor deposition (CVD), metallorganic CVD, pulsed-laser deposition or template-based growth techniques. Unfortunately, all of these methods are used at a steep cost in time and money. High temperatures or vacuum typically are required, along with complicated processing steps and, often, noxious chemical compounds.

"In other words," Zhong said, "the methods aren't suitable for large-scale production [at] low cost."

Zhong's group currently is testing novel and less toxic fabrication methods that would produce doped ZnO microcrystals more simply and cheaply. The team's focus is on using transition metals

such as manganese, cobalt and iron to dope ZnO nanorods for use in nanoscale magnetic data storage media.

But Zhong and his colleagues aren't the only ones intrigued by the possibilities of ZnO.

"ZnO demonstrates an extremely diverse range of tunable geometries, from dots to rods to wires to tri- and tetrapod motifs," said Jeffery L. Coffer, chemistry professor at Texas Christian University in Fort Worth. He and his colleagues recently published work on the latter form – four-pointed objects with shapes like children's jacks – which emit two distinct wavelengths after being coated with erbium ions and irradiated. They also found that adding a layer of germanium prior to erbium doping enhanced the tetrapod's photoluminescence. Their report appeared in the Jan. 6, 2010 issue of *Crystal Growth & Design*.

SEMICONDUCTOR MANUFACTURERS ARE FEELING INCREASED PRESSURE TO INCLUDE NONTOXIC MATERIALS IN THEIR PRODUCTS.

"We are currently attempting to construct core/shell platforms that combine the properties of reactive nanoscale semiconductors such as germanium that can be packaged and passivated with the stable ZnO shell, both with and without additional dopant species," Coffer said. "It is a rich field with plenty of things to explore."

Along with changes in morphology, doping adds character to ZnO crystals. Doped with erbium, for example, ZnO emits at 1.54 µm and is particularly useful in LEDs, laser diodes and optical amplifiers. Upconversion permits emission in the visible range. Other common dopants include aluminum and indium.

Laying them down

Another key to effective use of ZnO in optoelectrical or optomechanical devices is finding the best substrate upon which to grow or deposit the crystals. According to Eric Prouzet and his colleague Kam Tong Leung, both from the University of Waterloo in Ontario, Canada, there remain challenges in devising inexpensive conductive substrates. They also note that developing novel ways to create specific micro- or nanoscale patterns of ZnO on a substrate is of high importance.

"The challenge is to achieve large-scale preparation on cheap supports like plastic films as well as integration [into] specific devices," Prouzet said.

Prouzet, Leung and their colleagues reported in the Jan. 12, 2010 issue of the journal *Chemistry of Materials* on one such candidate substrate, polypyrrole. A fairly well-known conducting polymer, it can be formed into wide swaths of thin film that are conductive enough to permit growth of ZnO nanocrystals via electrodeposition.

Because it is transparent to visible light yet darkens when exposed to ultraviolet wavelengths, ZnO also can be used as the basis of UV sensors. Rohm Semiconductors USA LLC, based in San Diego, recently announced what it calls a high-precision UV sensor that comprises a ZnO thin film. The device is sensitive enough to distinguish between the UVA (320 to 400 nm) and UVB (280 to 320 nm) bands without the use of an optical filter.

lynn.savage@photonics.com

Photonics North 2010

Co-Located with Photovoltaics Canada First National Scientific Conference

JUNE 1-3, 2010

FALLSVIEW CASINO RESORT

NIAGARA FALLS, CANADA

WWW.PHOTONICSNORTH.COM

Canada has a long tradition of ground-breaking excellence in the field of photonics thanks to the extensive research carried out by its universities, government laboratories and the industry.

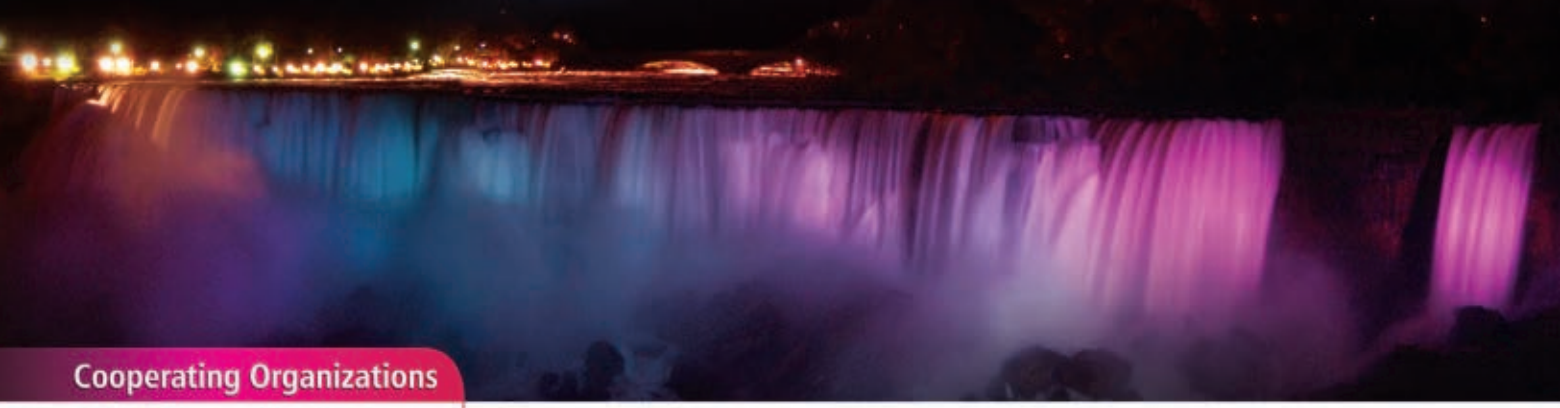
The goal of Photonics North is to bring together people, industries and organizations from around the world and create vertical business opportunities. The Canadian Photonics Consortium is proud organizer and host of the prestigious Photonics North 2010 event in Niagara Falls, at the Fallsview Casino Resort and would like to invite everyone to participate.

In an effort to sustain the business success of our global community, we welcome all opportunities to establish international relationships that could further contribute to the rapid growth of worldwide development.

EXHIBITOR PRODUCT SHOWCASE

JUNE 2-3, 2010

- FIND NEW VENUES FOR YOUR PRODUCT DEVELOPMENT
- A CHANCE TO DISCOVER UNIQUE BUSINESS OPPORTUNITIES WITH A MINIMUM OF TIME & ENERGY
- PROMOTE NEW TECHNOLOGY TRANSFERS
- INTERNATIONAL NETWORKING
- SALES LEAD GENERATION THROUGH NEW FIELD/AREA BUYERS
- EXPAND YOUR PRODUCT/TECHNOLOGY MANUFACTURING AND DEVELOPMENT RANGE THROUGH OTHER RELATED TECHNOLOGIES



Cooperating Organizations

SPIE

CPC
Canadian Photonics Consortium
Consortium photonique du Canada

OPIN
Ontario Photonics Industry Network

ICIP
CIPI

Réseau photonique du Québec
Quebec Photonic Network

COPL
Centre d'optique, photonique et laser

INO

The art of microspectroscopy

BY CAREN B. LES, NEWS EDITOR

■ “Microspectroscopy is basically the ability to obtain spectra of microscopic samples or sampling areas. It differs from other microscopy techniques in that it is primarily used to acquire spectra rather than images,” according to Paul Martin, president of Craic Technologies Inc. Based in San Dimas, Calif., the company specializes in microscopy and microspectroscopy in the UV-VIS-NIR regions. ■

Martin noted that both spectra and high-resolution digital images can be acquired with the company’s microspectrophotometers, also known as microspectrometers (including its QDI 2010 model), which are designed to measure the UV-VIS-NIR spectra of microscopic samples or microscopic areas of larger objects. Of the two types of instruments available, the fully integrated microspectrometer has been built for microspectroscopy, while the microscope spectrophotometer unit has been designed to attach to an open photoport of an optical microscope. Depending upon the configuration, microspectrophotometers can nondestructively measure the spectra of samples, even at the submicron level, by transmission, reflectance, fluorescence, and electron and polarization microspectroscopy, according to the company.

Applications for the UV-VIS-NIR regions are numerous, ranging from forensic sciences to geology to materials science, biology and pharmacology. “A lot of microspectroscopy is also done in the semiconductor and photovoltaic fields for everything from film thickness measurements to contaminant analysis,” Martin commented.

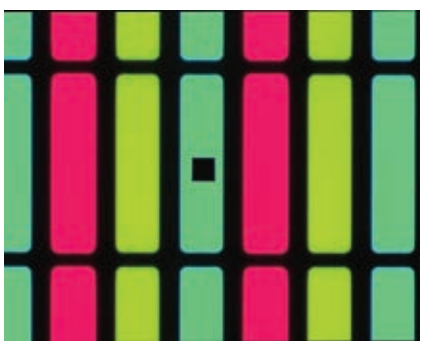
He noted that, although Craic Technologies specializes in integrating optical microscopy with optical spectroscopy, he has seen spectrometers of various types added to confocal, scanning electron and IR microscopes, and that Raman microspectrometers are also quite prevalent.

“Among the challenges faced in the microspectroscopy field are the problems that come with combining the operation of a microscope with a spectrophotometer, and the fact that you have a lot less light to work with at the microscopic level,” Martin said. “To acquire good-quality

spectral data easily, it takes a well-thought-out design in terms of optics, hardware and software. Engineers are always trying to improve sensitivities as well as ease of use," he added.

"When purchasing an instrument system, it is important to consider the *entire* integrated tool, and not just the components," Martin explained. "As an example, the theoretical spectral range of the detector will be far larger than that of the instrument once you add a monochromator, optics, light sources and even the sample – yet the spectral range of only the detector is often quoted."

Craic Technologies' QDI 2010 microspectrophotometer is a state-of-the-art instrument for UV-VIS-NIR microspectroscopy in the fields of forensics, materials science, biology, drug development and geology, according to the company. Photos courtesy of Craic Technologies Inc.



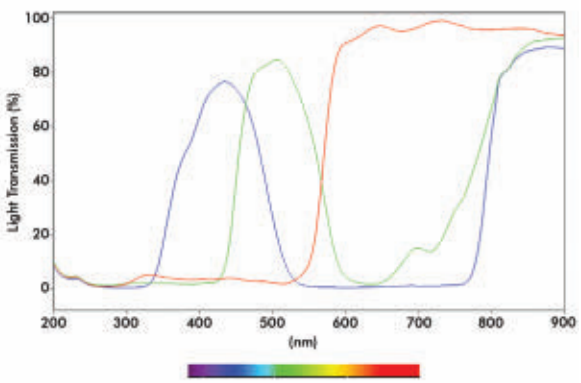
This is an image of how an organic LED chip appears under a microspectrometer when a spectral measurement is being made. The black square is the entrance aperture of the spectrometer.

Microspectroscopy provides the ability to transfer most spectroscopy methods to the microscope world, said Uwe Ortmann, head of sales and marketing at PicoQuant GmbH in Berlin. Spectroscopic techniques in common practice will be transferable to microscopic or even nanoscopic dimensions. The research will evolve to encompass the study of smaller and smaller samples, environments and particles. Confocal microscopy is commonly combined with time domain studies and intensity fluctuation (fluorescence correlation and cross-correlation spectroscopy), he said, adding that the company's customers are also able to combine atomic force and confocal microscopy. Applications for microspectroscopy currently dominate in cell biology and protein research, mostly at the fundamental level.

A system for microspectroscopy, PicoQuant's MicroTime 200 confocal time-resolved microscope is a high-end research tool for lifetime imaging, fluorescence correlation and single-molecule detection. It offers attomolar sensitivity down to the single-molecule level, Ortmann said, adding that the company is dedicated to making the instrument systems more user-friendly and lowering their costs.

Systems and advantages

In late November 2009, Craic Technologies announced the compatibility of Windows 7 computer programming with its Minerva microspectrometer control and spectral analysis software. The company says that scientists will notice a more fluid response with the program's enhanced stability and advanced memory management. Windows 7 will further improve the usability of the software with features such



Shown is an overlay of three spectra from the organic LED chip (but with three different-colored pixels).

as the quick resizing of windows, easier-to-see icons, speedy access to often-used documents and spectra, and a fast search engine to locate and quickly analyze data.

In 2009, Craic Technologies noted that its QDI 2010 microspectrophotometer, combining both UV microscopy spectral imaging and the analytical capabilities of UV-VIS-NIR microspectroscopy, can be configured to help manufacturers locate and identify organic and inorganic contaminants in hard disk drive components such as read-write heads. Techniques commonly used for this purpose, such as inspection with optical microscopes, have not been able to adequately detect or analyze contaminants, according to the company.

Craic Technologies also announced that its UV microspectrophotometers, such as the QDI 2010, can rapidly differentiate DNA from salt and even protein crystals by absorbance microspectroscopy – and that they can also qualify the crystal once it has been located and identified. Study of the structure of DNA is commonly done with x-ray crystallography, which requires the growth of DNA crystals that are stable and free from protein contaminants.

The company says that, using normal microscopy techniques, it is difficult even to identify DNA crystals, much less determine whether they are viable. DNA readily absorbs light at 260 nm, but a salt or protein will not absorb light at that wavelength. Due to the inherent flexibility of microspectrophotometers, besides imaging the crystals themselves, they can produce microspectra of crystals as small as a micron. The ability to use microspectra to qualify the crystal can save valuable time by enabling the selection of only viable crystals for the next step of a growth process.

Craic Technologies' microspectroscopic technologies and techniques have applications in areas such as vitrinite coal analysis, measurement of surface plasmon resonance on the microscopic scale, and the rapid and accurate metrology of organic LED and liquid crystal displays for color, intensity and mura.

FTIR microspectroscopy applications

Biochemical changes associated with prostate cancer can be discriminated by Fourier transform infrared (FTIR) microspectroscopy to classify organ-confined and locally invasive prostate cancers, according to scientists at the Molecular Imaging Program at Stanford and the Stanford Infrared Optics and Photomedicine Center, both at Stanford University in California. The group compared the method with histological pathology for the evaluation of tissue for improved prostate cancer diagnosis and treatment. A report on the study appears in the December 2009 issue of *Trends in Biotechnology*.

■ "When purchasing an instrument system, it is important to consider the *entire* integrated tool, and not just the components," Martin explained. ■

Published by Thermo Fisher Scientific Inc. of Waltham, Mass., Application Note: 51517, titled *FT-IR Microspectroscopy in Forensic and Crime Lab Analysis*, covers the use of Thermo Scientific's Nicolet iN10 infrared microscope – an optical microscope with integrated Fourier transform infrared instrumentation – in detecting counterfeit money, and in analyzing hair fiber, and tablet, paint and fingerprint residue.

Other methods and applications

In the area of Raman microspectroscopy, Craic Technologies' CTR-1 MicroRaman spectrometer performs micro Raman spectroscopy rapidly by standard Raman scattering or by surface-enhanced Raman spectroscopy. Spectra of microscopic images are acquired while the user views them with a high-resolution digital imaging system. The device has applications in such areas as biological research and semiconductor metrology.

Published in the January 2010 issue of the *Journal of Synchrotron Radiation*, an article by F. Hahn and C.A. Melendres discusses their work using synchrotron IR reflectance microspectroscopy to study film formation and the breakdown of copper.

Developments and applications of soft x-ray spectromicroscopy with a focus on scanning transmission x-ray microscopy are discussed in an article written by Tae Hyun Yoon, a researcher at Hanyang University in Seoul, South Korea. Published in *Applied Spectroscopy Reviews* in March 2009, the article notes that, as a result of significant advances in x-ray optics and the greater availability of third-generation synchrotron sources, this spectromicroscopic technique has become an important analytical tool in several disciplines, including the environmental and materials sciences.

caren.les@photonics.com

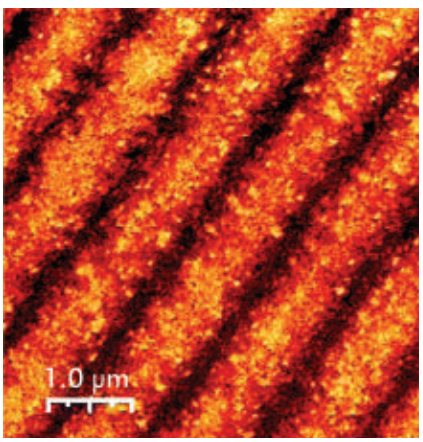
Beaming through to NOVEL USES for HOLOGRAPHY

BY LYNN SAVAGE, FEATURES EDITOR

Typically, green, simple three-dimensional images of objects on flat paper are not unknown to today's kids – or to anyone who has grown up during the past few decades. We encountered them first as wonderments – optical tricks that astounded and pleased the eye in the same way as flicker rings and early 3-D schlock movies. As playthings for kids, holographic pictures never exploded into the public conscience as lasers and telescopes did, but, more recently, holography has found several niches in which important work can be done.

lynn.savage@photonics.com

And a touch of silver nanoparticles



To create a hologram, two beams of light are reflected off an object. This usually involves a pair of lasers or one laser and a beamsplitter. Interferometric differences caused by the first (illuminating) beam and the second (reference) beam record spatial information from the object onto a photographic plate. This information does not include just intensity, such as in photography, but also dimension. The twin-beam technique also can be used to form a special type of diffraction – or holographic – grating. Here, however, the interference fringes are imposed onto a photoresistive material. The resulting grating exhibits less light scattering than a standard one.

At Université de Haute-Alsace in Mulhouse, France, Lavinia Balan and her colleagues are improving the process of recording holographic gratings by adding silver nanoparticles to the mix. In a one-pot technique, her group performed nanoparticle synthesis concurrently with photochemical preparation of a polyacrylic base. The silver particles, now imbued into the acrylic interference pattern, significantly enhance both the holographic and diffraction efficiency of the grating. The team reported its work in the Dec. 22, 2009, issue of *Chemistry of Materials*.

Even more unique

Although there is a lot of ongoing research into novel ways to explore holographic principles, most of the practical, day-to-day uses of holograms are in measures such as securing licenses, passports, credit cards and other portable accoutrements that often are the targets of identity thieves. There are a large number of companies that churn out holographic stickers for credit cards, ID badges and product labels at a commodities level. But some companies, such as JDSU Corp. in Milpitas, Calif., strive to improve the uniqueness of holograms to ensure secure identification of people and products.

The company recently updated its lines of hot-stamped foil products, security laminates, and pressure-sensitive labels and seals. It also has developed a process, dubbed HoloFuse, that addresses possible flaws in standard printed holographic products.

Security mavens like holography for IDs and product packaging because no two holograms are ever alike, even if they are made with similar equipment imaging the same object. But even state-of-the-art materials, such as polycarbonate-coated cards, are made with a laminate process that imperfectly bonds the plastic to the hologram. The holograms used in clear-laminate cards also are prone to fading – from the lamination process on – and thieves can peel the layers of a legitimate ID apart and incorporate the hologram into a false document.

JDSU's HoloFuse material is a polycarbonate film that directly incorporates the holographic pattern into its surface. No adhesives are needed, and no fading is possible. There also are no layers of disparate materials to strip apart, leaving potential ID thieves adrift.

Holography has a certain "wow" factor to it that draws the public, especially children, to science museums and art exhibits. Most people don't know the science behind the technique, but for some, one really cool hologram acts as a gateway to a lifelong interest in science.

Heard it through the cell grapevine

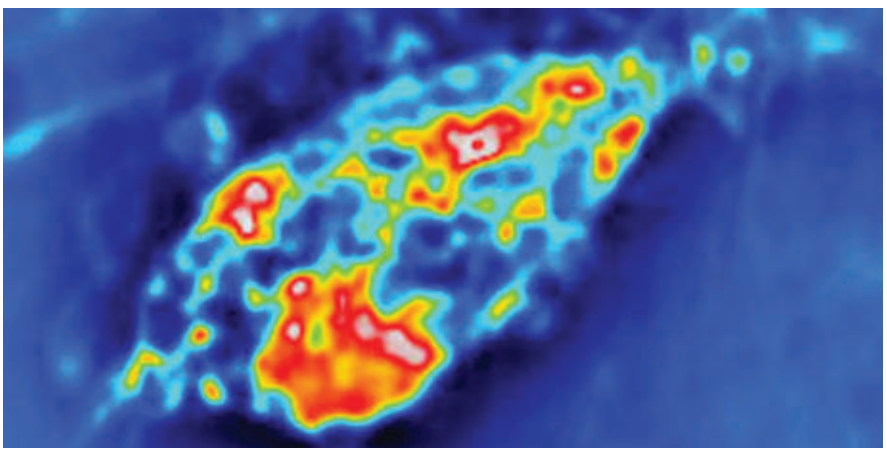
Understanding the cells that comprise our bodies ultimately will require that we find out how they communicate with each other. Whether they are neurons or blood cells, tumor cells or stem cells, they must "talk" to each other to accomplish their biological tasks. And if they talk to one another, Gabriel Popescu of the Beckman Institute for Advanced Science and Technology in Urbana, Ill., wants to listen in.

Where normal cellular research comprises microscopy of fixed, dead cells, Popescu and his colleagues combine light-scattering, interferometry and microscopy to create videos of live cells in action.

"We are actually accurately measuring their motion at the nanoscale," he said. "So that, in many ways, with all of these vibrations, [it] is very close to listening to something."

Ultimately, Popescu wants to be able to talk back, but for now it's about the process. Adding interferometric tools to a basic microscope setup did not provide mere images to look at; it provided the quantitative information that truly reveals the nanoscale structure of the cells.

"That is fairly unique. Commercial microscopes don't do that," he said. "In a way, this is combining holography with microscopy. It's a new but very dynamic field that we are contributing to."



DISKCON Asia Pacific

March 8, 2010 – Thailand Science Park Convention Centre, Bangkok, Thailand
March 11, 2010 – Keppel Club, Singapore
March 12, 2010 – Golf Tournament, Keppel Club, Singapore
March 15, 2010 – Sofitel Hotel, Suzhou, China

DISKCON®
• ASIA-PACIFIC •
presented by IDEMA

For more information, please contact Shirley Ng at sng@idema.org

THE STRUGGLE to keep RESEARCH REAL

BY HANK HOGAN, CONTRIBUTING EDITOR

Beneath a scientist's lab coat beats a human heart. So it should be no surprise that researchers sometimes fudge – or outright fake – their data.

Often, this manipulation takes the form of a doctored image. Michael Kalichman, director of the research ethics program at the University of California, San Diego, recalls reading neuropathology papers as part of the peer review process prior to publication. Sometimes he'd find the same image appearing twice in the same submission. The second time it might be rotated or at a different magnification. In the paper, though, it would be presented as completely different from the first image.

"At the very least, somebody was sloppy in their record keeping," Kalichman said. "At the very most, somebody was trying to mislead about what they had actually done."

While the fraud may appear minimal, the National Institutes of Health (NIH) in Bethesda, Md., and universities and other organizations take the problem seriously. To combat it, they give tutorials to researchers and put systems in place. There also are enforcement arms that actively investigate allegations.

Fraud figures

The amount of scientific misconduct that goes on is hard to pin down, Kalichman said. There are well-known examples where a researcher has been shown to have committed fraud, such as the fake cloning claims of South Korean scientist Hwang Woo-suk. Based on the number of cases like this that have been publicly discovered and adjudicated, the rate of serious research misconduct could be one in 100,000 scientists.

However, the amount of misconduct could be much higher than this low figure indicates. An analysis of data from several surveys that appeared in *PLoS One* in May 2009 found that 1.97 percent of scientists admitted to serious misconduct, and more than 14 percent had witnessed it in others.

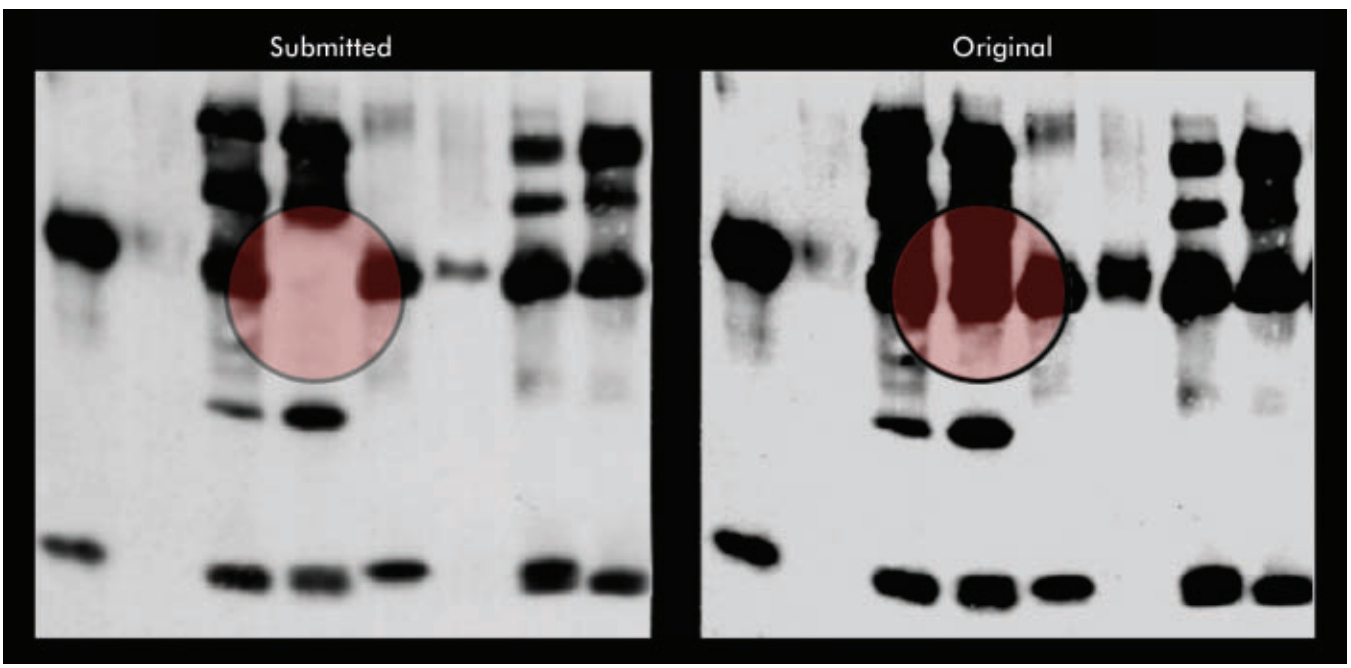
The paper's author, Daniele Fanelli, is a research fellow at the University of Edinburgh in the UK. He noted that the first figure is probably an underestimate, since not all researchers will report their own misconduct.

There are good reasons to believe the second figure is an overestimate, he said. "Most surveys did not control for the possibility that several respondents are thinking of the same colleague."

In one survey, however, only one researcher per department was asked about misconduct in that department. In that case, the figure was 5.25 percent, Fanelli said.

It must be remembered, however, that what is thought by others to be lab fraud or misconduct may not, in fact, be so. The Office of Research Integrity (ORI), which is part of the US Department of Health and Human Services, oversees and directs research integrity activities for the US government public health services.

In 2007, the ORI closed 28 cases, with 10 resulting in research misconduct find-



The original gel blot image on the right had some data removed when submitted for publication, as can be seen by comparing the two panels in the area highlighted by the circle. Such manipulation can be innocent, but it could also be a deliberate attempt to deceive. Courtesy of Hany Farid, Dartmouth College.

ings, administrative actions or both. That ratio was in line with the historical average and shows that most of the allegations were not true or could not be proved.

Using technology

By some estimates, up to 20 percent of all images submitted for publication have been improperly manipulated. This figure is open to debate, in part because the definition of what kind of manipulation is allowable varies from journal to journal.

In general, it's considered appropriate to make an adjustment if it's done to all pixels and is disclosed. An example might be the use of false color to make the differences in a gray-scale image more easily visible.

There are limits to this general principle, however. Adjusting the brightness and contrast of a gel blot image, for example, would treat all pixels equally. However, it could result in the gray background and faint blots disappearing. Paper reviewers and journal editors must guard against this, which can be hard to detect and which can arise from innocent intentions.

Attempts to deceive, on the other hand, often involve adding or subtracting pixels. That selective treatment makes it possible to catch the alterations automatically.

"The algorithms that you can develop are ones that target specific forms of manipulation," explained Hany Farid, a professor of computer science at Dartmouth College in Hanover, N.H., and an expert on digital image forensics.

Farid demonstrated some years ago that image segmentation techniques based on intensity can be employed to detect deletion, duplication and removal of small blemishes. A tampered image that is processed through these segmentation algorithms will yield an output with visible indicators, such as solid boxes where data

has been duplicated or removed. Software can then look for and find these regions.

Farid noted that the tools to automate the process do not yet exist, but he foresees a time when they will. He also noted that the algorithms will never be able to catch all possible fraudulent image manipulation.

Employing other tools

For that reason, policies must be put in place to guard against fraud. Farid, for example, advocates having researchers submit the original images along with those that will appear in a paper.

Another example of a policy solution can be found in the ethics training done at NIH. This has been regularly held for all of the agency's own researchers for the past 10 years, said Joan P. Schwartz, the agency's intramural research integrity officer and assistant director of the office of intramural research.

One part of this training is the use of hypothetical cases, which change from year to year. The theme for this past year was dual-use research – work that could be used to help as well as harm. A few years ago, the training involved image manipulation, which offers the potential to be both good and bad.

In all instances, the goal of these scenarios is to get everyone in a department talking, Schwartz said. "We purposely make the cases a little bit gray so that they generate discussion. They don't necessarily have a right or wrong answer."

In addition to the hypothetical cases, she noted that the agency has an online course that's intended to get new employees up to speed with NIH research guidelines. It has been adopted by many universities and research organizations around the world.

Despite these efforts, Schwartz noted that the rate of misconduct appears to be holding steady. Thus, training alone is not the complete answer.

Another knob to turn

The solution may involve a change in the structure of science, said Raymond De Vries, a professor of bioethics at the University of Michigan Medical School in Ann Arbor. Together with colleagues Brian Martinson and Melissa Anderson, he has surveyed researchers to see how many self-report minor and major scientific misconduct. The second category includes such breaches as falsification, fabrication and plagiarism. The group also has collected scientists' opinions about the fairness of the science system and about researchers' experience with competitive pressure.

The team's results show that minor and major misconduct are linked. Those admitting to the former are far more likely to report committing the latter. More competitive, rather than cooperative, views on research also led to more admissions of misconduct.

Another factor is the amount of perceived organizational injustice. The rewards of science are promotions, tenure, grant money, prestige and so on. These may not be distributed fairly, and scientists who report injustice in their workplace also report higher levels of misconduct. Thus, improving organizational justice – or at least how it's perceived – may increase research integrity and decrease lab fraud.

Summing up the findings, De Vries said of scientists, "If they feel like they're being treated fairly, they actually report less misconduct."

hank.hogan@photonics.com

spotlight

Lasers, Laser Accessories & Light Sources

Laser Stabilizer Removes Noise and Drift
Spend your time monitoring your experiment, rather than your laser, with a BEOC laser stabilizer. Our LPC, placed in the optical path, does the work of a power meter, a variable attenuator and a laser intensity stabilizer. Reduce DC drift to less than 0.03% long term. Standard, custom and OEM models are available to meet your requirements in the 325- to 1700-nm wavelength range.

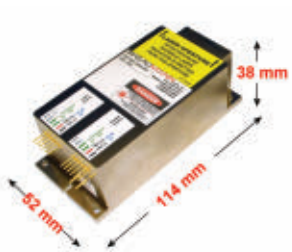
BEOC
Brockton Electro-Optics Corp
(508) 559-9958
sales@brocktoneo.com
www.brocktoneo.com

LaserTurn® Cylindrical Laser Processing Systems
LaserTurn® series integrated motion subsystems for cylindrical laser processing applications combine automated material handling with direct-drive linear and rotary motion. Systems feature a three-jaw gripper with a 25-mm aperture for ID or OD gripping, precision collets for 0.1- to 30-mm-diameter materials, travels up to 300 mm and up to a 30-mm clear aperture for product feed through.

AEROTECH®
(412) 963-7470
sales@aerotech.com
www.aerotech.com

FemtoFiber pro Ultrafast Fiber Laser
TOPTICA's new FemtoFiber pro features the highest peak power of its class, along with complete hands-off operation. With a focus on reliability and robustness, new technologies have found their way into this professional-grade product; e.g., the saturable absorber mirror. Usable for many applications, including life sciences, time-domain terahertz and ultrafast spectroscopy, the FemtoFiber pro is a complex laser system used for multicolor experiments with optically synchronized laser pulses.

TOPTICA PHOTONICS
(585) 657-6663
sales@toptica-usa.com
www.toptica.com



New 2.94-µm 1-W Laser Module
Sheaumann Laser offers the first commercially available, hermetically sealed 2.94-µm diode-pumped solid-state laser. With a CW free-space output of 1 W, it is the highest power that has been achieved from a compact, lightweight package. It has a typical TEM_{00} M^2 value of 1.12 and a beam divergence of 1.7 mrad.

SHEAUMANN
(508) 970-0600
sales@sheaumann.com
www.sheaumann.com

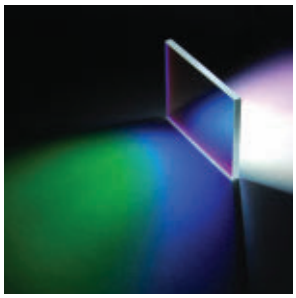
spotlight
spotlight
spotlight

Your best products deserve the Spotlight
Our Spotlight feature is a quick, easy, low-cost way to start advertising with *Photonics Spectra*. Showcase your products in a modular, ⅛-page, four-color ad unit. Three themes rotate month to month – Optics & Optics Fabrication; Imaging Components & Systems; and Lasers, Laser Accessories & Light Sources. Contact us at (413) 499-0514 or at advertising@photonics.com.

PHOTONICS MEDIA
THE PULSE OF THE INDUSTRY
(413) 499-0514
photonics.com
advertising@photonics.com

spotlight

Lasers, Laser Accessories & Light Sources



Tunable Bandpass Filters

Semrock has broken new ground with the release of VersaChrome™ tunable bandpass filters. VersaChrome filters offer wavelength tunability over a very wide range of wavelengths by adjusting the angle of incidence, with essentially no change in spectral performance. With a tuning range of greater than 12% of the normal-incidence wavelength, only five filters are needed to cover the full visible spectrum.

Semrock
(585) 594-7000
semrock@idexcorp.com
www.semrock.com

High-Resolution Spectrum Analyzer for IR Lasers

The 721B-MIR laser spectrum analyzer provides the most complete spectral characterization of lasers that operate at mid-infrared wavelengths. Absolute wavelength is measured to an accuracy of ±1.0 part per million, and spectral properties are determined to a resolution as high as 2 GHz. Now, researchers working with quantum cascade lasers for high-resolution spectroscopy, photochemistry or optical sensing applications can achieve more meaningful experimental results with accurate spectral information.

Bristol Instruments
(585) 924-2620
info@bristol-inst.com
www.bristol-inst.com

Smallest High-Precision Hexapod Positioners

PI offers the largest selection of submicron-precision hexapod 6D micropositioners and microrobots – ideal tools for precision alignment and handling, from fibers to MEMS to heavy optics. Load range: 2 to 1000 kg. Parallel 6D motion; vacuum compatibility; very high stiffness. A virtual, vector-based pivot point and powerful software allow 6D nanoalignment faster and more precise than ever. Applications: microscopy, optics, medical technology, astronomy, tracking and alignment.

PI
(508) 832-3456
photonics@pi-usa.us
www.pi-usa.us

NanoScan Laser Beam Profiler

Photon Inc.'s NanoScan measures virtually any beam of interest with either a silicon, germanium or pyroelectric detector to cover the UV to the far-IR beyond 100 µm. Pulsed and CW beams, near- and far-field profiles, M^2 laser propagation and collimation/divergence all can be accomplished using just one instrument. Ease of use, analysis speed, and accurate, repeatable results and NIST traceability are all yours with NanoScan.

PHOTON Inc.
Precision Beam Profiling
(408) 226-1000
mrussell@photon-inc.com
www.photon-inc.com

HighFinesse Wavelength Meters

When accuracy and performance are critical to your success, TOPTICA delivers! Our HighFinesse wavelength meters offer the highest accuracy for both pulsed and CW applications and offer accuracies to 2 MHz, measurement speeds of 200 Hz, fast measurement of pulsed IR lasers and multichannel options to measure several lasers in parallel. No need for factory calibration, due to solid-state design and no moving parts. This feature set will ensure that your wavelength needs are met with outstanding performance.

TOPTICA PHOTONICS
(585) 657-6663
sales@toptica-usa.com
www.toptica.com

Single-Mode Pulse Amplifier Fiber

NKT Photonics A/S has introduced a new version of its double-clad rod-type fiber for use in fiber amplifiers. The DC-285/100-PM-Yb-ROD is based on proprietary and patented Crystal Fibre air-clad technology and features a single-mode 100-µm polarization-maintaining core with high absorption and low photodarkening. The ytterbium-doped rod is used in output stages of amplifier chains for high-power pulsed laser amplification, where it can sustain megawatt peak power levels. The ytterbium core has an effective mode field area of >4500 µm^2. The 285-µm pump core diameter accepts pump light at numerical apertures up to 0.55 for pumping at 915 or 976 nm. Pump absorption is 30 dB/m for 976 nm and is polarization-independent. Output of the fiber is single-transverse-mode beam quality, and it has been tested with >100-W average power over a range of pulse durations and repetition rates.

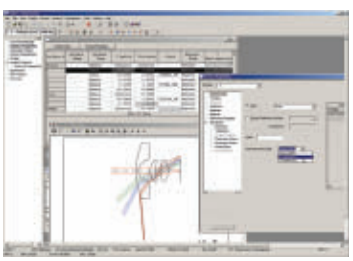
NKT Photonics
fiber_sales@nktphotonics.com

Machine Vision Camera

Viewbits, a division of Computer Modules Inc., has launched a 12-megapixel, 25-fps machine vision camera with a 1.9-in. monochrome progressive-scan CMOS sensor. The Iyeron is compact and shock-resistant. The window of interest partial scanning mode delivers the fast frame rate and can be programmed to display up to 28 square windows within one image, and the user can select certain ones to be read out. Features include a Camera Link interface, a 4:3 aspect ratio, and electronic global and random trigger shutters. Applications include high-speed video capture, factory automation, robotics, military, and medical and scientific imaging. Pixel size is 6 × 6 µm, minimum illumination is 30 lx, gain control is from 0 to 18 dB, and power consumption is ~5 W from a 12-VDC supply.

Viewbits
ray@compumodules.com

Optical Design Software

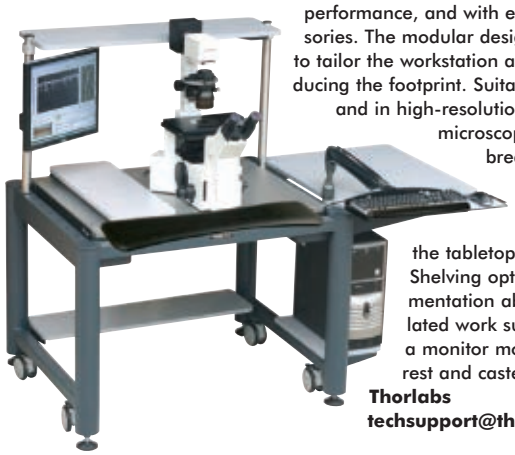


CODE V 10.2 optical design software from Optical Research Associates has enhancements that simplify use and provide greater flexibility. Improved ray tracing algorithms accommodate design of optical systems with extreme aspheres, hyperhemispherical fields of view and highly tilted components. Custom macro writing has been simplified, enabling users to specify any appropriate external program as the default text editor. Expanded graphical output options include smarter defaults for producing optical system drawings with the View Lens feature. File conversion improvements allow all plots to be saved in common formats, including bmp, gif, jpeg, png and tiff. The updated status bar shows more user-selected system parameters, and the Transmission Analysis feature has been expanded to list Fresnel losses, absorption, diffraction efficiency and filter interferograms.

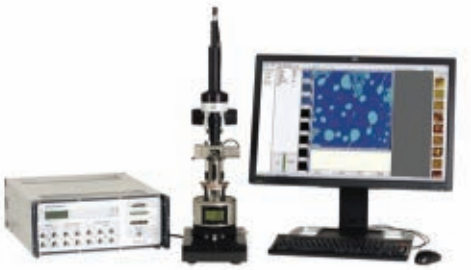
Optical Research Associates
info@opticalres.com

Antivibration Workstations

Ergonomic ScienceDesk workstation frames and accessories have been announced by Thorlabs Ltd. The second-generation products have been upgraded with improvements to the durable welded steel construction and vibration isolation performance, and with expanded and redesigned accessories. The modular design and accessories allow users to tailor the workstation around an imaging system, reducing the footprint. Suitable for use in electrophysiology and in high-resolution, confocal and scanning probe microscopy, the workstation includes a breadboard and frame, with working surfaces ranging from 0.61 × 0.91 mm to 0.91 × 1.22 mm. The frame encloses the tabletop to prevent accidental jarring. Shelving options enable placement of instrumentation above, below or around the isolated work surface. Other accessories include a monitor mount, a keyboard holder, a wrist rest and casters.



Thorlabs
techsupport@thorlabs.com



Scanning Probe Microscope

The MultiMode 8 scanning probe microscope launched by Veeco Instruments Inc. employs two proprietary and patent-pending technologies, ScanAsyst and PeakForce QNM. The former has an automated imaging optimization mode that provides access to advanced applications to obtain research-quality results; the latter is a quantitative nanomechanical property mapping option that delivers accurate and repeatable results for modulus and adhesion measurements while preserving sample and probe integrity. The NanoScope Version 8.1 software offers a simplified interface and more powerful tools for data acquisition and off-line analysis. The system features a rigid mechanical design and advanced control electronics.

Veeco Instruments
sales@veeco.com

Thermopile Detectors

Newport Corp. has expanded its 818P series thermopile detectors with the fan-cooled 818P-500-55, the water-cooled 818P-3KW-060 and the high-sensitivity 818P-001-12NIR. The first handles up to 500 W of continuous optical power and features a 55-mm-diameter active area and very flat responses, from 0.19 to 20 µm. It offers 100-mW measurable power, with 8 kW/cm^2 maximum power density at 1064 nm, continuous-wave. The second measures up to 3 kW of CW optical power and, when illumination is limited to 5 min, can handle up to 4 kW. Output connections include an attached cable with a DB15 connector and/or a USB port. The third is a 12-mm-diameter sensor that measures down to microwatt-level optical power in wavelengths from 0.28 to 1.36 µm. It is calibrated with a fused silica window mounted on the tube, and a tube screwed onto the detector head reduces power fluctuations from air turbulence.

Newport Corp.
jay.jeong@newport.com

GET OPTICAL SOLUTIONS TO POWER YOUR NETWORK

OFCNFOEC 2010

THE FUTURE OF OPTICAL COMMUNICATIONS IS HERE

TECHNICAL CONFERENCE: MARCH 21-25
EXPOSITION: MARCH 23-25
SAN DIEGO CONVENTION CENTER

ROADM OPTICAL FIBER NETWORKS
TELECOM CARRIER TRANSPORT FTTx
DATACOM
TEST AND MEASUREMENT
PON OPTICAL GRIDS GREEN INTERNET R&D
ACCESS
TRANSMISSION ENGINEERING COMMUNICATIONS 100G
TECHNOLOGIES ETHERNET WDM IMPLEMENTATION

ATTEND THE WORLD'S LEADING EVENT FOR OPTICAL COMMUNICATIONS AND NETWORKING PROFESSIONALS

SIGN UP FOR YOUR FREE EXHIBITS PASS PLUS ADMISSION & RECEIVE:

- ✓ Full Exhibition Access With 500 Exhibitors
- ✓ Market Watch & Service Provider Summit Business Programming
- ✓ Fiber Optic Switch & Technology Center
- ✓ FTTx Resource Center
- ✓ Plastic Optical Fiber Market & Technology Center
- ✓ Optical Switch, Green Telecom, and Asia Pavilions
- ✓ Plenary Session With Three Industry Luminaries
- ✓ Video Theater, Job Fair, and New Product Introduction Presentations

REGISTER TODAY FOR YOUR FREE EXHIBITS PASS PLUS ADMISSION!
WWW.OFCNFOEC.ORG

SPONSORED BY:
IEEE COMMUNICATIONS SOCIETY | IEEE photonics SOCIETY | OSA The Optical Society

NON-FINANCIAL TECHNICAL CO-SPONSOR:
Telcordia

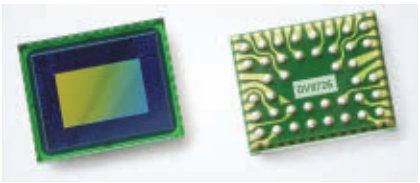
Medical Imaging

Rad-icon Imaging Corp., a division of Dalsa Corp., has released the Helios10 MD panel, the first product in the company's new Helios camera family. With an active sensing area of 20 × 25 cm, the CMOS x-ray panel is a medical-grade cassette package with an integrated handle. It was designed to meet the requirements of a variety of medical imaging applications such as full-field digital mammography, general radiography, bone densitometry and other mobile digital radiography uses. The panel builds on the tiled configuration of Rad-icon's Rad-Eye100 very large area CMOS image sensors to achieve its total active sensing area, while maintaining high image resolution with a pixel size of 96 µm. The active-pixel CMOS photodiode array at the core of the panel consists of more than 5 million pixels that convert light emitted by the integrated scintillator screen into an electrical signal. The detector's low-noise, 14-bit digital output produces crisp, sharp images, high sensitivity and a high dynamic range.
Rad-icon
sales@rad-icon.com

Power Meters

The Flash handheld power meters manufactured by Gentec Electro-Optics Inc. deliver a response time that the company says is at least two times shorter than that of most other models on the market. They allow the user to take more measurements in less time, and their low noise level enables accurate measurement of powers as low as 2 W. Features include fully customizable calibration, a rugged all-metal body, a high damage threshold and an effective aperture of 55 mm. Operating temperature ranges from 10 to 40 °C. The meters are suitable for use in job shops and laser servicing. They are available in two models and are designed to be stable when placed flat on a table.
Gentec
info@gentec-eo.com

HD Video Sensor



A high-definition (HD) video sensor has been unveiled by OmniVision Technologies Inc. The compact OV9726 delivers 720-pixel HD video at 30 fps and is suitable for use in notebooks, netbooks, webcams, mobile phones, portable media players and other mobile entertainment devices. Built on a proprietary 1.75-µm backside illumination pixel architecture, it achieves low-light sensitivity of 1480 mV/lx-sec in a 1/6.5 form factor. Because the image sensor receives light through the back of the chip, there is no metal wiring to block the image light, and the entire back of the sensor can be photosensitive. The front of the chip surface area is devoted entirely to processing, increasing the number of metal layers. Capturing light on the back of the sensor reduces the distance that the light has to travel to the pixels and provides a wider angle of light acceptance.
OmniVision Technologies
sfoster@ovt.com

Deconvolution Software

Scientific Volume Imaging BV has released version 3.5 of its Huygens 3-D deconvolution, visualization and analysis software. This version includes the newly developed object stabilizer tool that can measure and correct for cell motion in time series, or movements in Z-series that are caused by shaking or thermal drift. Stabilization methods based on cross correlation, multi-object tracking or center of mass alignment can be selected and involve X-Y-Z translation and axial rotation. New features include improved spherical aberration correction by taking into account the coverslip position and imaging direction, and an HDF5 file format reader and writer to store more microscopic parameters and data in a fully open, compact and easy to access format. The graphical interface has been modernized, scheduling of high-throughput deconvolution tasks is improved, and settings in visualization and analysis tools can be saved in templates.
Scientific Imaging
info@svi.nl

CO_2 Laser

Coherent Inc. has unveiled the pulsed Diamond E-1000, a compact sealed 1-kW CO_2 laser suited for use in small machines and for space-sensitive applications involving cutting, perforating and drilling of paper, plastic films, plastics, glass, carbon composites and thin metals. It requires no external gas supply, and the only connections to the laser are a power cord and a water hose, rendering it easy to mount on a moving robotic arm. Beam characteristics include spatial mode quality of M^2 <1.2 and a square wave pulse shape that delivers up to 2.5 kW of peak power. The laser is liquid-cooled and equipped with onboard Internet-accessible diagnostics and control. It operates from 10.2 to 10.8 µm and outputs 1000 W. Peak effective power is >2500 W, power stability is ±5%, full-angle beam divergence is <15 mrad, and pulse frequency is from single-shot to 200 kHz.
Coherent
tech.sales@coherent.com

Gigabit Ethernet Multispectral Cameras

FluxData Inc. has added Gigabit Ethernet connectivity to its FD-1665 three-CCD multispectral

imaging cameras, supplied in the same 121.9 × 88.9 × 111.8-mm form factor as the company's FireWire cameras. GigE supports cable lengths up to 100 m and data transfer rates up to 1000 Mb/s. The cameras are built around the FD-1665 optical prism engine, which reduces spherical and chromatic aberration and enables the use of standard 35-mm single-lens-reflex F- or T-mount lenses. The modular design encompasses 12 CCD sensor options with varying frame rates up to 120 fps and resolutions up to 1626 × 1236. Filtering options include polarization, multispectral, and high dynamic range. The Gigabit Ethernet option renders the cameras suitable for use in machine vision, surveillance and medical imaging, and offers the flexibility of increased remote deployment of the camera from the host computer.
FluxData
info@fluxdata.com

Spectrometers

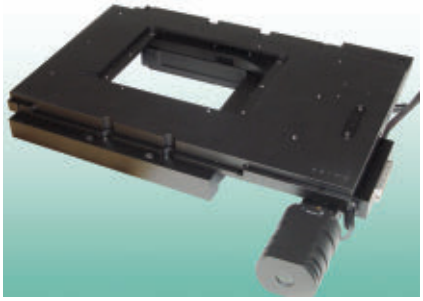
Ocean Optics Inc. has expanded the wavelengths of its XR series miniature monolithic fiber optic spectrometers to cover from ~200 to 1050 nm. The newly developed XR-1 grating overcomes the challenges of providing broad UV-NIR coverage in a single device. It offers density of 500 lines per millimeter and is available preconfigured in the USB2000+, JAZ-EL2000 and USB4000 and can be added as an option to custom-built systems. The spectrometers deliver optical resolution of ~2 nm FWHM. A proprietary order-sorting filter is applied directly to the detector to eliminate second- and third-order effects. The 25-µm slit on the preconfigured units provides good optical resolution. The devices are suitable for setups that require both UV-VIS and VIS-NIR measurements and for measurement of samples with response across the entire wavelength range, such as solar irradiance, atomic emission line measurement and some plasma applications.
Ocean Optics
info@oceanoptics.com

Sample Prep Kit

To simplify quality assurance and UVA protection factor analysis in the development and testing of sunscreen and cosmetics using Labsphere's UV-2000S transmittance analyzer, the company has introduced the UV2000S, a sample preparation starter kit. It includes all tools needed to prepare the appropriate in vitro sunscreen sample common to Boot Star, Colipa, FDA and user-defined sun protection factor (SPF) measurement methods. The kit includes a tube of Vaseline, a positive displacement pipette, pipette capillaries and pistons (25 µl), pipette capillaries (100 µl), nonpowdered finger cots and a sample preparation guide. The

benchtop R&D system rapidly measures the spectral transmission of sunscreen products, especially those with SPF factors of 50 and above, as well as UVA/UVB protection factor. It measures the diffuse transmittance of a product sample over the 250- to 450-nm ultraviolet range.
Labsphere
labsphere@labsphere.com

Flattop Motorized Microscope Stage



Prior Scientific Inc. has introduced the H117P2IX flattop stage for the Olympus IX series inverted microscopes. Suitable for all high-precision biomedical and materials sciences scanning operations, it was designed to assist researchers conducting prolonged live-cell studies. The stage maximizes access to the nosepiece for correction collar adjustment, and miniaturized drive boxes occupy a fraction of the space of previous models. With all of the drive components mounted below the top plate, it also provides easy access for micromanipulators, environmental chambers and robotic loaders. The device enables scanning using a broad range of sample holders, including microtiter plates, slide holders, petri dishes, well plates, flasks, hemocytometers and metallurgical sample holders. Stages can be driven by proprietary motor controllers or by compatible systems in existing OEM configurations.
Prior Scientific
ddoherty@prior.com

Ductless Fume Hood

Air Science USA has introduced the Purair 20, a ductless fume hood that protects operators using hazardous substances. A face velocity at 100 ft/min ensures containment of fumes, and an alarm alerts the operator when the airflow level becomes unacceptable. All mechanisms in the head are on the clean side of the filter, preventing contamination. Switches and electrical components are isolated from the dirty airflow, and the work area has a removable spillage

tray that can be cleaned. The main filter can be chosen from 14 types of carbon, including media for vapors of organics, solvents, acids, mercury and formaldehyde. Optional integral lighting is available. The hood measures 1244.6 × 698.5 × 1206.5 mm, with other sizes available up to 2438.4 mm wide.
Air Science USA
info@air-science.com

Pan and Tilt Mounts

The APT series pan and tilt mounts unveiled by Aerotech Inc. are designed for use in positioning applications in the security, defense and surveillance markets. The drive mechanism has a gear preloading feature that self-adjusts for the effects of wear and temperature variation. The Ensemble controller responds to motion commands via Ethernet, or it can be programmed for stand-alone operation. The slip ring carries camera connections to the base of the unit. Continuous 360° pan rotation with limited travel tilt is standard. An inertial stabilization option integrates gyroscopes and inertial sensors to maintain the line of sight when operated on aircraft, ships and land vehicles. Maximum pan and tilt speed is 180°/s, tilt range is ±95°, payload is 35 kg, and position resolution is 7.6 arcsec. Unidirectional position repeatability is 10 arcsec, and bidirectional, 30 arcsec.
Aerotech
sales@aerotech.com

Blackbody Source

The BBS-200 blackbody source from Optikos Corp. is a reference source of infrared radiation similar in geometry to the primary standard of the UK's National Physical Laboratory. Designed to emit maximum flux at any temperature, it makes measurements in the 2- to 14-μm thermal wavebands and can be used for calibrating thermal imagers and radiometers. It is heated and cooled by a recirculating water bath connected by insulated hoses with self-sealing quick-disconnect connectors. It has a double-helix water jacket in which water circulates in the cylindrical heat exchanger from front to back and vice versa, simultaneously, to minimize thermal gradients along the cavity. A motorized shutter closes off the cavity while the blackbody is changing temperature, shortening settling time and minimizing proximity heating of the instrument being calibrated.
Optikos
sales@optikos.com

Thermoelectric Controller

A high-power thermoelectric cooler controller has been launched by Elite Thermal Engineering. The MC-1000 is configurable to drive all of the company's thermoelectric cold plates with up to 600 W of power output, and auxiliary power for fans or pumps up to 40 W. To operate the controller, the user wires the thermo-

electric cooler, fan and temperature sensor to the terminal block on the back of the unit, plugs in the provided power cord and flips the switch. A knob in the front panel adjusts the temperature, and an LCD displays the set and actual temperatures. The device can be factory-configured for various power output mixes, with power output starting at tens of watts, voltage from 12 to 48 VDC and current up to 12 A. It also can be used as a heater controller and is designed to work with a digital temperature sensor, which is shipped as an accessory. It is immune to electromagnetic compatibility noise and can be placed up to 20 m away from the controller.

Elite Thermal Engineering
contact@elitethermalimaging.com

Linear Stage

The PA 30x40-SM01 from Steinmeyer Inc. is a single-axis precision linear stage used in miniature robotics, pick-and-place devices, specimen handling for life sciences and scientific applications where precision positioning with a narrow footprint is required. Fully enclosed, it measures 30 × 40 mm and offers travel ranges from 25 to 150 mm. Positioning repeatability is 1 µm, maximum speed is 50 mm/s, and load capacity is 100 N. The system comprises a proprietary preloaded 8-mm-diameter ball screw, a size 9 linear guideway, noncontact limit switches, and a choice of a stepper motor or a DC servomotor with encoder. A separate motion controller is available as an option.

Steinmeyer
jskaltsas@steinmeyer.com

Glass Filter

Laservision USA has introduced a glass and nanospec laser safety filter that covers OD 7+ from 190 to 535 nm and OD 6+ from 1030 to 1064 nm. The 00530 is a thin-film filter with a dielectric thin-film coating that provides maximum viewing with good protection. It is available in a wide variety of frames.

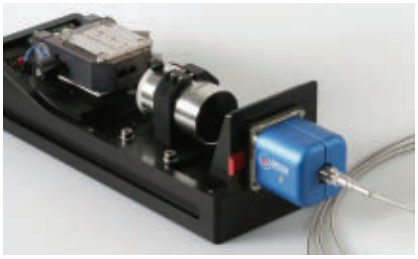
Laservision
info@lasersafety.com

CO_2 Lasers

Synrad Inc. has launched the 48-1, a 10-W laser for marking permanent, traceable and sterile lot and date codes, order numbers and other manufacturing or personal data on medical devices. It also can be used on plastic tubing, implantable devices, glass vials and paper packaging. Designed for easy OEM integration into machinery, it can identify products without the use of hazardous inks or chemicals. It delivers a TEM_{00} beam with 95% purity and M^2 <1.2. Ellipticity is <1.2, rise time is <150 µs, beam diameter is 3.5 mm, and full-angle beam divergence is 4 mrad. The OEM version is air-cooled, and the key switch version is cooled by water. Maximum heat load is 300 W, input voltage is 30 VDC, and input current is 7 A.

Synrad
synrad@synrad.com

Tunable Diode Lasers

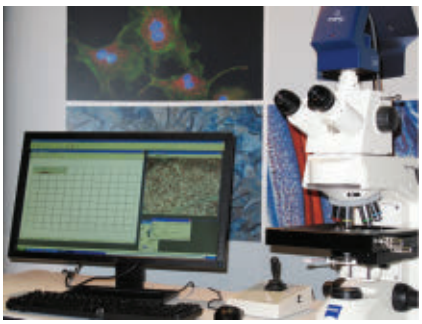


Toptica Photonics Inc. has announced that its DL pro ultrastable tunable diode lasers are now available at all diode wavelengths between 372 and 1670 nm. The design of the new version, called the DL 100/pro, enables external cavity diode lasers that are stable against acoustical, mechanical and thermal disturbances. It allows easy coarse tuning across the complete gain spectrum of the integrated laser diode, making it suitable for Bose-Einstein condensation and quantum coupling experiments. Output power range is up to 300 mW.
Toptica Photonics
info@toptica.com

Micropositioning X-Y Stages

Micropositioning X-Y stages from IntelLiDrives Inc. have integrated micropositioning multiaxis X-Y-Z systems built with LSMA-173 series motorized actuators to provide up to 200-mm travel. Driven by a brushless or stepper motor with a ground ball screw, they provide resolution of up to 0.1 µm. The actuator's low-profile, high-stability, compact and monolithic design enables integration into high-precision measurement and manufacturing systems. MLA (micro linear actuator)-173 translation stages have two limit sensors for end of travel and referencing. Graduated knobs enable manual operation and position observation. Load capacity is 8 kg, and straightness is 5 µm. Applications include fiber optic alignment, laser diode research, biomedicine and inspection systems.
IntelLiDrives
admin@intellidrives.com

Microscope Upgrade

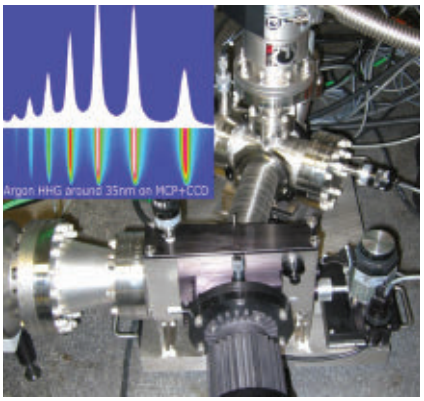


The Turbo Slide Scanner from Jenoptik Optical Systems Inc. is a turnkey upgrade for existing microscopes, converting them into turbo digital scanning instruments for digitizing, archiving, slide telepathology, frozen sections, immunohistochemistry and tumor boards. Microscopes from Zeiss, Nikon, Olympus and Leica are supported. Because it works with existing microscopes and computers, it generates images cost-effectively.
Jenoptik Optical Systems
ludwig.eckl@jenoptik.com

DPSS Laser

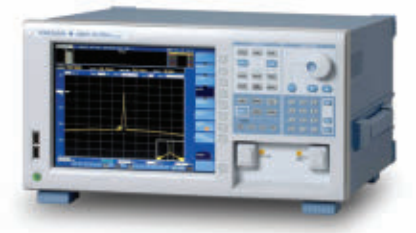
Klastech-Karpushko Laser Technologies GmbH has launched a 442-nm, <200-mm-long diode-pumped solid-state (DPSS) laser as an alternative to HeCd gas types. Beam pointing stability is <10 µrad/°C, and lifetime is >10,000 h. The Concerto achieves <0.5% rms noise, offers a diffraction-limited TEM_{00} output beam with M^2 >1.05, produces 20 mW of continuous-wave power and provides long-term power stability of <2%. Spectral linewidth is <1 MHz and coherence length, >100 m. Polarization is vertical, with a polarization ratio of ≥100:1. Measuring 188 × 80 × 66.3 mm, it operates over a temperature range from 15 to 35 °C. The air-cooled laser delivers ultrahigh second-harmonic conversion efficiency and intrinsic single-longitudinal-mode performance from a scalable design. Applications include disc mastering, data storage, Raman spectroscopy, reprographics, thin-film analysis and holography.
Klastech-Karpushko Laser Technologies
r.brueggemann@klastech.de

Optical Spectrometer



McPherson Inc.'s 248/130 grazing incidence wavelength dispersive optical spectrometer enables rapid analysis of spectral light in the ~1- to 300-nm wavelength region (4 to ~1200 eV). It is useful for spectroscopy in the vacuum-UV and also the extreme- and soft-x-ray wavelength regions. Using direct-detection CCDs, gated image intensifiers or fast channel electron multipliers for detection, it provides a wide working range and flexibility in spectral acquisition. It is completely assembled, vacuum leak-checked and calibrated with respect to wavelength. It can include adapters, differential pumping and grazing incidence collection optics to facilitate connection to the experiment. It ships with a wavelength calibration certification that facilitates rapid identification of closely spaced high harmonics. Configured in reverse, the instrument operates as a tunable light source. Vacuum-UV spectroscopy accessories including various detector systems and wavelength calibration sources are available from <1 nm to the visible.
McPherson
mcp@mcphersoninc.com

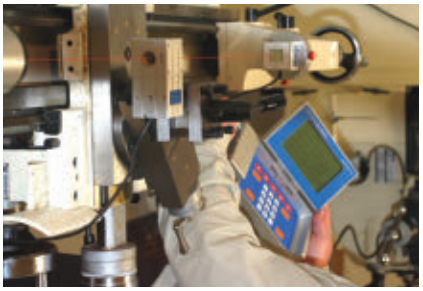
Optical Spectrum Analyzer



The Yokogawa Test & Measurement Div. has announced the AQ6373, an optical spectrum analyzer that measures from 350 to 1200 nm. It features a color analysis function that renders it suitable for measuring LEDs and laser light sources. Wavelength accuracy is ±0.5 nm, wavelength resolution is down to 0.01 nm, and sensitivity is −80 dBm. Standard sweep time is 1 s, and 0.5 s in automatic mode. The free-

space optical input makes the instrument suitable for use with single-mode, multimode and large-diameter-core fibers. A built-in light source aids optical alignment. The 10.4-in. bright display has an intuitive graphical user interface, and operation can be controlled via USB mouse, keyboard and panel keys. Internal memory of 128 MB is backed up by USB memory support. Functions include filtering, automatic measurements and pass/fail testing. Fast remote operation is available via GPIB, RS-232 and Ethernet. Applications include R&D evaluation and production testing of short-wavelength laser filters and LEDs.
Yokogawa
terry.marrinan@nl.yokogawa.com

Transparent Receiver



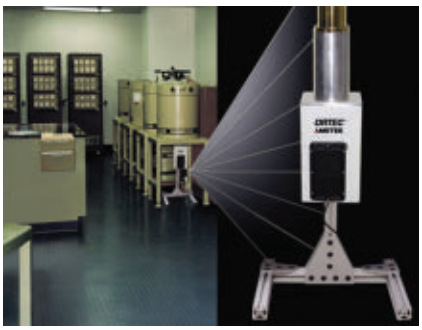
Pinpoint Laser Systems has expanded its Microgage 2D family with the introduction of a transparent receiver that allows a laser beam to pass through it while making precise position measurements for aligning machinery and equipment. The compact device is suitable for bore alignment and checking extruder barrels and shaft bearings. A narrow laser beam provides a measuring reference line, and the receiver determines the position of a machine or subassembly relative to the beam. It operates over distances of ≥100 ft and delivers measurement precision of 0.0005 in. The system and receiver can be used for lathe and spindle alignment, checking machine tool run-out, and roll and web alignment. The two-axis system operates on batteries, and all components are machined of solid aluminum with a hard anodized coating for wear resistance. It includes a sealed push-button keypad and a large LCD display.
Pinpoint Laser Systems
knelson@pinlaser.com

Thermal Imaging Cameras

The PTI-170L series portable thermal imaging cameras released by Process Sensors Corp. have a 384 × 288-pixel UFPA detector and operate at 60 Hz. Dual vision capabilities blend high-resolution thermal and visible light images on one screen to facilitate analysis and problem detection. A choice of six color palettes enables users to detect temperature anomalies. Features include manually focusable optics that are adjustable from 300 mm to infinity and an onboard full-color CCD camera. Video output is in PAL and NTSC formats, a distance-adjustable

position laser pointer is standard, and a high-resolution 2.5-in. LCD color VGA digital backlit display is included. Report-generating software produces detailed summaries in an instant. The fully radiometric cameras have a 24° × 18° field of view, a spectral range of 8 to ~14 µm and spatial resolution of 1.3 mrad.
Process Sensors
irtemp@processsensors.com

Laboratory Detector Module



The LDM100-GEM from the Ortec Products Group of Ametek Advanced Measurement Technology is an integrated gamma-ray spectrometer for fixed and mobile counting room applications. The compact self-contained laboratory detector module (LDM) generates <20 W of waste heat. It includes a high-purity germanium detector element encapsulated within a cryostat and cooled by a miniature cryocooler, so there is no need to thermal cycle during partial warm-up. It is powered from a 10- to 17-VDC supply and has a built-in battery backup that provides an additional 3 h of operation during a power failure. It includes a built-in high-stability digital signal processor. An AC or DC power source and a PC on which to install the accompanying Maestro MCA software make a complete gamma spectrometry system.
Ortec Products Group/Ametek
ortec.info@ametek.com

Shutter Systems

Vincent Associates has announced three additions to its Uniblitz N-CAS DSS (design scalable shutter) series: the 10-mm-aperture DSS10, the 20-mm-aperture DSS20 and the 25-mm-aperture DSS25. The patent-pending devices have flat mounting surfaces on both sides and have no external actuator or other interfering components, allowing flush mounting. Drive and damping components related to the mechanical motion of the shutter are contained or integrated within. The only moving parts are the drive ring and the blades, limiting points of wear. A circular envelope with a concentric aperture enables fast integration into customer-specific applications, and bi-stable operation reduces power draw.
Vincent Associates
photonics@uniblitz.com

Video Processors

Calibre UK Ltd. has unveiled a range of HQView video processors, including models that perform sophisticated warp mapping and seamless soft-edge blending of multiple projected images. The scaler-switchers combine Integrated Device Technology's Reon video processing with Calibre's state-of-the-art HQV algorithms, hardware and firmware to deliver good image quality for corporate audio/visual, pro-

fessional and broadcast applications. Available are eight compact or IU rack-mountable models offering a variety of input types and configurations, ranging from component and composite/YC to 3G-SDI, with output resolution of up to 1080-pixel WUXGA. Users can select between low-latency and highest image quality modes, with picture-in-picture, picture-and-picture or picture-on-picture output.
Calibre
markl@calibreuk.com

Spatial Light Modulators

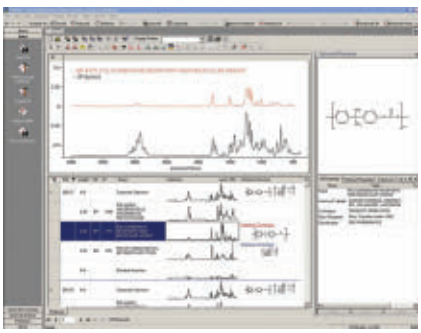
The Pluto phase-only spatial light modulators from Holoeye Photonics AG are based on liquid-crystal-on-silicon microdisplays with high-definition TV 1920 × 1080-pixel resolution, and they provide a phase shift of 2 π up to 1550 nm. For easy integration into optical setups, they are packaged in a compact 121 × 73 ×

22-mm housing. Four models are available, covering the 405- to 700-nm, 700- to 900-nm, 900- to 1100-nm and the 1550-nm wavelengths. The programmable devices are supplied with driver software to control settings and image parameters. The software provides easy gamma control to configure the modulator for various applications. Tailored application software enables generation of dynamic optical functions such as gratings, lenses, axicons and apertures, as well as calculation of diffractive optical elements based on user-defined images.
Holoeye Photonics
contact@holoeye.com

Fiber Collimator

Micro Laser Systems Inc. has introduced the FC40 fiber collimator, which has a large 46-mm aperture and generates a beam measuring ~20 mm. It has adjustable focus with no rotation to enable fine tuning of the wavelength. Once the proper focus or collimation is found, it can be locked down. All optics have a broadband antireflection coating that has no epoxy in the optical path. Wavefront error is $<\lambda/10$ over $1/e^2$ points. Output is diffraction-limited to yield a Gaussian beam at large distances. The collimator is packaged in a stainless steel housing and is available with FC or FC/APC receptacles. An optional mount is available for attaching it to a tripod or optical hardware. Applications include lidar, free-space communications, interferometry and large structure alignment.
Micro Laser Systems
sales@microlaser.com

Software/Database Package



Bio-Rad Laboratories Inc. has released version 8.1 of its KnowItAll Informatics system, a fully integrated software and database package that includes database building and management, search, analysis, structure drawing and reporting in a single user interface. The spectral mixture analysis tool has been improved to allow researchers to import the digital spectrum to be analyzed, and the software searches and compares the sample to reference databases of known compounds. Results include mixture component ratios to help researchers understand the relative proportions of the components.
Bio-Rad Laboratories
informatics.usa@bio-rad.com

Optical Spectrum Analyzer

To facilitate network commissioning, upgrading and troubleshooting for carriers and network equipment manufacturers, Exfo Electro-Optical Engineering Inc. has launched the FTB-5240BP, a field optical spectrum analyzer. Field crews can analyze the spectral content of any modula-

tion format, measure the optical signal-to-noise ratio between ultradense signals, track nonlinear effects and monitor component imperfections. The system can perform in-depth characterization and troubleshooting on ultradense wavelength-division multiplexing networks with limited spacing of 25 and 12.5 GHz. It makes optical signal-to-noise ratio measurements in systems where noise fluctuates from channel to channel, such as reconfigurable optical add/drop multiplexers and 40-G testing in next-generation networks.
Exfo Electro-Optical Engineering
isales@exfo.com

Crystal Imaging and Detection

Rigaku Automation's Minstrel HT UV high-throughput ultraviolet and visible crystal imaging and protein crystal monitoring system is for use in protein crystallization experiments. The robotic device can find crystals in complex drops and can distinguish protein ones from nonprotein ones. Proprietary Clean Light Technology provides UV illumination for positive crystal identification without photodamage and allows UV light to be focused onto the well of interest and then strobed to minimize UV exposure time so that the crystal imaging has no effect on diffraction quality. The technology brings no additional heat to the well.
Rigaku Automation
info@rigaku.com

Terahertz System

TeraView Ltd. has unveiled the CW Spectra 499, a continuous-wave terahertz system with fiber-fed external devices. The compact and fully tunable spectrometer and detector operate in the 50- to 1500-GHz range, with high spectral resolution. The system is suitable for use in solid-state physics research, terahertz propagation in metamaterials, high-frequency dielectric measurements, gas and solid phase spectroscopy, medical tissue characterization and nondestructive testing. The turnkey system employs proprietary GaAs-based photomixers and optical fibers for flexibility. Imaging and spectral analysis software is supplied, and a gantry can be added for imaging of large objects.
TeraView
phil.taday@teraview.com

Airborne Amplifiers

Endevco Corp. has launched a series of compact, lightweight and rugged airborne amplifiers for use in flight test applications. Designed for use with piezoelectric microphones and accelerometers, they operate from an onboard aircraft DC power source. The 2680M-XXX is a charge amplifier that offers one biased and one unbiased output, both adjustable with a common gain control. An optional low-pass filter is available. Model 2685V is a voltage amplifier

for use with Isotron accelerometers. It provides a constant current power source to a transducer's integral electronics while maintaining a two-wire connection. Both models have a hybrid microcircuit construction and are supplied in a compact and rugged package, with low power consumption. Output voltage is proportional to input acceleration or sound, and amplifier sensitivity is not affected by input cable capacitance.
Endevco
bruce.lent@meggitt.com

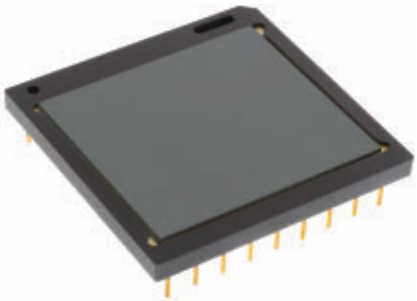
Wafer Inspection System

Iris, a macro wafer defect inspection system launched by SemiProbe, is for use by microelectronic device manufacturers. It detects contamination, processes damage and flaws in the circuit pattern, and is suitable for use with microelectromechanical systems, optical components, double-sided devices and photovoltaics. It detects visual defects as small as 3 μm, including probe marks, ink dots, residual films, through silicon vias, bumps, incomplete etches, scratches, cracks and chips, passivation and large-scale contamination. When a defect is identified, its failure code is noted on the wafer map, and the mapping tool enables graphical and data analysis of the inspection during and after the scan. The system is available with manual visual inspection on a semiautomatic stage or with automated inspection using the proprietary Pilot pattern recognition system.
SemiProbe
don@semiprobe.com

Die-Bonding Materials

Shin-Etsu Silicones of America has introduced the KER series, a line of silicone die-bond materials that provide advanced encapsulating performance for high-brightness LEDs. The products were developed as a die encapsulation, die-attach adhesive and lens-type material to provide long-term reliability for applications in general-purpose lighting as well as in high-brightness LEDs. The methyl silicone-based systems harden by using a heat-cured platinum catalyst. The KER-300-M2, KER-3100-U2 and KER-3200-T1 offer a broad spectrum of silicone polymer chemistry and structural composition. Applications include display equipment such as traffic light signals, backlight sources such as LED TVs, and automobile headlights. The products are available in clear, opaque and white thin-bond line versions to minimize light absorption and to maximize heat dissipation.
Shin-Etsu Silicones
ebishop@shinetsusilicones.com

Infrared Detector



Ulis has launched a long-wave 640 × 480-pixel uncooled 17-μm-format infrared detector to upgrade the image quality of the infrared cameras used in surveillance, enhanced night driving and thermography applications, such as detect-

ing heat loss in buildings. Measuring 24 × 24 mm and weighing 10 g, it consumes <0.160 W of power. Operating temperature range is from −40 to 85 °C, typical array operability is >99.9%, typical signal response is >7 mV/K, and standard deviation is ≤1.5%. Spectral response is from 8 to 14 μm, area fill factor is 70%, and thermal time constant is <10 ms. The focal plane array is made of resistive amorphous silicon and features a CMOS multiplexer integrated circuit with ripple imaging operation.

Ulis
c.chapuis@ulis-ir.com

High-Output Emitter

Cal Sensors announces the launch of PIRE-Plus, a high-output, high-pulse-rate emitter that can be pulsed as a source of blackbody radiation for near- to far-infrared applications at 180 Hz with 50% modulation depth. With a pulsing speed that the company says is 18 times faster than alternative technologies offer, it enables users to obtain accurate readings of materials and trace gases with concentrations at very low parts per million. The solid-state emitter maximizes signal-to-noise performance, expanding the measurement dynamic range and resolution. It produces output of 4×10^{-2} W/cm^2 at 1 in. from the filament and includes integrated drive electronics in an industry-standard 14-pin DIP integrated circuit package. The device is suitable for use in a variety of applications, including industrial and medical gas analysis, environmental monitoring, process control instrumentation, spectroscopy and plastics sorting.

Cal Sensors
info@calsensors.com

Lightguide Film Technology

Avago Technologies has announced an ultrathin high-brightness lightguide film technology for backlighting cell phones, handheld games and global positioning systems. It enables designers to reduce the number of LEDs needed to illuminate backlit keypads. The graphic fusion multimode exchangeable (G2MEX) technology relieves the complexity and congested icons on keypads and keyboards. Key characters can be overlapped and selectively illuminated, and the illumination areas are transparent to each other. With this technology, only two side-firing LEDs are needed to backlight display icons uniformly.

Avago Technologies
support@avagotech.com

Infrared Camera

Telops Inc. has developed a line of advanced infrared cameras designed for use by research scientists and infrared experts. The Hyper-Cam FAST-IR is a 1000-fps full-frame camera that enables thermal imaging of dynamic events with high temporal resolution and is suitable for use in military, R&D, scientific and industrial applications. Real-time calibrated images are visible, even in raw data output mode. Features include a fast filter wheel and complete control with the software development kit. It has an InSb detector and operates over the 3- to 5-μm spectral range with 320 × 256-pixel resolution. Noise equivalent delta temperature is 14 mK, detector pitch is 30 μm, integration time is from 3 μs to 1.8 ms, and dynamic range is 16 bits. Operating temperature range is from −15 to 1500 °C.

Telops
contact@telops.com

Fiber Laser

Diode Laser Concepts Inc. has added fiber-pigtailed diode laser systems to its product offerings with the introduction of Teleos. Delivering good optical stability and performance, the thermoelectrically cooled OEM system provides an alternative laser solution for flow cytometry, cell scanning, confocal microscopy and other bioinstrumentation, medical and scientific applications. At 643 and 405 nm, it features up to 60 mW of output power from the exit aperture of the single-mode polarization-maintaining fiber, with an output power stability of <1% over 12 h. It also offers a TEM_{00} spatial mode beam with an M^2 value of <1.1 with integrated laser drive electronics, using advanced electronic, thermal and mechanical stability design

features. Customizable specs include the fiber type, fiber length, fiber termination, wavelength, output power and mechanical mounting.

Diode Laser Concepts
sales@diodelaserconcepts.com

b ANOTHER BRIGHT IDEA

Advertise your new product in *Photonics Showcase* or in the Spotlight section of *Photonics Spectra*.

Reach all of our readers in these low-cost, lead-generating features.

Call Craig Suriner at (413) 499-0514, or e-mail Craig.Suriner@Photonics.com.

HAPPENINGS

PAPERS

Laser Optics 2010 (June 28 – July 2) St. Petersburg, Russia
Deadline: abstracts and summaries, March 1
Organizers of Laser Optics 2010 invite abstracts of 35 to 40 words and summaries of one page for oral and poster presentations. Topics to be considered include solid-state lasers and nonlinear frequency conversion; high-power gas lasers; laser beam control; superintense light fields and ultrafast processes; and semiconductor materials, lasers and devices. Contact Program and Organizing Committee, Institute for Laser Physics of Vavilov SOI Corp., +7 812 328 5734; conf2010@laseroptics.ru; www.laseroptics.ru.

Remote Sensing and Security + Defence (September 20-23) Toulouse, France
Deadline: abstracts, March 22
Researchers are encouraged to submit their latest work for the SPIE Remote Sensing conference in areas such as lidar, next-generation satellites and synthetic aperture radar image analysis. Topics to be addressed in SPIE Security+Defence include infrared systems, biological and chemical sensing, unmanned/unattended sensors, optical materials, and imaging and display technologies. Contact SPIE, +1 (360) 676-3290; customerservice@spie.org; spie.org/x6262.xml.

EWOFS 2010 (September 8-10) Porto, Portugal
Deadline: submissions, March 31, noon EDT (16:00 GDT)
Original papers are sought for the fourth European Workshop on Optical Fibre Sensors. The scope of the workshop is wide enough to include new concepts, developments and applications in the field of optical fiber technology. Among the relevant topics are distributed sensing, and passive and active devices for photonic sensing. Contact INESC Porto, University of Porto, +351 220 402 301; ewofs@inescporto.pt; www.ewofs.org.

MARCH

MEDTEC Europe (March 23-25) Stuttgart, Germany. Contact Canon Communications, +1 (310) 445-4200; info@cancom.com; Mr. Alison Trebble, +44 1458 835 955.

Intertech Image Sensors Europe 2010 (March 23-25) London. Contact Stacey Ludlow at IntertechPira, +44 1372 802 052; stacey.ludlow@pira-international.com.

23rd International Conference on 3-D Image Processing in Microscopy/22nd International Conference on Confocal Microscopy (March 28-31) Shanghai, China. Contact Qiushi Ren, +86 21 3420 4080; fax: +86 21 3420 4078; www.focusonmicroscopy.org.

Principles of Lasers and Laser Safety Course (March 30-31) Cincinnati. Contact Rockwell Laser Industries, +1 (513) 271-1568; fax: +1 (513) 271-1598; info@rli.com.

Machine Vision China 2010 (March 31-April 2) Shanghai, China. Contact Guo Qinrui, +86 21 6875 8536; guo.qinrui@sh.china.ahk.de; US: Dana Whalls, +1 (734) 994-6088; dwhalls@robotics.org.

APRIL

SPIE Defense, Security + Sensing 2010 (April 5-9) Orlando, Fla. Contact SPIE, +1 (360) 676-3290; www.spie.org.

CISILE 2010: International Exhibition for Analytical and Testing Instrumentation, Optical/Electronic Optical Instrumentation, Laboratory Furniture and Equipment, and Biotechnology and Instrumentation (April 8-10) Beijing. Contact Ivy Lee, +86 10 883 951 25; ivylee@cisile.com.cn; www.cisile.com.cn.

OSA Optics & Photonics Congress: Biomedical Optics and 3-D Imaging (April 12-14) Miami. Contact the Optical Society of America, +1 (202) 223-8130; www.osa.org.

Illumination and Stray Light Analysis Using Zemax (April 12-16) Celebration, Fla. Contact Zemax Development Corp., +1 (425) 822-3406; sales@zemax.com; www.zemax.com.

SPIE Photonics Europe 2010 (April 12-16) Brussels, Belgium. Contact Amy Nelson, +44 29 2089 4747; amy@spieeurope.org; spieeurope.org.

Lighting Japan 2010: LED/OLED Lighting Technology Expo (April 14-16) Tokyo. Contact Reed Exhibitions Japan Ltd., +81 3 3349 8568; www.lightingjapan.jp.

2010 IEEE International Symposium on Biomedical Imaging (April 14-17) Rotterdam, the Netherlands. Contact Laura J. Wolf, +1 (732) 981-3433; emb-exec@ieee.org; www.embs.org.

Laser 2010: American Society for Laser Medicine and Surgery's 30th Annual Conference (April 14-18) Phoenix. Contact Nadine Tosk, +1 (847) 920-9858; www.aslms.org.

Smart Fabrics 2010 (April 15-17) Miami. Contact IntertechPira, +1 (207) 781-9618; www.smartfabricsconference.com.

8th European Machine Vision Business Conference (April 16-17) Istanbul, Turkey. Contact EMVA, +49 69 6603 1466; fax: +49 69 6603 2466; www.emva.org.

Society of Vacuum Coaters 2010: 53rd Annual Technical Conference (April 17-22) Orlando, Fla. Contact SVC, +1 (505) 856-7188; svcinfo@svc.org.

IEEE Wireless Communications & Networking Conference (April 18-21) Sydney, Australia. Contact Heather Ann Sweeney, +1 (212) 705-8938; h.sweeney@comsoc.org; www.ieee-wcnc.org/2010.

Photonics 2010: World of Lasers and Optics (April 19-22) Moscow. Contact Expocentre, +7 499 795 3799; www.photonics-expo.ru.

Interactive Displays 2010 (April 20-22) San Jose, Calif. Contact IntertechPira, +1 (207) 781-9800; www.intertechpira.com.

Organic Photovoltaics 2010 (April 28-30) Philadelphia. Contact IntertechPira, +1 (207) 781-9800; www.intertechpira.com.

MAY

Laser Safety Officer Course (May 3) Cincinnati. Contact Rockwell Laser Industries, +1 (513) 271-1568; fax: +1 (513) 271-1598; info@rli.com.

iMAPS New England: 37th Annual Symposium & Expo (May 4) Boxborough, Mass. Contact Harvey Smith, +1 (508) 699-4767; harveys@imapsne.org.

Principles of Lasers and Laser Safety Course (May 11-12) Cincinnati. Contact Rockwell Laser Industries, +1 (513) 271-1568; fax: +1 (513) 271-1598; info@rli.com.

CLEO/QELS 2010: Laser Science to Photonic Applications (May 16-21) San Jose, Calif. Includes PhotonXpo. Contact Optical Society of America, +1 (202) 416-1907; custserv@osa.org; www.cleoconference.org.

Sensor + Test 2010: The Measurement Fair (May 18-20) Nuremberg, Germany. Contact AMA Service GmbH, +49 5033 9639 0; fax: +49 5033 1056; www.sensor-test.de.

2010 IEEE International Communications Conference (May 23-27) Cape Town, South Africa. Contact Heather Ann Sweeney, +1 (212) 705-8938; h.sweeney@comsoc.org.

SID: 2010 International Symposium, Seminar and Exhibition for the Electronic Display Industry (May 23-28) Seattle. Contact Mark Goldfarb, +1 (212) 460-8090 Ext. 202; mark@sid.org; www.sid.org.

10th International Conference of the European Society for Precision Engineering & Nanotechnology (EUSPEN) (May 31-June 4) Delft, the Netherlands. Contact Debbie Nyman, +44 1234 754 154; debbie-nyman@euspen.eu.

JUNE

EIPBN: 54th International Conference on Electron, Ion and Photon Beam Technology and Nanofabrication (June 1-4) Anchorage, Alaska. Contact Marty Feldman, +1 (225) 578-5489; feldman@ece.lsu.edu; www.eipbn.org.

h HAPPENINGS

Optical Interference Coatings (June 6-11) Tucson, Ariz. Contact OSA, +1 (202) 223-8130; info@osa.org; www.osa.org.

Sensors Expo & Conference (June 7-9) Rosemont, Ill. Contact Questex Media Group Inc., +1 (617) 219-8300; www.sensorsexpo.com.

Imaging and Applied Optics (June 7-10) Tucson, Ariz. Contact OSA, +1 (202) 223-8130; info@osa.org; www.osa.org.

LASYS 2010 (June 8-10) Stuttgart, Germany. Includes a short course titled "Basics on Lasers and Laser Material Processing." Contact Messe Stuttgart International, +49 711 258 9550; fax: +49 711 258 9440; www.messe-stuttgart.de.

EuroLED 2010 (June 9-10) West Midlands, UK. Contact Eve Gaut, +44 121 250 3515; eveg@astonsciencepark.co.uk; www.euroled.org.uk.

OSA Optics & Photonics Congress (June 21-24) Karlsruhe, Germany. Contact OSA, +1 (202) 223-8130; info@osa.org; www.osa.org.

Nanotech Conference & Expo 2010 (June 21-25) Anaheim, Calif. Contact Sarah Wenning, +1 (925) 901-4959; fax: +1 (925) 886-8461; www.techconnectworld.com.

4D Technology Corporation....66

a
Aerotech Inc. 60
Anchor Optics 69
Applied Scientific Instrumentation....58
Argyle International 70
Arroyo Instruments LLC....71

b
Bristol Instruments Inc. 52, 61
Brockton Electro-Optics Corp. 60

c
Cargille Laboratories....48
Coherent Inc. 11
Cooke Corporation Ltd. 15
CVI Melles Griot....19, 21

d
Directed Energy Inc. 65

e
Edmund Optics....44, 45

g
Gooch & Housego....69

h
Hellma USA....8
Hospitalité Québec....50

i
IDEMA Show Group 56
Image Science Ltd. 20

k
Klastech Karpushko Laser Technologies GmbH 10

l
Lake Shore Cryotronics Inc. 75
Landesmesse Stuttgart....70
Lightmachinery Inc. 48, 73

m
Mad City Labs 66
Master Bond Inc. 67
Meller Optics Inc. 67
Micro Laser Systems....80
Mightex Systems 77

n
Newport Corp 26, 59
nm Laser Products Inc. 73
Nusil Technology 27

o
Ocean Thin Films 12
Opco Laboratory Inc. 22
Optical Society of America....36, 63
Optics Balzers AG 73
Optimax Systems Inc. 41
Oxxius 74

p
Photon Engineering LLC....28
Photon Inc. 61
Photonic Products....38
Photonis USA Inc. 49
PI (Physik Instrumente) L.P. 61, 64
Picoquant GmbH 31
Power Technology Inc. 23
Princeton Instruments....13

r
Reed Exhibitions Japan Ltd. 68
Research Electro-Optics....CV3
Rolyn Optics Co. 30
RPC Photonics Inc. 25
Rsoft Design Group....6

s
Semrock Inc. 61
Sensors Unlimited Inc. Part of Goodrich Corporation....9
Sheaumann Laser Inc. 60
Shenzhen BMC Herong Exhibition 76
Siskiyou Corporation....24
Society of Vacuum Coaters....72
Spectrogon US Inc. 74
Spectrum Scientific Inc. 77
SphereOptics LLC....17
Stanford Research Systems Inc. 3, 39
Sutter Instrument 78
Sydor Optics Inc. 71

t
The Chinese Mechanical Engineering Society 80
Thermo Fisher Scientific....7
Tohkai Sangyo Co. Ltd. 70
Toptica Photonics Inc. 60, 61
Trioptics GmbH....53

v
Varian Australia PLY Ltd. CV2
Vortran Laser Technology Inc. 58, 78

w
Westech Optical Corp. 14
Williams Advanced Materials....CV4

Depending on the kindness of strangers

With the help of hundreds of people you've never met, you might be able to get a grand view of a tourist destination you've never visited.

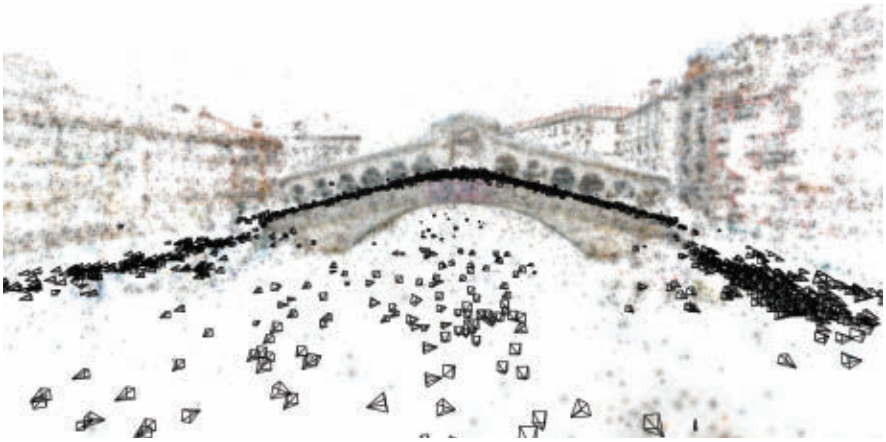
Imaging science has led to ways to create detailed recordings of famous landmarks, including the Colosseum in Rome and the Eiffel Tower in Paris. Such recordings provide exquisite three-dimensional views but require painstaking measurement via laser or acoustic systems, and expensive high-end cameras. Now, however, a team of researchers at the University of Washington (UW) in Seattle has devised a 3-D image reconstruction method that pulls photographs from an Internet-based repository and stitches them together with unheralded speed.

Acting under Sameer Agarwal, assistant professor of computer science and engineering, the group processed hundreds of thousands of snapshots taken by tourists in and around Rome and Venice, Italy, as well as in Dubrovnik, Croatia. The photos were found by searching for the cities' names on flickr.com, a public photo-hosting site owned by Yahoo Inc.

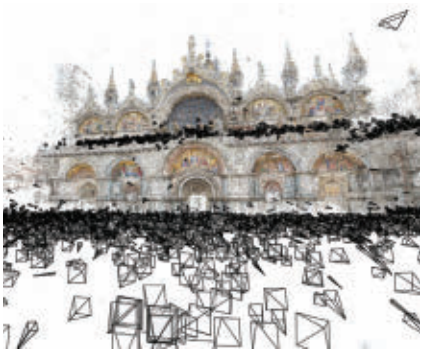
For example, to create representations of Venice – some of which are shown here – the UW scientists downloaded 250,000 images taken by a disparate group of tourists. Despite differences in cameras and lenses used, viewing angles, backgrounds, lighting and other factors, the software developed by the team pieced together richly detailed models of the entire city, not just of individual buildings and features.

Agarwal and his colleagues processed the multitude of snapshots with a series of 62 computer nodes, each comprising dual quad-core chips. The algorithms they designed searched first for the most likely pairs of matching points between individual images. After these likely pairs were identified, the software then refined the matching – including dimensional information – and stitched the images together. With the computing power on hand, they completed the matching and reconstruction process in only about 65 hours.

lynn.savage@photonics.com



Composites courtesy of the University of Washington.



euro PHOTONICS

February/March 2010

Putting Imaging in the Picture

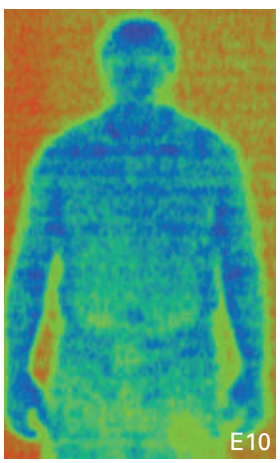
Finding Toxins in Vegetables

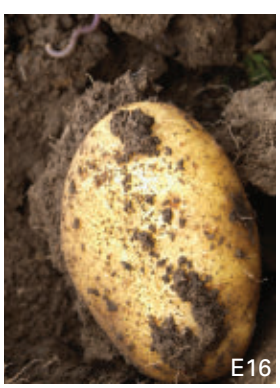
PATENTS AND SYNTHETIC BIOLOGY RESEARCH

www.Photonics.com

PHOTONICS MEDIA | Worldwide Coverage: Optics, Lasers, Imaging, Fiber Optics, Electro-Optics, Photonics Component Manufacturing

euro PHOTONICS
Volume 15 | Issue 2





NEWS

E 4 | EURO NEWS
White light supercontinuum: power struggle
The 3-D way to slice it
It's a terascale world after all
Germany: managing the downswing
Let it shine the easy way: laser polishing

FEATURES

E 10 | PUTTING IMAGING IN THE PICTURE
by Marie Freebody, Contributing Editor
Images today are produced in myriad ways – using infrared, fluorescence, bioluminescence, x-ray machines, optical coherence tomography, lidar – for use in a variety of industries.

E 14 | PATENT ISSUES IN SYNTHETIC BIOLOGY RESEARCH
by Jörg Schwartz, Contributing Editor
The roles patents play in this emerging biophotonics application.

E 16 | ECOPHOTONICS
by Krista D. Zanolli, Contributing Editor
Spectroscopy detects toxins in veggies.

DEPARTMENTS

E 18 | PRODUCT PREVIEW

E 23 | ADVERTISER INDEX

THE COVER

The intellectual property issues surrounding synthetic biology research inspired this month's cover. Some say granting ownership to someone who "discovers" something created by nature is equivalent to allowing someone who catches a butterfly to patent the creature. This month's cover was designed by EuroPhotonics Art Director Juliana T. Willey.

PHOTONICS

The technology of generating and harnessing light and other forms of radiant energy whose quantum unit is the photon. The range of applications of photonics extends from energy generation to detection to communications and information processing.

emva
european machine vision association

EMVA Business Conference 2010

8th European Machine Vision Business Conference
April 16th and April 17th, 2010, Istanbul, Turkey

International platform for networking and business intelligence.
Where machine vision business leaders meet.

www.emva.org

Golden Sponsor

VISION 2010

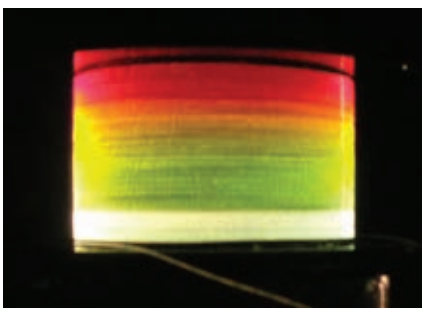
Silver Sponsors

PROFACTOR
ETAM
OMRON
STEMMER IMAGING
ISRA VISION
SVS-VISTEK
MATRIX VISION
JAI See the possibilities

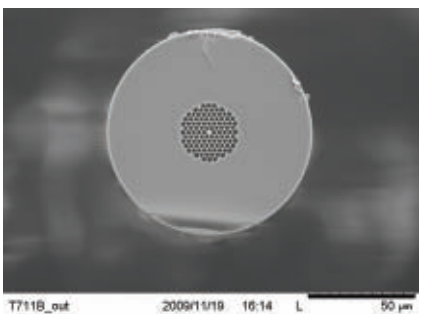
White light supercontinuum: Power struggle

LILLE, France – Researchers are pioneering a practical way of generating high-power white light suitable for applications including spectroscopy, microscopy and optical coherence tomography. Producing high-power light across a broad spectrum, also known as a supercontinuum, is not easy. It requires high-power pumping to trigger significant nonlinear effects (usually within a nonlinear medium such as an optical fiber). In this process, incident light can be converted into supercontinuous white light.

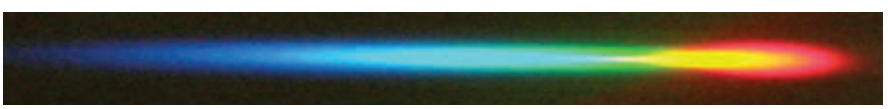
Today's pump source of choice is the pulsed laser. With typical peak powers of up to several tens of kilowatts, it provides more than enough power to excite most nonlinear effects. On the other hand, the average power of a compact and low-cost continuous wave (CW) laser is much lower (between 10 and 100 W), falling far short of meeting the requirements of the job. Now, Alexandre Kudlinski and colleagues at the University of Lille have managed to compensate for this power shortfall, generating a CW-pumped supercontinuum spanning the elusive visible region.



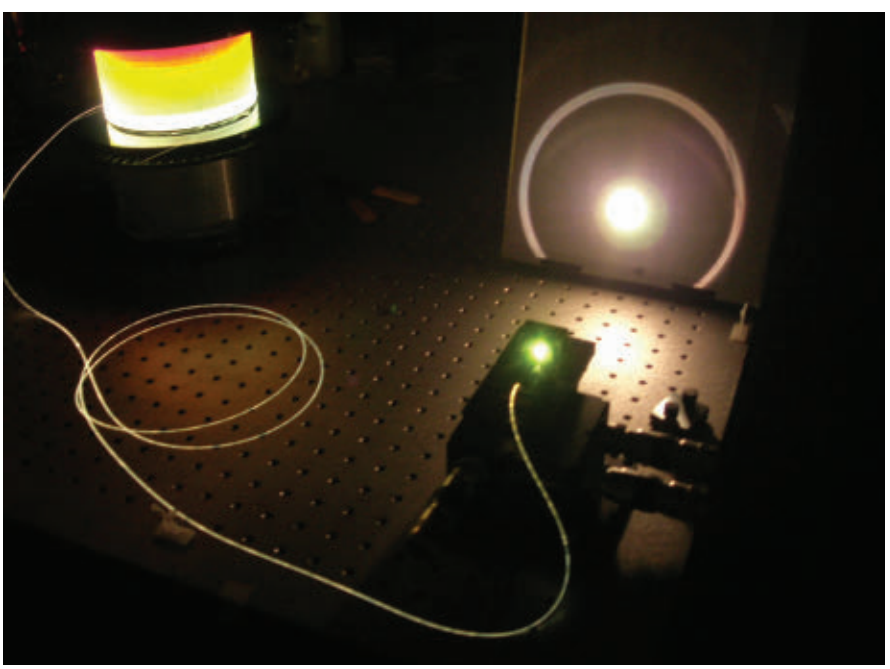
This photograph is of the illuminated fiber spool during CW supercontinuum experiments. The red light is generated first and progressively turns into yellow as the fiber length increases. Finally, all visible wavelengths are generated, leading to white light collimated with a lens at the fiber output.



Shown are scanning electron microscope images of the tapered photonic crystal fiber output face (outer diameter of 85 µm). The black regions are airholes and the gray regions, silica. The germanium dioxide-doped core appears slightly lighter at the center of the structure.



The white-light-output spot, collimated and dispersed with a prism, shows the whole visible spectrum generated in the fiber.



In this experimental setup of CW supercontinuum generation, the illuminated fiber spool and fiber end are delivering high-power white light through a collimating lens. Images courtesy of Université Lille 1.

The group's white light source extends from 470 to more than 1750 nm, with almost 10 W of average power for a pump of just 45 W. Kudlinski believes that this alternative approach opens up possibilities that could benefit many applications, including flow cytometry, endoscopy, optical coherence tomography and fluorescence microscopy.

"Most commercial confocal microscopes are generally made up of several visible CW lasers to excite fluorophores in various biological samples," he explained. "Many interesting fluorophores are unusable because of the lack of suitable laser sources to excite them. Our CW supercontinuum source provides the required wavelengths with sufficient spectral power density for efficient excitation of new, useful fluorophores."

What's more, a CW supercontinuum is much easier to use than its pulsed counterparts. There is no need to synchronize the detection setup with the source, as opposed to when using a pulsed supercontinuum where expensive and cumbersome synchronization elements are required.

The researchers found that achieving their goal involved a careful balancing act between increasing the nonlinear response of the optical fiber and maintaining optimized dispersion. They opted for a photonic crystal fiber with a germanium dioxide-doped core to promote nonlinear behavior, and they controlled the resulting dispersion using a cleverly tapered fiber design.

"It is well-known that germanium dioxide enhances both the Kerr and Raman nonlinear responses of silica glass, which is, of course, beneficial for

supercontinuum generation," Kudlinski said. "On the other hand, germanium dioxide modifies the dispersion properties, making it generally unsuitable for efficient supercontinuum generation. The key to our work was to adjust the dispersion by transversally controlling the size of the airholes within the microstructured fiber and by longitudinally decreasing the zero-dispersion wavelength along the length of the fiber."

In the next stage of the research, Kudlinski aims to reach even shorter wavelengths (down to 350 nm), which is particularly interesting for many applications, including fluorescence microscopy. He also plans to test the source by integrating it into the laboratory's confocal microscopes.

Marie Freebody
marie.freebody@photonics.com

The 3-D way to slice it

GIRONA, Spain, and LODI, Italy – They may all look the same in their transparent packets in your supermarket's refrigerated cases, but hams, sausages and cheeses are nowhere near uniform, and slicing them remains a challenge for the food industry. Today's fixed-volume or fixed-weight approaches deal with shape variations and require significant margins, factors that cause more food to be placed in a pack than is needed. That extra cost to the manufacturer eventually is borne by the customer.

A new three-dimensional imaging system developed by Spanish 3-D software company AQSense and Italian solution provider ImagingLab srl uses three line-laser emitters and three cameras to generate a contour of the whole object before it is sliced, with less than 1 percent measurement error. Demonstrated at Vision Show 2009 in Stuttgart, Germany, in November, it calculates the best way of slicing while the job is being processed, at speeds in the range of 10 m per minute.

Three-dimensional measurements are a hot topic in machine vision (see "Vision Market on the Upswing" at photonics.com), with quality control a key area of application. Industrial 3-D measurement systems typically generate "point clouds" of data, with the size of the cloud depending upon the object and the resolution of the measurement system. The bigger the cloud, the more demanding the processing.

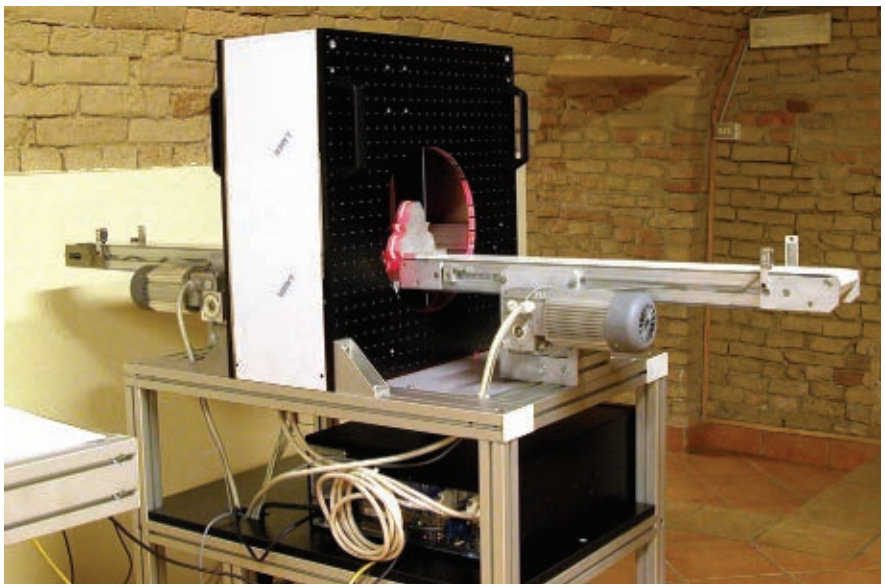
Typically, the goal of such data handling is to compare the test object with a computer-aided design model to see whether it has any defects, a process that determines a pass/fail decision. Doing this at high speed for complex objects is demanding, but rapid progress is being made on the hardware side, with faster and more intelligent cameras and computers.

New algorithms also are enabling quick matching of 3-D objects, somewhat similar to 2-D pattern recognition. "Our goal is to offer a comprehensive library such as those available for 2-D machine vision," said Ramon Palli, AQSense's CEO.

He said the challenge is not only in calculating the full shape, but also in extracting the data from the measurement. "Laser triangulation is a most widely used detection method, but for many surface types, the data is not directly usable and requires calculating the peak in the reflected laser light before that data can be used."

Such is the case for surfaces where the light is not just reflected but where it partially penetrates the material; e.g., when the reflected light has a non-Gaussian profile, and the peak intensity and center of gravity are not the same.

This know-how and that of 3-D shape analysis – in the form of the company's software library SAL3D – were combined with the hardware and system integration skills of ImagingLab when developing the



A laser-triangulation-based three-dimensional scanner generates a point cloud of measurement points, used to determine the shape of cheese or ham before it is sliced. This example shows the growing capabilities of 3-D imaging, while making food preparation and processing more efficient.

360° scanner prototype for food processing. ImagingLab also wrote LabView application software, including sample handling and user interface.

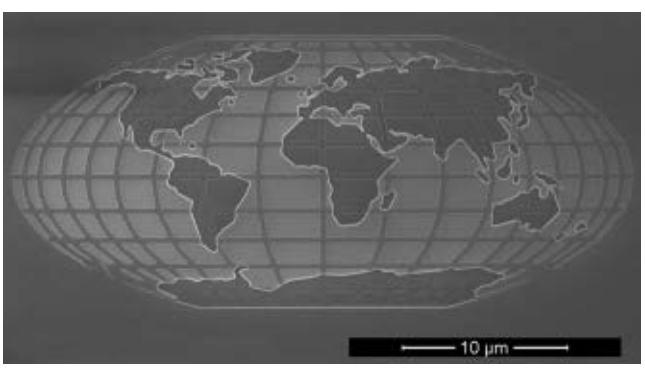
Both companies say that slicing food is just the beginning. The combination of 3-D machine vision and robotics is needed for flexible manufacturing in a wide range of areas – with both their 3-D library and the application software being compatible with any other 3-D imaging device generating point clouds.

Jörg Schwartz
joerg.schwartz@photonics.com

It's a terascale world after all

GHENT, Belgium – Using high-resolution optical lithography techniques that are important in microelectronics fabrication, researchers in Belgium have produced a terascale world map with a circumference of only 40 µm, or about half the width of a human hair.

With CMOS fabrication tools, scientists at the Photonics Research Group, a laboratory of Ghent University that is associated with the Interuniversity Microelectronics Center (IMEC), put the map in a corner of an optical silicon chip designed for one of the group's research projects on nanophotonic integrated circuits. The world map was defined on a silicon photonics test chip in IMEC's cleanroom for 200-mm processing.



The small map is viewed through a scanning electron microscope. Images ©Photonics Research Group-University of Ghent 2009.

The smallest features resolved on the map are about 100 nm, a size that is still several times larger than today's state-of-the-art transistors. However, the scale reduction enables more complex optical functions on a single chip for applications in telecommunications, high-speed computing, biotech-

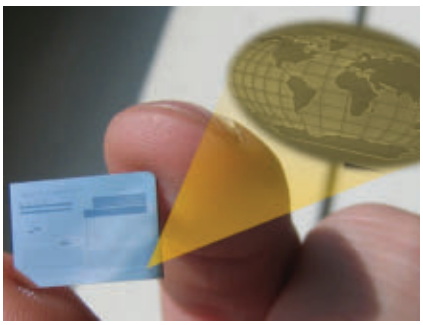
nology and health care, the researchers said.

The fabrication process consisted of 30 steps, including layer depositions and chemical etching on a silicon-on-insulator wafer. Four different layer thicknesses were resolved, and these corresponded to four different images, or mask layers, that had to be patterned separately.

The silicon photonic technology developed with these chips integrates optical circuits onto a small chip: Light can be manipulated on a submicrometer scale in tiny strips of silicon called waveguides or photonic wires, which means that these silicon photonic circuits can pack a million times more components into the same space than today's commercial glass-based photonics can.

The circuits developed on this chip were used to demonstrate photonic wires with the lowest propagation losses, the researchers said. Also, structures were developed to improve the efficiency of coupling light from the outside world, as with an optical fiber, to the wires on a chip.

Located in Leuven, Belgium, the Photonics Research Group works to build on technologies developed for the microelectronics industry to create smart photonic chips for health care, communications, identification and biosciences.



The terascale world map, created using high-resolution optical lithography techniques, is hidden in the bottom right corner of a photonic chip.

The small map is viewed through an optical microscope. The different colors are caused by interference effects in the different layer thicknesses of silicon.

Melinda Rose
melinda.rose@photonics.com

Germany: Managing the downswing

BERLIN – Looking back on 2009, many business analysts see Germany as less hard-hit by the recession than some other European countries, and a feeling prevails that "it could have been worse." However, as was the case in most neighboring countries, the government had to use tax money to keep things going. The German government, with a new coalition since the September 2009 elections, did this not by nationalizing whole sectors or by cutting the sales tax but by injecting funds into key industries – with indirect relief also for many parts of the photonics sector.

Cars are important in Germany, not only for the average citizen but for the overall economy, with the auto industry providing 1.4 million jobs plus many more that depend on vehicle manufacturing. The car scrappage scheme available in the first nine months of 2009, although criticized by many, probably has helped this key industry to avoid a much deeper dive; other countries also have adopted the incentive program.

Rolling right along

Not surprisingly, large sectors of the photonics industry depend on core German businesses such as engineering and automobile manufacturing. As a result, there is little talk of companies struggling, and the outlook is even moderately positive. As for Germany's machine vision industry, overall business volume was down 30 percent; the VDMA, the national engineering association, described 2009 as "lost." However, it also reported signs that in 2010, the numbers will be positive again, as they were for more than a decade up until 2008 (see "Vision on the Upswing," November 2009 photonics.com).

Laser machinery maker Trumpf GmbH & Co. KG of Ditzingen, which also is heavily involved in car manufacturing, expects a "transition" year. "We have identified an economic upswing in individual markets, and there are signs that order declines may be slowing," said President Nicola Leibinger-Kammüller in presenting

The European x-ray laser research facility XFEL is under construction in the vicinity of Hamburg, Germany. Beginning in 2014, it will generate extremely intense x-ray flashes to be used by researchers worldwide.

the company's results. Despite considerable sales declines, the company closed out the year with a profit. The only business division that saw any growth – of 11 percent – was medical technology.

The impact of the downturn on the country's job market has been found to be surprisingly small, with fears of a jump in the unemployment rate proved wrong. One reason for this is that many employers are reluctant to lay off workers for fear that skilled staff cannot be replaced when times get better. This is particularly true for the photonics field: Spectaris, the German Association for Optical, Medical and Mechatronical Technologies, has identified a shortage of skilled labor; working with 11 companies, it has launched a campaign called LightAlliance to raise awareness of optical technologies among students and to encourage them to consider careers in photonics.

Renewable still green

Environmental awareness has a long history in Germany, and "green" technologies such as renewable energy continue to gain significance in the overall economy. Generous funding for solar cell installations (see "Make green energy, not war," October 2009, p. E18) has helped a whole industry to grow – although, as with the car scrappage scheme, a lot of the funding goes abroad to vendors producing at lower cost.

So even this sector saw a dip, but demand for solar power systems is expected to grow this year in Germany and in several important foreign markets, despite the financial crisis, according to the latest predictions of BSW-Solar, the interest group of the German solar energy industry. This forecast is only put at risk by the new government's recent announcement that it will cut its generous subsidy to citizens feeding solar electricity into the national grid.

If you think all the money has been spent by now, think again. Even in difficult times, when solving immediate issues with short-term stimulus packages dominates the news, it is important not to lose sight of the midrange and long-term future. The Federal Ministry of Education and Research is still the largest national supporter of photonics research, with significant funding going to a broad range of optical technologies, such as "femtonics" (materials processing and medicine with ultrashort laser pulses), high-performance diode lasers, biophotonics and organic LEDs.

On the research horizon, the outlook also is promising. In November 2009, an agreement signed by 13 European countries established XFEL (X-ray Free-Electron Laser) as an international research center. The facility, near Hamburg, is expected to be commissioned in 2014 and will make it possible to depict molecules that in the past were too small for imaging techniques or that could not be fixed, and to film molecules during chemical reactions.

Jörg Schwartz
joerg.schwartz@photonics.com

Let it shine the easy way: Laser polishing

AACHEN, Germany – Polishing by hand is not a very popular job – unless you own a classic car and give it a shine over the weekend. But in many industries, polished surfaces are a very necessary evil; for example, medical implants, various metallic products and optics all require precise polishing.

Free-form surfaces such as this mold require high-quality polishing to ensure seamless manufacturing and good surface quality of the mass product. To date, this has been a manual job, but now lasers can help.

In molding and toolmaking for industrial production, polishing often is the last step in making the important master that is used to make car or machine parts, medical instruments, or even pills or food. The polished surface should be free of contamination and should not create friction or adhesion.

No doubt, there is a wide range of mechanical polishing machines available to do this; however, in practice they can be applied to relatively simple surface geometries only. Whenever the shape is more sophisticated and the parts hard to reach – as is often the case with injection molds for plastic parts – manual polishing has been the only option.

Now, however, lasers may revolutionize how these polishing tasks are performed. Unlike the classic process, which removes material via grinding and polishing, the laser process involves melting the surface of the medium to a depth of about 50 to 100 µm. Surface tension makes the liquid metal flow evenly and solidify smoothly.

Laser polishing is described by Dr. Edgar Willenborg, a researcher at Fraunhofer Institute for Laser Technology (ILT), in his award-winning 2005 dissertation. In it, he asserts that manual metal polishing is an art, not just a skill: "Polishing is not only a very labor-intensive task. The quality also depends to a huge degree on the skills and experience of the polisher – making it almost an art rather than a technology."

As for the laser method of polishing metal, it has one thing in common with the traditional manual art: It requires several stages. "This is because metals are a little too liquid," Willenborg explained. "Amorphous materials like glass are more viscous and also won't create crystallization defects when changing phase."

In the first step, the laser is set to melt to a depth of about 100 µm; during the following stages, the penetration depth gradually is reduced. The result is a surface roughness (Ra) of about 50 nm, an adequate level for many applications. The high end of metal polishing, however, remains a human domain, with an experienced polisher reaching as little as 5 nm.

The melting depth can be determined by adjusting various parameters, such as the laser output power, the speed the beam travels along the surface and the length of the pulses. In fact, the laser is operated in continuous-wave mode for the rough preprocessing stage before it is switched to pulsed operation for the fine work. For metals, typically diode-pumped solid-state lasers (Nd:YAG or Nd:YVO_4) are used.

This process also can be used for materials other than metals, including glass and plastic optics, and for functions other than polishing. "Molds are only one application, and we are working on a whole range of laser polishing applications at ILT," Willenborg stressed.

For glass and plastic optics, CO_2 lasers are used because they absorb better and can simplify another tough job: polishing aspheric lenses.

Jörg Schwartz
joerg.schwartz@photonics.com

PUTTING IMAGING IN THE PICTURE

BY MARIE FREEBODY, CONTRIBUTING EDITOR

It is now more than 180 years since the first image was captured by Joseph Nicéphore Niépce from an upstairs window on his estate in France using pewter plates and a camera obscura – the forerunner of today's cameras.

Images today are produced in myriad ways – using infrared, fluorescence, bioluminescence, x-ray machines, optical coherence tomography (OCT), lidar – for use in the medical, scientific and business industries; for space exploration; and for security purposes by the military and governments.

One of the most important breakthroughs in optical imaging in recent years is the development of CCD sensors, which laid the foundation for digital photography. Inventors of the CCD, Willard Sterling Boyle and George E. Smith, were duly recognized in 2009 with the Nobel Prize for physics.

Important advances also have occurred in the way we process and deliver images, such as compression technology used in digital TV, image processing associated with medical imaging and diagnosis, and the development of LCD displays for consumer electronics.

Medical imaging: Tools of the trade

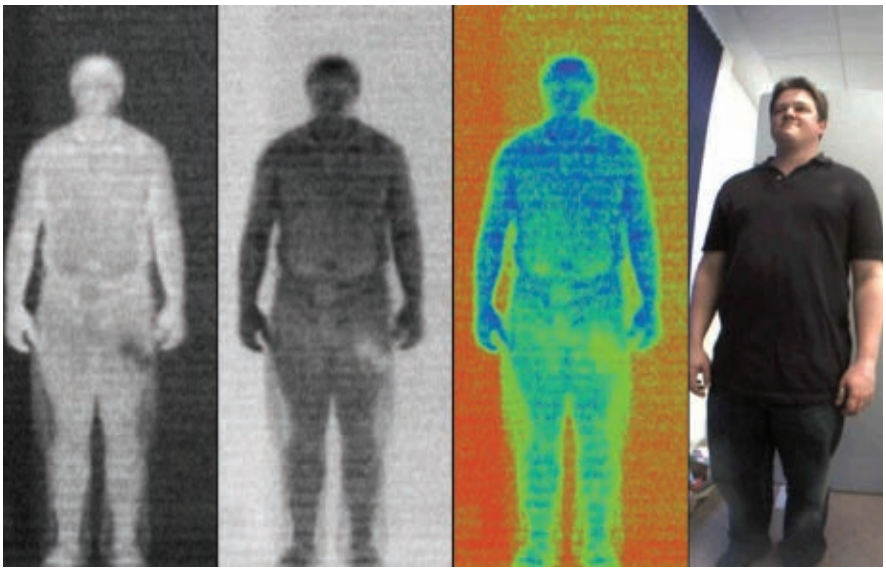
Today, the most significant optical imaging tool used in medical imaging is still the standard optical microscope, which is used to analyze excised tissue. Tens of millions of biopsies are analyzed annually by trained histopathologists using these microscopes. However, it is not medical imaging in the same way as x-ray, MRI or CT, which can provide real-time images of a patient noninvasively.

Optical endoscopes are used widely for looking inside the body. But unlike x-ray and MRI, they do not provide a subsurface image. Another imaging method gaining momentum is confocal endoscopy via handheld probes or endoscopes. This technology provides high-resolution subsurface images but a very small field of view and very limited depth – up to approximately 250 µm.

OCT, undoubtedly a groundbreaker in terms of optical imaging, also is widely used in ophthalmology. In recent years, incremental improvements in the design of component light sources and probes have been opening the door to new applications; e.g., OCT imaging is expected to become widely used in diagnosing many types of cancer and in guiding treatment. It is making rapid progress in cardiology (scanning arteries for vulnerable plaques)

These images show Michelson Diagnostics' VivoSight multibeam OCT scanner in action at University College Hospital in London. This product is not currently approved for clinical use in the USA. Images courtesy of Michelson Diagnostics.

The T5000 is an outdoor people-screening system that can detect concealed threats at distances suitable for operational requirements. It can be used for checkpoint security, urban surveillance and counter-terrorism applications. Courtesy of ThruVision Systems Ltd.



Screening people for concealed objects is just one of the promising applications of terahertz radiation. Courtesy of ThruVision Systems Ltd.

and as a general-purpose imaging tool in dermatology.

"The combination of high-resolution, real-time two- and three-dimensional imaging capability, ease of use as well as nonionizing properties make it of great interest to clinicians," said Jon Holmes, chief executive officer of Michelson Diagnostics Ltd. in Kent, UK. "In most cases, the depth of penetration is sufficient to penetrate mucosal layers to reveal details of organs and organelles that are too small to be seen with other imaging modalities and too deep for conventional microscopy."

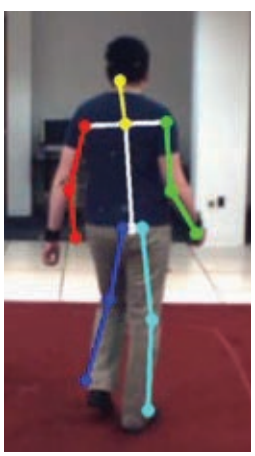
As volumes rise and component costs fall, Holmes believes that OCT also may make progress in price-sensitive applications such as dentistry – for early diagnosis of tooth decay and gum disease.

"Commercial growth will take off rapidly once OCT has 'conquered' a couple more clinical applications – as it has already done so in ophthalmology," he said. "It will be seen that transferring the knowledge gained into new applications is just a matter of engineering and clinical testing."

Terahertz imaging: New applications

Astronomical imaging has always been a major driver of innovations in optics. New imaging technology came to life when the European Space Agency's Star-Tiger team captured the world's first terahertz-frequency picture of a human hand in September 2002.

Terahertz waves, defined as frequencies from 100 GHz to 100 THz, easily can pass



Extracting a person's "pose" using a single camera can be used to assess improvement in a patient's body movement after an operation or physiotherapy. Courtesy of Digital Imaging Research Centre.

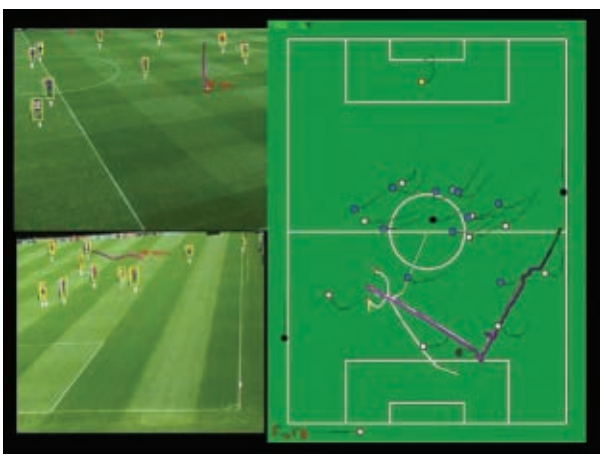
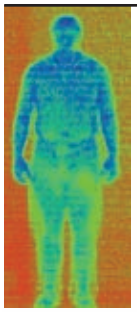


Image processing can help track players and a football during a match, to convey game information to a mobile phone. Courtesy of Digital Imaging Research Centre.



Tracking people and vehicles across various cameras can be useful in interpreting movement for public closed-circuit television systems or for traffic monitoring. Courtesy of Digital Imaging Research Centre.

through some solid materials, such as walls and clothes, penetrating materials that are usually opaque to both visible and infrared radiation. This makes terahertz cameras ideal for security applications, where they potentially could be used to screen airport passengers for hidden objects.

For the screening of dangers of a different kind, terahertz also is showing great promise in medical imaging. Light at this part of the spectrum is absorbed strongly by large biological molecules and by water and is subject to far less scatter than visible or infrared wavelengths, resulting in sharper images. Furthermore, unlike x-rays, terahertz radiation is nonionizing, so there are no safety issues to consider.

Technology operating in the terahertz regime is still in its infancy compared with the rest of the electromagnetic spectrum. This is largely a result of the "terahertz gap" between solid-state electronic devices and photonic devices. Despite this, a growing number of firms are catching on to the untapped potential of terahertz technology.

"Our current products all image passively at 1250 microns," said Chris Mann, chief scientific adviser at ThruVision Systems Ltd. in Abingdon, UK. "With respect to passive imagery, this part of the electromagnetic spectrum is completely unexplored, and as the imaging equipment becomes more widely available, we are convinced many new applications will emerge."

Companies such as ThruVision are helping terahertz advance into other fields. One of the first to emerge is in production and quality control. Infrared cameras are used routinely in this sector, but for some materials, their limited penetration means they cannot meet industry needs. In contrast, terahertz cameras can see through great thicknesses – 10 to 1000 nm – of many common low-density manufacturing materials to spot unwanted defects, such as voids or inclusions, in real time.

Digital imaging, processing

Enhancing and extracting features of interest are all part and parcel of image processing. Increasingly powerful computers have enabled image processing to be performed in real time, opening up many ultramodern applications.

"Much of the human brain is used to

process visual information so that we can make decisions, explain, archive and so on," said Dr. Sergio Velastin, director of the Digital Imaging Research Centre at Kingston University in the UK. "To be able to do the same automatically using computers is an important goal for a wide range of practical applications, including surveillance, driverless trains, unmanned space exploration, automatic tagging of contents and advanced robotics, to name a few."

Digital imaging is being adopted increasingly in manufacturing industries, where it is used in machine vision systems for sorting, quality control and assembly. But one of the most intriguing applications lies in motion capture.

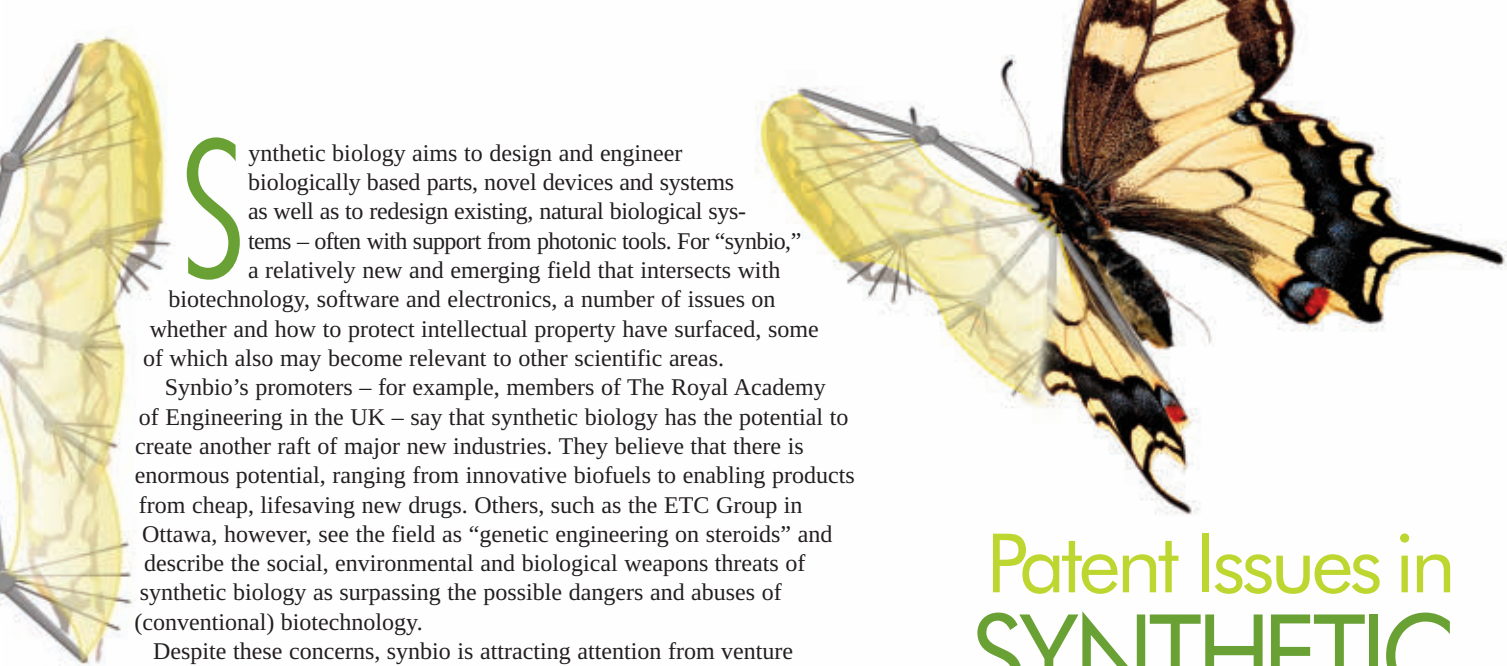
Motion-capture systems can be used to track and interpret movement – be it human behavior for public closed-circuit television systems or vehicle motion for traffic monitoring. "Understanding human/vehicular behavior helps to prevent incidents," Velastin said. "And detecting anomalies in normal behavior means better controls can be put in place."

Motion capture also is making waves in medicine, where it can be used to assess improvement in body movement after physiotherapy or an operation, and it is finding application in the gaming industry to create virtual worlds.

The possibilities may seem endless, but according to Velastin, investors must be more adventurous to fund companies that will encourage end users and suppliers to embrace the potential of imaging. An idea of what we could expect in the next five to 10 years includes assisted living for the elderly or infirm, driver-assisted systems in the automotive industry, and intelligent home/office environments that respond according to human presence and motion.

marie.freebody@photonics.com

These images track the same person across many cameras for public closed-circuit television systems. Courtesy of Digital Imaging Research Centre.



Patent Issues in SYNTHETIC BIOLOGY RESEARCH

Their role in this emerging biophotonics application

BY DR. JÖRG SCHWARTZ
CONTRIBUTING EDITOR

Synthetic biology is an emerging field that intersects with biotechnology, software and electronics, so intellectual property protection is unclear. Some activists say that granting commercial ownership to someone isolating something created by evolution is like giving an entomologist the right to patent a butterfly caught in his net.

Synthetic biology aims to design and engineer biologically based parts, novel devices and systems as well as to redesign existing, natural biological systems – often with support from photonic tools. For "synbio," a relatively new and emerging field that intersects with biotechnology, software and electronics, a number of issues on whether and how to protect intellectual property have surfaced, some of which also may become relevant to other scientific areas.

Synbio's promoters – for example, members of The Royal Academy of Engineering in the UK – say that synthetic biology has the potential to create another raft of major new industries. They believe that there is enormous potential, ranging from innovative biofuels to enabling products from cheap, lifesaving new drugs. Others, such as the ETC Group in Ottawa, however, see the field as "genetic engineering on steroids" and describe the social, environmental and biological weapons threats of synthetic biology as surpassing the possible dangers and abuses of (conventional) biotechnology.

Despite these concerns, synbio is attracting attention from venture capitalists, major corporations and startup companies. Some say investment is attracted because of the ability to claim patent rights for the "discovery" of things that exist in nature, while others see the need to offer appropriate – commercial – protection of inventions in this field to keep it going.

At a November 2009 event called "Patenting Synthetic Biology – A Transatlantic Perspective," hosted by the Synthetic Biology Project at the Woodrow Wilson Center in Washington, the audience discussed factors influencing policies on the evolution of intellectual property protection for synthetic biology with Dr. Berthold Rutz of the European Patent Office (EPO) and with John LeGuyader of the US Patent and Trademark Office (USPTO).

Morality vs. commerce

The question as to whether something that already exists in nature is patentable is clearly answered in Europe by the Regulations of the European Patent Convention (EPC), which state in part that any biological material – i.e., any material containing genetic information and capable of producing itself or of being reproduced in a biological system – shall be patentable. However, this applies only if it has been isolated from its natural environment or produced by means of a technical process; i.e., has been made technically available.

The same applies in the US and, based on case law in the 1980s, the USPTO "considers nonnaturally occurring, nonhuman multicellular living organisms, including animals, to be patentable." However, if the broadest possible interpretation of an invention as a whole encompasses a human being, a rejection must be made, "but pieces are OK," LeGuyader said. Europe has similar rules, with the EPC prohibiting patents from modifying the germ line genetic identity of human beings and processes for cloning human beings.

"Making" parts of humans may sound scary, and clearly there is an ethical aspect to the whole argument, despite the fact that the Washington discussion stayed mainly at the level of patent technicalities, with both speakers stating that they are not policymakers. Nevertheless, in Europe there are explicit connections between ethics and intellectual property in the morality clause in the EPC (Article 53), excluding inventions contrary to "ordre public" or morality from being patentable. "Biologic weapons would be an example," Rutz said.

In addition, there is the European Group on Ethics in Science and New Technologies (EGE), which published its "Opinion Nr. 25 Ethics in Synthetic Biology" just recently. The EGE proposes that debates on the most appropriate ways to ensure the public access to the results of synthetic biology be launched. These debates should include what can be objects of patent and what should be available through open access.

However, as Rutz explained, although this group has been tasked by the European Commission, the role of the EGE is "legally not fully clear," and its recommendations are not binding for the EPO but "are taken, of course, into consideration."

Same engineering tools?

Beyond that, anyone applying for a potentially unethical patent must be in "possession" of the invention and must very clearly state what he or she does – namely, in a description forming part of the patent application that gets published. A slight difference is that, in the US, for any patent, the best way must be described, whereas in Europe, at least one way of carrying out the invention – not necessarily even a good way – must be included in the application. Also in Europe, there are further requirements, including clear and concise claims and disclosure of the invention in a manner sufficiently complete that it can be carried out by a person skilled in the art, a process used if claims are too broad, Rutz said.

The flip side of patents making all this public is that they offer the owner exclusivity and protection – and commercial gain via license fees. This begs the question of whether applying the rules of patenting – proved in other fields of engineering – to synthetic biology is such a good idea. Some activists say that giving exclusive commercial ownership to someone isolating something that evolution has created is like giving an entomologist the right to patent a butterfly that ends up in his catcher.

But even for those closer to the technology, there are open questions. In his presentation, Rutz quoted professor Joachim Henkel from Technical University Munich, who sees that, in synthetic biology, "building blocks such as genes that have a certain function are synthesized and put into a cell so that a cell starts to produce a certain substance. To arrive at this result, you need sometimes hundreds of these building blocks. Now if each of these building blocks is protected by a patent, any innovation which is based on any of them is blocked." He suggests excluding biological building blocks from being patentable and allowing this only for the complex biological structures that result from these building blocks.

An open source arrangement – as used in software development – could be a potential route. Asked whether this would be compatible with patents, the USPTO's LeGuyader referred to a study by the US Department of Health and Human Services on how gene patents affect medical applications with a "neutral" outcome, but he also admitted that only time will tell.

And Rutz expresses hope that some form of arrangement can be reached between industry and research to keep research going. Many see this as crucial, and the same applies from a photonics perspective because only active research will stimulate the need for photonic tools, including using light to identify networks of protein for cellular engineering (see "Light Reveals Neuron Function," Photonics.com, Sept. 17, 2009).

For more information on the synbio event or to view the webcast, visit: www.synbioproject.org.

joerg.schwartz@photonics.com

ECOPhotonics

Spectroscopy detects toxins in veggies

LYON, France – For as long as picky eaters have resorted to hiding vegetables or feeding them to the dog under the table, they also have sought excuses not to eat them. But "They're icky" doesn't hold up against the advice of nutritionists. And now neither does the health concern, "What if the soil is polluted?"

A new high-resolution, time-resolved spectroscopy system is helping researchers directly measure trace pollutants in fresh vegetables that are intended for public consumption. There goes the "pollutant" excuse.

The research, led by Jin Yu, a professor at the University of Lyon, used a system composed of Andor Technology's iStar ICCD camera and Mechelle 5000 spectrograph to detect optical emissions from plasma using a technique called laser-induced breakdown spectroscopy (LIBS).

LIBS is useful for detecting trace elements because it is both sensitive and reliable. In the LIBS process, a high-power laser pulse is focused onto a sample – in this case, a vegetable – to create plasma, a gas made up of electrons and ions; a spectrograph then analyzes its optical emission. The LIBS technique has appeal because little or no sample preparation is required to obtain useful results, opening up the possibility of field applications.

Yu and his team observed the emission spectrum of the plasma generated by focusing a laser pulse on a potato skin. Within a fixed time window, the emission from the plasma plume was collected and evaluated by the detection system, which determines electron density and plasma temperature. From those readings, the trace element concentrations were determined. This technique is the first step toward studying the link between soil pollution and food impurities.

"The real challenge for the LIBS technique is to get quantitative measurements of trace elements contained in a complex matrix, such as a fresh vegetable, because we don't know in detail the property of the plasma generated by a laser on it," Yu said. "The Andor system is important to this work because we can make time-resolved observations of the plasma."

Time-resolved observations are important because the plasma plumes expand with time. After about 1 µs from the incident laser pulse, discrete spectral lines start to become apparent. The spectral lines and the timing vary depending upon the sample, the distance from the center of the plasma and the wavelength of the laser light, but the evolution of the changes within the plasma plume occurs on a microsecond timescale.

Yu also noted the importance to the study of the system's high resolution. "The Andor system also has a high resolution. When we combine these attributes, we can simultaneously measure a large number of elements. It's a truly multiple-element detection system," he said. The spectrograph also allows measurements over a very large spectral range – from the ultraviolet to the infrared.

"There are several metals that are harmful or beneficial to your health. One example is copper, which is toxic if you absorb too much of it. You can prevent vegetables grown in environments with too much copper from reaching the food chain and clean up those places, if you have a sensitive and reliable detection technique," added Dr. Matthieu Baudelet, a member of Yu's team who is now at the University of Central Florida in Orlando. "LIBS is a good technique for this kind of analysis because the hot plasma can excite every element in a vegetable – even if it's present at low concentrations."

Results of the study were published in the November 2009 issue of *Spectrochimica Acta, Part B.*

Krista D. Zanolli
krista.zanolli@photonics.com

"You can prevent vegetables grown in environments with too much copper reaching the food chain and clean up those places, if you have a sensitive and reliable detection technique."

PRODUCT PREVIEW

Laser-Based Light Source

The picoEmerald, a turnkey, solid-state laser-based light source developed by High Q Laser Innovation GmbH and APE, is now available for coherent anti-Stokes Raman scattering microscopy applications. Combining a picosecond laser and an optical parametric oscillator (OPO) into a single-box system, the device supplies three fully automated temporally and spatially overlapping ultrafast pulse trains: 1064 nm out of the laser oscillator itself, from 690 to 990 nm (signal range), and from 1150 to 2300 nm (idler range) from the OPO. The OPO's controller maintains the power stability and wavelength tuning, while the pump and Stokes beams are tailored to be sent into the microscope. The instrument is suitable for research use in biology, medicine and other life sciences applications.

High Q Laser
sales@highqlaser.at

1-, 2-Megapixel Cameras

Baumer Ltd.'s SX cameras are for industrial vision applications requiring 1- to 2-megapixel resolution at frame rates of up to 120 fps. Featuring Kodak Co.'s progressive-scan interline CCD image sensors with Quad-Tap technology, the cameras offer resolution of 1024 × 1024 pixels. The 1-megapixel cameras achieve speeds of 120 fps, depending upon the number of output taps used, and the 2-megapixel cameras offer horizontal and vertical resolutions of 1600 × 1200 pixels and operate at speeds of up to 68 fps. All models measure 52 × 52 × 54 mm, have a 5.5 × 5.5-µm pixel size, and offer rugged housing and robust electronics that withstand a variety of application environments. The digital interface is Camera Link. Applications for the monochrome and color cameras include measuring and medical technologies, and semiconductor inspection.

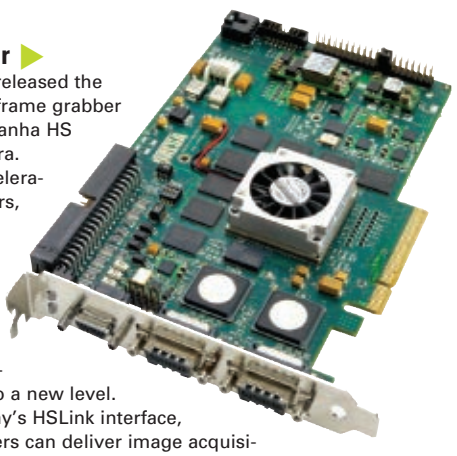
Baumer
sales.us@baumer.com

High-Power LEDs

The new calibration LEDs in the ACS-530 series from Instrument Systems GmbH enable users to check optical instruments easily and reliably. Calibrated using traceable standards for luminous flux and intensity, the LEDs offer reproducible and stable optical output power for reliable measurements. They feature photometric stability of 0.1% and are housed in a casing with low thermal conductivity together with a thermoelectric cooling element to eliminate sensitivity to external temperature fluctuations, and a temperature sensor. The LEDs are available in red, green, blue and white. They are suitable for checking results for dominant wavelength, color coordinates and color temperature.

Instrument Systems
sales@instrumentsystems.de

Frame Grabber



Dalsa Corp. has released the Xcelera-HS PX8 frame grabber to support its Piranha HS 12k 90-kHz camera. Based on the Xcelera-CL frame grabbers, the HS series leverages the PCI Express platform to bring traditional image acquisition and processing technology to a new level. With the company's HSLink interface, the frame grabbers can deliver image acquisition bandwidth of 1.5 GB/s and host transfer bandwidth of 2 GB/s over multiple-lane PCI Express implementations. The interface delivers scalable bandwidth in 300-MB/s steps, from 300 to 6000 MB/s. Applications include solar cells, flat panel displays, semiconductor electronics inspection and machine vision.

Dalsa
sales.europe@dalsa.com

550-nm Yellow Laser

Oxxius SA has released the SLIM-550, a yellow diode-pumped solid-state laser that emits up to 200 mW at 550 nm. The instrument features a monolithic resonator, optical noise of <0.2% rms and pointing stability of <5 µrad. It consumes as little as 10 W. The device is suitable for fluorescence applications, enabling efficient light collection from phycoerythrin without unwanted excitation of allophycocyanin. It also enables optical excitation of fluorescent proteins, including DsRed and dTomato.

Oxxius
sales@oxxius.com

Ultraquiet Air Compressor

Newport Corp. has introduced the ACWS, a compact, ultraquiet air compressor, to supply air to any of its IsoStation workstations or SmartTable-OTS (optical table systems). The supply tank can supply air for up to three workstations, making it suitable for new labs or for upgrading existing nitrogen-bottle configurations. The compressor operates intermittently, based on air usage, and is monitored by a sensor that maintains the reserve tank's preset minimum pressure. It includes a high-grade 5-µm air filter/regulator. For higher-capacity needs, the company's ACGP offers the same ultraquiet performance for larger isolator systems, including the S-2000 Stabilizer family of isolators. It features superprecise vertical adjustment down to >±0.25 mm, and it operates from 0 to 120 lb/sq in.

Newport
warren.booth@newport.com

DPSS Laser

Verve, a diode-pumped solid-state (DPSS) laser from Klastech-Karpushko Laser Technologies GmbH, provides CW output at 266 nm and is suitable for semiconductor inspection and UV spectroscopy applications. Using the company's iMAT laser technology, which provides second-harmonic-conversion efficiency, the 100-mW laser features reduced power consumption and minimal heat generation. It requires no water cooling and remains mechanically stable throughout operation, ensuring that the beam pointing stability is maintained to >10 µrad/°C. The laser also delivers silent running at <0.5% rms, diffraction-limited output beams with M^2 >1.05 and long-term power stability of <2%, and it produces pitch-perfect single-frequency performance with a linewidth of <1 MHz.

Klastech
r.brueggemann@klastech.de

LED Microscope

Olympus Scientific Equipment Group has unveiled the Olympus CX21LED microscope for use by medical and veterinary students, doctors and professionals working in small laboratories. The ergonomically designed LED system offers easy handling, ultralong-life illumination and robust capabilities. Suitable for imaging using bright-field illumination, it delivers crisp, bright images, and dark-field imaging is available with the addition of a dark-field stop. An addition to the company's CS microscope line, it complements the CX21 model with halogen illumination and joins the CX31 and CX41, which handle phase contrast, polarized light, fluorescence imaging and other techniques for forensic and laboratory applications.

Olympus
microscopy@olympus.com

Dye Laser

The Credo-YHP high-repetition-rate dye laser system from Spectra-Physics, a division of Newport Corp., offers the proprietary diode-pumped solid-state Navigator 532-40 integrated into the laser box for assured alignment, a smaller footprint and portability. With tunable wavelength coverage from 370 to 900 nm, the system can cover 216-, 228- and 247-nm wavelengths with an optional doubler. It delivers a wavelength accuracy of <30 pm, divergence of 0.5 mrad and vertical polarization of >98%. It is suitable for laser-induced fluorescence and combustion applications.

Spectra-Physics
hans.dabeesing@newport.com

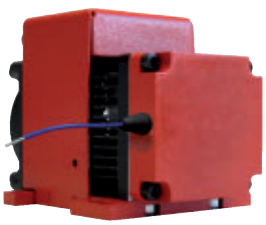
Flexible Photovoltaics

Rofin-Baasel UK Ltd. has released a reel-to-reel system designed to incorporate multiple laser sources for processing tasks on Si, µSi, copper indium gallium selenide and organic

cells, all within a single machine. Built on a granite base, the system incorporates high-speed, high-precision motorized axes to drive vibration-proof optics when used in the step-and-repeat mode. Beam positioning is achieved using fast, precise galvo scanning heads for on-the-fly applications. When coupled with the company's PowerLine SL PV laser series, the system is suitable for use in flexible photovoltaic applications.

Rofin
sales@rofin-baasel.co.uk

Laser Diode Module



Frankfurt Laser Co. has introduced a line of high-power temperature-stabilized laser diode modules for medical and materials processing applications. The HEML-FC series is equipped with multimode fiber output and provides high output power for a variety of applications that require compact, rugged laser sources combined with fiber light delivery. The modules offer stable power output of <1% and a wavelength of <0.5 nm over a wide temperature band from 0 to 40 °C. They also provide good pointing stability and alignment and are supplied with high-power laser diodes up to 2 W or with green diode-pumped solid-state lasers up to 200 mW.

Frankfurt Laser
sales@frlaserco.com

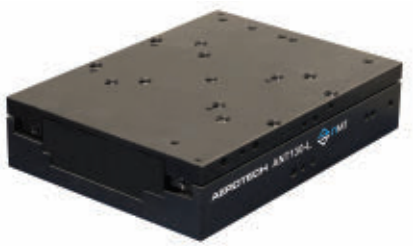
Laser Power Extensions

Power extensions for Dilas Industrial Laser Systems' Compact diode laser system series have been released. Delivering 300 W from a 200-µm fiber and 400 W from a 300-µm fiber at 9xx nm, the turnkey systems are based on conduction-cooled diode laser bars. They are available with an industrial water-to-air chiller, a power supply and an integrated control unit. Their features are controlled by 24-V interface signals, and their 19-in. rack mount for laser and cooling units is suitable for OEM integrators. They can be combined with a range of accessories for process control, including laser processing heads, cameras, pyrometers and galvo scanners. When combined with a galvo scanner, they are suitable for quasi-simultaneous plastics welding. Other applications include medical device manufacturing and automotive.

Dilas
sales@dilas.com

Positioning Stages

Aerotech Ltd. has added another ANT series of linear positioning stages to its ultrahigh-precision nano Motion Technology (nMT) range of products. The ANT130-L delivers a higher load capacity and provides increased travel of up to 160 mm, while maintaining the nMT characteristics of precision, rapid acceleration, high speed and 1-nm positioning resolution. The stages have a nominal width of 130 mm and are available in 35-, 60-, 110- and 160-mm travel ranges, each with a choice of two certified accuracy grades between ±2 µm and ±250 nm. They offer in-position stability of 3 nm and repeatability to 50 nm. They feature anti-creep cross-roller bearings and deliver zero backlash or hysteresis.



Aerotech
sales@aerotech.co.uk

DPSS Laser

The Cobolt Samba 05-01 is a continuous-wave single-frequency diode-pumped solid-state (DPSS) laser operating at 532 nm with up to 1 W of output power in a TEM_{00} beam. Manufactured by Cobolt AB, the laser is suitable for applications including Raman spectroscopy, interferometry, flow dynamics, high-speed fluorescence analysis and laser pumping. It is available on the same platform as the company's Zouk model. Its new proprietary cavity design provides typical ultralow noise performance <0.1% rms and a narrow spectral linewidth of <1 MHz. Designed with the company's proprietary HTCure technology in a compact and hermetically sealed package, it can withstand multiple 60-*g* mechanical shocks in operation without any sign of degraded performance. It also can be exposed to temperatures >100 °C and is insensitive to pressure and humidity.

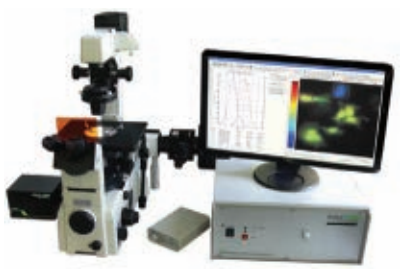
Cobolt
info@cobolt.se

Electroabsorption Modulator

To meet customer needs for an optical modulator with low insertion loss and low drive voltage for radio-over-fiber applications and remote antennas, CIP Technologies has released the 60G-R-EAM-1550 reflective electroabsorption modulator. Featuring a combined modulation and photodetection transducer that works at up to 60 GHz, the

device produces an insertion loss of 3.6 dB, and it provides digital optical modulation at 50 Gb/s and radio-frequency modulation over its 60-GHz bandwidth. Operating across the 1550-nm C-band with a low-chirp parameter, it is intended for use with a laser diode source.
CIP Technologies
info@ciphotonics.com

Phosphorescence Imaging



Lambert Instruments has added the LIFA-X to its line of fluorescence lifetime imaging attachments. Suitable for long-lifetime imaging microscopy from 0.1 ns to 1 ms, it can be used for measuring reactive oxygen species in cells or oxygen concentrations using optodes. It can be attached to any wide-field fluorescence microscope and works in the homodyne frequency domain. Its high-frequency mode provides lifetime measurements in the 0 to 300-ns range, while the low-frequency mode delivers measurements in the 300-ns to 1-ms range.
Lambert Instruments
ria@lambert-instruments.com

USB Camera

Videology Imaging Solutions Inc. has introduced an industrial-grade autofocus 10× optical zoom photo identification camera for applications including security, visitor management and passport photos. The camera is fully USB 2.0-compliant and is compatible with the company's TWAIN, Windows Driver Model and DirectX products. Featuring a 2-megapixel progressive-scan sensor that creates sharp edges, it provides still image capture and has streaming video capabilities. A software development kit is also available.
Videology
sales@videology.com

Nanopositioning Stages

PI (Physik Instrumente) LP has introduced two multiaxis stages for superresolution microscopy. The stages provide accurate motion with subnanometer resolution in two and three axes over travel ranges of 200 µm in X-Y and X-Y-Z. The nano1×3 stages are designed for inverted microscopes from Leica, Nikon, Olympus and Zeiss. The large aperture accommodates microscopy accessories such as slide and petri dish holders. Features include a 24-bit controller with USB, Ethernet and RS-232 interfaces and analog control, closed-loop control for subnanometer precision, and ceramic-encapsulated piezo drives for a longer lifetime. All parts are black anodized for minimum reflection. Options include a manual X-Y stage with a motor upgrade. Also available is software support for leading image acquisition packages.

PI (Physik Instrumente)
photonics@pi-usa.us

Rod-Type Fiber Laser

Eolite Systems has released the Octopus, a rod-type laser for thin-film scribing applications. With up to 16 fiber-delivery channels, each beam provides light at 515 or 1030 nm, with pulse duration as low as 10 ns, peak power up to 4 kW and repetition rates up to 300 kHz. Each fiber channel (up to 5 m long) provides up to 4 W at 515 nm with good beam quality, or up to 30 W in a uniform multimode output configuration. Each channel can be independently power controlled. The laser's rod-type technology, together with demux fiber architecture, enables independent multifiber delivery. Other applications include silicon doping and solar cell scribing.
Eolite Systems
contact@eolite.com

Laser Shutters

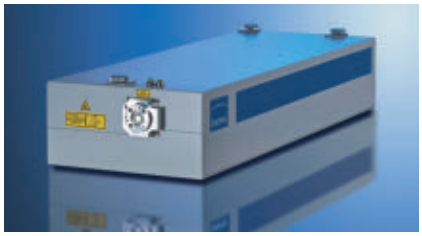
The FlexSorb line of laser shutters from nmLaser Products Inc. features a high damage threshold, quick switching speed, a small size, quiet operation and good thermal dissipation. The only moving part is a low-mass, flexible ferromagnetic cantilever membrane that operates in and out of the beam by noncontact electromagnetic techniques, reducing opening and closing shock, vibration and wear. The flexures are unaffected by foreign particles

clinging to the magnetic pole, and they offer long lifetimes. All units are immersion cleaning-compatible and can be provided for cleanroom applications. Slightly overdamped controllers eliminate system ring, ensuring efficient energy transfer to the magnet. That heat is merged with the laser optical absorption heat and is dissipated using thermal conduction to a common mounting surface.
nmLaser Products
sales@nmlaser.com

GigE Vision Camera

Matrox Imaging has unveiled the Matrox GatorEye, an industrial IP67-rated Gigabit Ethernet camera for use in machine vision applications. It is available in six sensor configurations: 640 × 480 at 110 fps with a ⅓-in. monochrome or color CCD; 1280 × 960 at 22 fps with a ⅓-in. monochrome or color CCD; and 1600 × 1200 at 15 fps with a 1/1.8-in. monochrome or color CCD. To connect to external devices, the camera has an optocoupled trigger input, strobe output, eight general-purpose input/outputs and a controlled current source for driving LED illuminators directly. It can be powered by 12- to 24-VDC or by Power over Ethernet.
Matrox Imaging
imaging.info@matrox.com

Solar Cell Processing



Jenoptik Laser, Optik, Systeme GmbH has released the JenLas disk IR50 for metal and emitter wrap-through applications. The laser combines beam quality in the infrared wavelength range at 1030 nm, with a flexible tunable pulse length. The 45-W system is suitable for laser drilling of silicon wafers for back-contact solar cells. It features passively cooled diodes, laser parameter adjustability and fast acousto-optic modulator power control. It delivers output power of >45 W at 30 kHz, linear polarization and a beam quality of M^2 ≤1.2. Other applications include 3-D prototyping, engraving, wafer dicing and scribing, microdrilling, microcutting and microstructuring.
Jenoptik Laser, Optik, Systeme
laser.sales@jenoptik.com

Dual-CCD Camera

The Orca-D2, a high-sensitivity camera for simultaneous dual-wavelength imaging, is available from Hamamatsu Photonics UK Ltd. Featuring two CCD devices and interchangeable optical blocks, the camera delivers ease of use with optical setup steps, including image alignment and focusing. It provides a wide field of view during wavelength imaging and delivers high sensitivity, low noise and a wide dynamic range. Its proprietary vacuum-sealed chamber technology promotes long-term, maintenance-free operation for demanding applications. It is suitable for Förster resonance energy transfer, ratio imaging and dual-wavelength total internal reflection fluorescence.
Hamamatsu
europe@hamamatsu.com

Baumer Optronics GmbH 15
www.baumer.com/cameras

Castech Inc. 6
www.castech.com

China Daheng Group Inc. 20
www.cdhcorp.com

European Machine Vision Association 3
www.emva.org/conference/upcoming/8th_emva_business_conference_2010

Image Science Ltd 8
www.image-science.co.uk

Iridian Spectral Technologies 9
www.iridian.ca

ISP Optics 22
www.ispoptics.eu

Jenoptik Polymer Systems 17
www.jenoptik-ps.de

Klastech Karpushko Laser Technologies GmbH 7
www.klastech.com

Lasermet Ltd 11
www.lasermet.com

Mikrocentrum 17
www.fotonica-evenement.nl/index.php?id=4

Newport Spectra-Physics 5
www.newport.com

nm Laser Products Inc. 17
www.nmlaser.com

PI (Physik Intrumente) L.P. 13
www.pi.ws

Scitec Instruments Ltd. 21
www.scitecinstruments.pl

Sill Optics GmbH 2
www.silloptics.com

SPIE International Society for Optical Engineering 24
www.spie.or/x12301.xml

Stemmer Imaging Services GmbH 19
www.stemmer-imaging.com

Advertising Contacts

Please visit our Web site, Photonics.com, for all your marketing needs.

Robert J. Briere, Director of Sales
Voice: +1 (413) 499-0514 Ext. 101
Fax: +1 (413) 443-0472
bob.briere@photonics.com

Penny Pretty, European Sales Manager
European Main Office
Laurin Publishing Company
Whitehouse
134 Templewood
Walters Ash
High Wycombe
Bucks, HP14 4UF, UK
Phone: +44 1494 461071
Fax: +44 1494 461198
penny.pretty@photonics.com

David Round, Advertising Associate
Photonics Media
19 Pine Ridge, Carshalton
Surrey, SM5 4QQ, UK
Phone: +44 208 773 9944
Fax: +44 208 181 6178
david.round@photonics.com

USA
Timothy A. Dupree, Regional Manager
Phone: +1 413 4990514 Ext. 111
Fax: +1 413 4423180
tim.dupree@photonics.com

Rebecca L. Pontier, Regional Manager
Phone: +1 413 4990514 Ext. 112
Fax: +1 413 4423180
becky.pontier@photonics.com

Joanne C. Gagnon, Advertising Associate
Phone: +1 413 4990514 Ext. 226
Fax: +1 413 4423180
joanne.gagnon@photonics.com

China
Hans Zhong
Phone: +86 755 2157 3066
Fax: +86 755 2872 6973
hans.zhong@yahoo.com.cn

Japan
Scott Shibasaki
Phone: +81 3 5225 6614
Fax: +81 3 5229 7253
s_shiba@optronics.co.jp

Reprint services
Voice: +1 (413) 499-0514
Fax: +1 (413) 443-0472
editorial@laurin.com

Mailing addresses:
Send all contracts, insertion orders and advertising copy to:
Laurin Publishing, PO Box 4949
Pittsfield, MA 01202-4949

Street address:
Laurin Publishing, Berkshire Common, 2 South St.
Pittsfield, MA 01201
Voice: +1 (413) 499-0514
Fax: +1 (413) 443-0472
E-mail: advertising@photonics.com

Register Today

NEW LOCATION

SPIE Photonics Europe

Connecting minds for global solutions

Gain visibility at Europe's premier 2010 forum on optics and photonics

Conferences: 12-16 April 2010
Exhibition: 13-15 April 2010

The Square Conference Centre
Brussels, Belgium

www.photonicseurope.org

SPIE
Connecting minds. Advancing light.

Think fully equipped

Think **REO**

Call or visit us online to have us think about you.

303.938.1960 | thinkreo.com

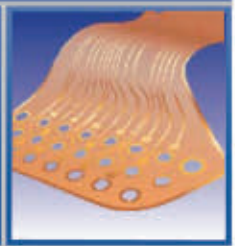
Research Electro-Optics, Inc. Boulder Colorado

REO™
precision optical solutions

Covering the full spectrum of your photonics needs.

Williams ADVANCED MATERIALS

BARR Precision Optics & Thin Film Coatings Group



Innovative Solutions, Exceptional Results !

Announcing Williams Advanced Materials has brought together BARR Associates, Inc. and Thin Film Technology, Inc. creating a highly advanced and diverse, precision optics, and thin film coating service provider, positioning the company as our Customers' First Choice™ when selecting a thin film coating solution.

Williams Advanced Materials – BARR Precision Optics & Thin Film Coatings Group

Services

- Precision Coatings Services
- Engineering Design Services

Markets

- Medical & Life Sciences
- Defense & Aerospace
- Space, Science & Astronomy
- Analytical Instrumentation

Product

- Optical Coatings
- Solderable Metallized Windows
- Precision Optical Filters
- Hybrid Circuits
- Optical Filter Assemblies
- Flexible Sensors & Interconnects

N. America - Specialty Coatings + (1) 805-688-4949, Precision Optics +(1) 978-692-7513
Europe + (44) 1 488-686056 Asia + (65) 6743-119

tft Thin Film Technology

BARR ASSOCIATES, INC.

www.williams-adv.com