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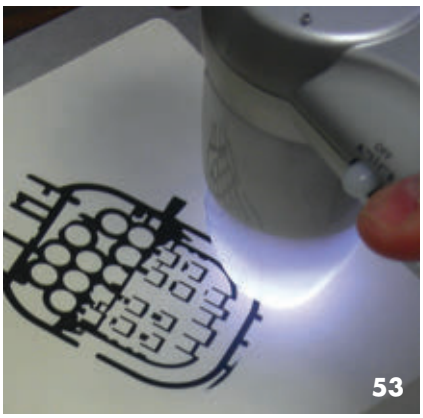
THE COVER

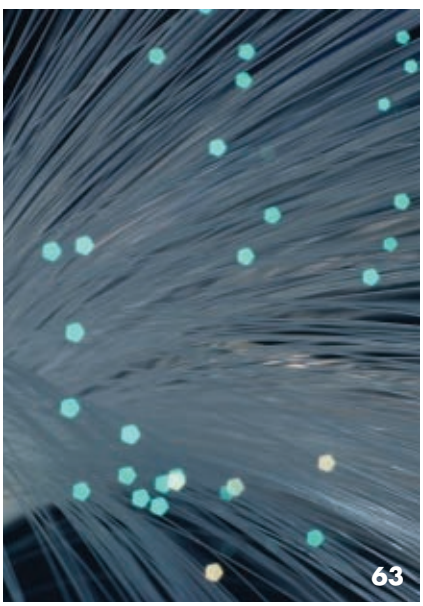
The massive Walgreens electronic billboard in New York's Times Square contains 12 million energy-efficient LEDs spanning 17,000 square feet, earning it bragging rights as the largest in the nation. New York-based D3 LED, the designer of the hi-tech hardware and software for the spectacular, used 10,987 modules, each containing 1024 to 1600 pixels. This month's cover was designed by *Photonics Spectra* Art Director Lisa N. Comstock.

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.

Volume 43 | Issue 3

FEATURES





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Careful with that eradication

This is what can happen when you mess with Mother Nature. In 1985, Australian scientists developed a program to kill off non-native cats on the island of Macquarie, a United Nations World Heritage site, because the felines were preying on native burrowing birds (see the February 2009 *Journal of Applied Ecology* online). Freed from the predators, the island's rabbits, also non-native, bred as rabbits tend to do devouring native vegetation and wreaking havoc on Macquarie's landscape and ecosystem.

Now ecological intervention isn't new, and clearly this isn't the first time that managing an ecosystem has produced unforeseen complications. Those who are loyal to the idea of balancing resources in accord with the needs of humans are far from buffaloed. Today prominent scientists, world leaders and citizens are calling for more unified systems of Earth's management – systems that would grow out of cooperation among leaders in research, technology, politics, social science and economics. Critics dismiss the ideology as arrogant or, at best, a pipe dream.

Not so fast. Our early failures are not much different from those that preceded some of our greatest achievements. History suggests that, with time and industry, we may succeed in developing new, enlightened and resourceful ways of balancing our lifestyles, our planet and our resources.

Almost 90 years ago, Soviet geochemist Vladimir I. Vernadsky wrote that humans were becoming a geological force, shaping the planet much as geological forces such as water, wind and earthquakes do. He envisioned a society enlightened by science that would lessen the impact of humans on Earth and its resources, calling it the "noosphere," a planet of the mind or "life's domain ruled by reason."

"We've come through a period of finally understanding the nature and magnitude of humanity's transformation of the earth," Harvard biologist Dr. William C. Clark told Andrew Revkin of *The New York Times* in 2002. "Having realized it, can we become clever enough at a big enough scale to be able to maintain the rates of progress? I think we can."

The satellites, imaging technology and computers already exist, and there are voluminous libraries of data and imagery already collected. Earth summits are becoming more plentiful and environmental concerns more familiar.

In many senses, we're just out of the gate. The tasks are daunting: Tens of thousands of decisions must be made to gain every inch of progress. Hurdles such as cost, consumption and the hoped-for alliance of vastly different countries, cultures and governments lie ahead. But weigh that against the prospect of a world coalition dedicated to monitoring and balancing all the forces on the planet.

Imagine that. I can.

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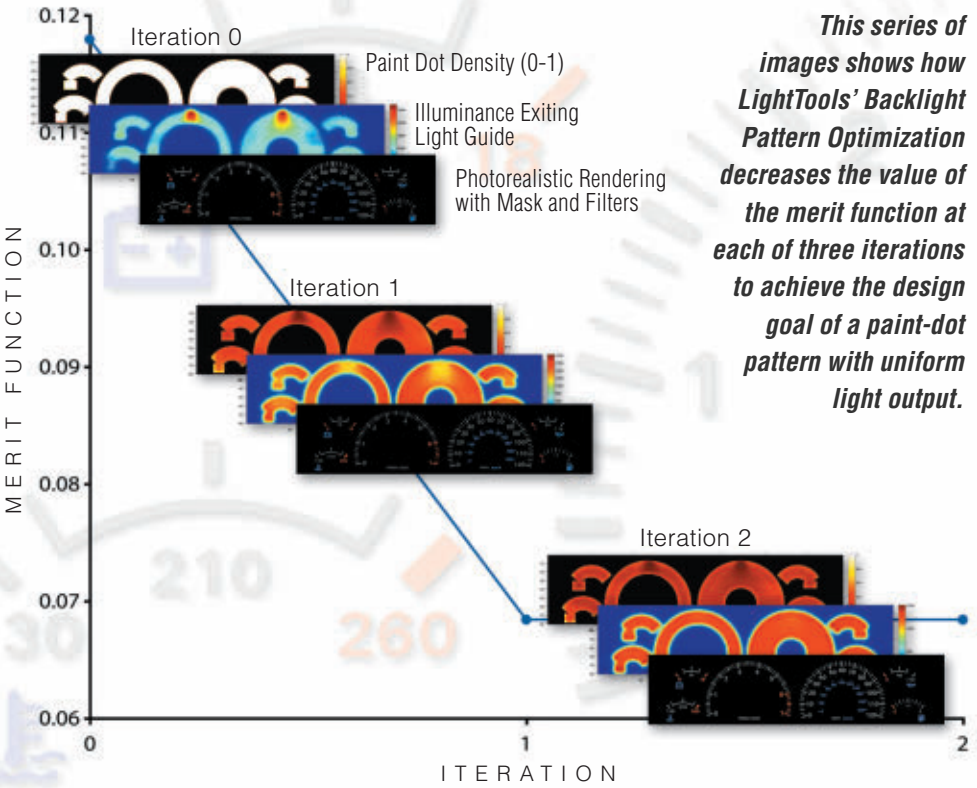

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Before "Lazybrains"

I only just read Laura S. Marshall's "Peregrinations" feature in the October issue of *Photonics Spectra* about the brain-activity game (" 'Lazybrains': a real mental workout").

I think it appropriate to note that this general idea, of a brain-activated game, is far from new. Our neighboring company across the parking lot displayed a similar game, called "BrainBall," probably five years ago. Although based on electronic monitoring of alpha waves, rather than on optoelectronic monitoring of blood flow, the end result seems to have been remarkably similar. I also might note that Dr. Dick Moberg, the principal of Moberg Research Inc., where we played this game, has been active for many years in the Philadelphia biomedical research community, possibly including Drexel University. He is a graduate of the University of Pennsylvania, adjacent to Drexel, lives in the same area and is a former adjunct professor of biotechnology. It seems quite possible that the Drexel people mentioned in your article, Jordan Santell and Paul Diefenbach, may have had contact with Dr. Moberg over the years. I cannot help wondering if they owe more of a debt to previous work than was reported in the article.

According to the link on Dr. Moberg's Web site (http://www.mobergresearch.com/brainball.html), "BrainBall" was invented in Sweden at the Interactive Institute and "has been the subject of several scientific research projects dealing with the interaction of humans and machines. Under the leadership of Magnus Jonsson, the first table was built in 1999 and subsequently shown at the Hanover Expo in 2000 and at Medica in Düsseldorf the same year. Research and developments continue at the Interactive Institute."

Laurence N. Wesson
Aurora Optics Inc.
Broad Axe, Pa.

The Editor Responds:

Space constraints prevented us from reporting on older, nonphotonic games that set the stage for a game like "Lazybrains," so thank you for sharing this interesting bit of history.

Laura S. Marshall
Features Editor

New covers win convert

After years of oblique, abstract, look-alike covers (a signature style for sure, but one I was never too fond of), first the new cover/interior design and then the chances you're taking with the covers – all laudable signs of progress.

Gene Marino
Andor Technology
South Windsor, Conn.

Wishes come true

I'm delighted to inform you that your wish has been granted ("Things I Want to See," page 20, January issue, "Snow Be Gone").

My company provides exactly these kinds of sensors and systems. They often are used to monitor roadway surfaces and runways at airports. We can predict freezing and icy conditions before they happen, and we can definitely measure them when they actually happen.

Unfortunately, you'll have to provide the "driveway heating" on your own.

Jim Tennermann
Vaisala Instruments
Woburn, Mass.

Banning the bulb

I read with interest your article (p. 106, January issue) on what seems to be a global, headlong rush to ban the incandescent bulb. Some of the write-ups I have seen on this subject include the downside of compact fluorescents: mercury vapor. There are some rather extensive guidelines published and proposed that should/must be followed when one of these breaks. (Do *not* vacuum the remnants, air out the room for hours, use a sealed bag, wear a mask.)

You might have included some of these warnings and cautionary notices. Are we curtailing one demon and replacing it with a more dangerous and sinister one?

Ray Turcotte
Computer Optics Inc.
Hudson, N.H.

Reducing lighting energy consumption

I'm responding to the sidebar "Banning the bulb" on page 106 of the January issue of *Photonics Spectra*.

It is gratifying that some countries are banning the incandescent bulb and promoting the substitution of LEDs and compact fluorescent bulbs (CFLs). I know of no environmental damage from LEDs, but CFLs contain mercury, and there is no guarantee that safe disposal sites will be offered or that users will conscientiously comply.

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I'm an engineer. I also have been environmentally involved for 30 years, starting with asbestos and lead abatement, then hazardous materials and fluorescent lamp reclamation, and now dealing with the effects of global warming.

In our zest to solve some of our world problems, we can create others. Accordingly, we should proceed cautiously. More efficient lighting certainly makes sense, but more importantly, educating users on wasteful practices can prevail. One good aspect of incandescent light is that it mimics natural light. Fluorescent lighting and LEDs can yield eyestrain.

Finally, in her last paragraph, Ms. Fischer refers to a three-fourths reduction in electricity with the use of CFLs versus incandescent lamps. I question this amount! Also, readers shouldn't be swayed into thinking that this is for all electricity. The primary "draw" of all electricity is by electric motors.

Fred J. Wittenberg
Evanston, Ill.

The Editor Responds:

You and other readers are correct in pointing out that changing to CFLs won't reduce total electrical consumption by three-fourths, but rather *lighting energy* consumption. Thank you for your mindful interpretation.

Charles T. Troy
Senior Editor

LEDs vs. CFLs

I wanted to drop you a quick note and tell you and the staff of *Photonics Spectra* how useful, relevant and interesting the articles are in this month's (January 2009) issue.

As I read through the magazine, I began to flag the articles of interest. When I was finished with January's issue, it had more flags than the famous amusement park.

I've been following news articles related to governmental attempts to ban incandescent lighting. Most I've seen mention compact fluorescents (CFLs) as the replacement and more often than not fail to mention LEDs as an alternative. I particularly liked the last line of your "Banning the bulb" article: "Imagine how much we can save when LED lighting begins replacing compact fluorescents."

It seems that the articles I've encountered compare either CFLs or LEDs with incandescent bulbs. I'm curious; has *Photonics Spectra* published articles with substantial data comparing and contrasting the benefits and cost savings of CFLs *and* LED technologies over incandescent lamps? If you have published stories, I've unfortunately missed them and would appreciate it if you could point me to those articles.

Fonda Moyers
Regional Manager
Opto Technology Inc.
Wheeling, Ill.

The Editor Responds:

Thank you for your high praise! We have not written articles comparing CFLs and LEDs just yet because LEDs are still in the development phase – at least as replacements in general-lighting applications. We are tracking the applications, however, and will provide our readers with comparison data and information about new developments as soon as possible.

Anne L. Fischer
Senior Editor

LEDs and light pollution

On page 63 of the January issue ("LEDs Light the Way to Homes and Businesses"), you wrote of installing LED outdoor lighting in drainage gates, which looks clever because it minimizes the wiring problems. However, this approach illuminates the sky, not the ground!

Wherever possible, we need to avoid illuminating the sky at night. It not only wastes energy, but it prevents us from viewing the moon, stars and planets.

I'd suggest a follow-up piece about efficient and effective outdoor night lighting.

Chris Curtin
Electronic Displays
Friday Harbor, Wash.

The Editor Responds:

The topic of light pollution is covered in this very issue.

Anne L. Fischer
Senior Editor

LEDs and the environment

LEDs are rightly being heralded as the next great advance in general lighting technology ("GreenLight," January issue). But to implement real environmental stewardship, we must look beyond just energy savings, especially in outdoor illumination. The effects of artificial nighttime

illumination itself on the environment are profound, and evidence for serious disturbance to not only ecology but human health continues to mount.

Most biological effects of light are color-dependent; on average, the shorter wavelengths tend to have stronger effects. Blue light also scatters more in the atmosphere, carrying the impact of outdoor lighting over greater distances.

The current development process of efficient, practical LEDs offers the ideal opportunity to create lighting with not only high energy efficiency but also built-in minimization of environmental and health impact via control of spectral output. And, especially in outdoor lighting, we should take advantage of LEDs' directional light output (as opposed to the nondirectional nature of traditional high-intensity discharge lamps) to create well-focused luminaires.

We have the opportunity to create a *truly* well-lit nighttime environment rather than emulating the glare-filled (and environmentally damaged) world that many of us have become accustomed to in just the past few decades. Environmental impact beyond just energy consumption must be included in all consideration of lighting improvement.

Drew Carhart
Illinois Coalition for Responsible Outdoor Lighting

From autos to solar

The transportation industry realizes the need to transition to a new energy source. For years, few manufacturers looked at what they were doing compared with what was needed. Looking at solar a few years ago, I figured that, if we covered the area from Orange County, Calif., to the Mexican border with solar devices, this would be a meaningful effort. If the device you are building has a small output, then of course you will need lots of them to make an impact.

The products must be mass-produceable and efficient. If you go to Google and enter the name of Shmuel Ovadia, managing director of SDE Energy Ltd., you will note that the current price of 1 MW is $900,000 for natural gas, $1.5 million for wind or coal, and $3 million for solar.

Israel has been going green for 40 years; its focus in this area is well worth noting. Few energy efforts get in each other's way, and this is fortunate because, at this point, we are going to need all of the viable ones. It is encouraging to see a few manufacturers settling down and actually dealing with reality. We have needed that for years.

I enjoyed your concise item "From Autos to Solar" (February 2009, *Photonics Spectra*) and hope that my response will give you some idea of the impact you have made with it.

Hugh Coleman
Kelso, Wash.

Funding connections

I enjoyed your *Photonics Spectra* article, "Infrared Imaging Gives UK Dentists a Better Look" (February 2009).

At the end, you said that the team developing the infrared imaging system for dentistry "is looking for funding for commercialization, via company startup or technology licensing to interested parties around the world."

Could you please put me in touch with the person responsible for the team's funding effort? I would like to investigate options that might be of interest to them here in the US.

Marcel R. Singleton
The Value Engineering Alliance
Cambridge, Mass.

The Editor Responds:

I have forwarded your expression of interest to the business development manager. The contact for anyone who wants to follow up on manufacturing solutions or investment in this venture is:

Simon Andrews
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Christine Connolly
Contributing Editor

Correction

In the FastTrack section of the February edition of *Photonics Spectra* (p. 29), we incorrectly reported that OptoAlignment had relocated to Charleston, N.C. In fact, the company has relocated to *Charlotte*, N.C. Also, the company's centration and alignment system is in the ultraprecision category at 0.5 µm/1.02 arcsec TIR.

PHOTONICS MEDIA

Online

Here's what you'll find this month on *Photonics.com:*

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WEB EXCLUSIVES:

Highlights From Mobile World Congress 2009

The first completely solar full-touchscreen phone, a "Dick Tracy"-style wristwatch phone, and the first pico projector chip set and mirasol displays are just some of the new products introduced in Barcelona at GSMA Mobile World Congress 2009, the mobile industry's largest annual event.

Cell Phone Trends for 2009

Check out some of the must-have features for 2009 in so-called "smart" phones (think mobile computers that make calls). Some of the hottest features include touch screens with "clickability," sophisticated accelerometers, full QWERTY keyboards, GPS capability, high-resolution cameras with flash, 3G networking and WiFi connectivity.

As Shenkenberg sees it

David L. Shenkenberg, features editor, delves into subjects that affect our industry, from laser safety to venture funding in the photonics industry.

Plus all the latest news, products and industry information you need each day.

Coming in April . . .

Astrophotonics: Astronomy may be the oldest science but today it's driving the development of the newest instrumentation such as large optical and infrared telescopes.

Forensic Science
Scanning electron microscopes and lasers are being used in ever-new ways to fight crime.

Quantum Computing
Single-atom quantum dots may bring us closer to true quantum computing.

State of the Economy
A report on how the current economic climate is affecting – and is likely to affect – photonics companies and research efforts.

GreenLight includes stories on using fluorescence detectors to find mercury in fish and in dental fillings; how WaterMill uses photonics to pull water right from the air and then kill bacteria in it using a UV sterilizer; and environmental safety in the photovoltaics, silicon cell and solar cell industries.

Plus all the regular features you look for month after month.

You can't afford to miss this issue.

Before Newton, there was Alhazen

BY DAVID L. SHENKENBERG, FEATURES EDITOR

A millennium ago, an Arab scientist authored more than 100 works on optics, astronomy, mathematics and religious philosophy. Although he was arguably one of the greatest scientists of all time, his name is little known to people living in Western countries today.

He is sometimes referred to by his last name, ibn al-Haytham, but he is most often called by his first name, Alhazen, although historians have noted that his first name is more accurately translated to al-Hasan or Abu Ali al-Hasan.

Alhazen was born in Basra in what is now Iraq in the year 965 and died around 1040. Although he was born in Basra, he lived most of his life in what is now called Cairo, Egypt. While Europeans languished in the Dark Ages, the Arabs were experiencing their Golden Age, and Alhazen is the most celebrated scientist of that time.

His most famous work, *Book of Optics*, was translated into Latin and disseminated throughout Europe in the Middle Ages. This work influenced many great thinkers, including Roger Bacon, who wrote a summary of it. In this book, Alhazen correctly identified that eyesight is caused by light entering the eye, contradicting an earlier belief espoused by Euclid and Ptolemy that light is emitted from the eye.

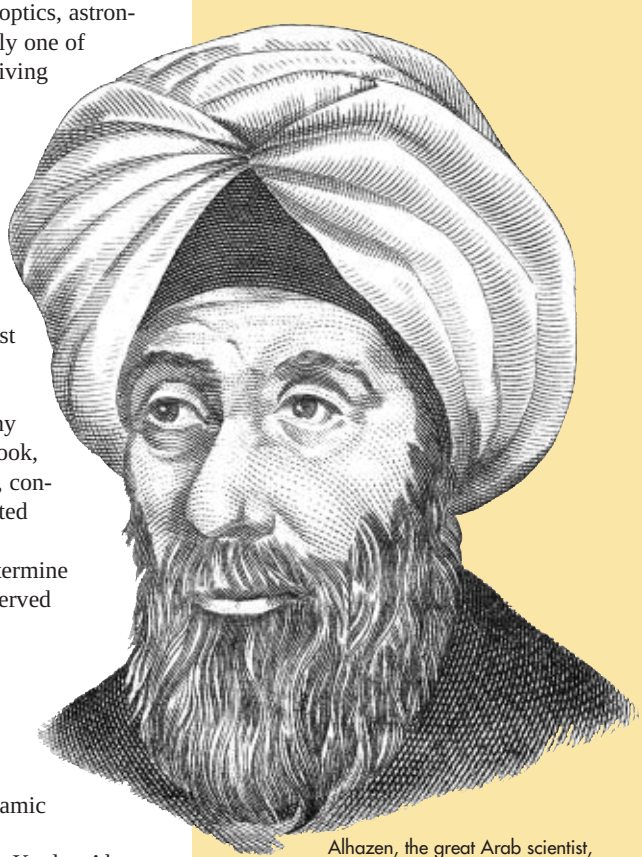
In what is known as Alhazen's problem, he also used conic sections to determine the point of reflection from a surface given the center of the eye and the observed point. He described a pinhole camera and the camera obscura.

Alhazen also described the refraction and the dispersion of light into its component colors, ideas credited to Isaac Newton. "Certainly in the field of optics, Newton himself stood on the shoulders of a giant who lived 700 years earlier," said Jim Al-Khalili, a physics professor at the University of Surrey in the UK. Khalili recently narrated "The Empire of Reason," a BBC program on Alhazen that is part of a three-part series on medieval Islamic scientists.

Alhazen also described the motion of the planets, which inspired Johannes Kepler. Alhazen was perhaps the first person to use the scientific method. Author Bradley Steffens calls him "the first scientist."

But Alhazen did have a low point in his career. He became overconfident and bragged that he could regulate the floods of the Nile. The ruler of the land, who was known as the Mad Caliph, heard this boast and ordered Alhazen to make good on it. Realizing that he faced an impossible task and fearing the punishment of the caliph, Alhazen feigned madness and was placed under house arrest from 1011 until the caliph's death in 1021. House arrest was a blessing in disguise because it gave him time to do his experiments and write books, including his famous book on optics.

david.shenkenberg@laurin.com



Alhazen, the great Arab scientist, made many contributions to optics.

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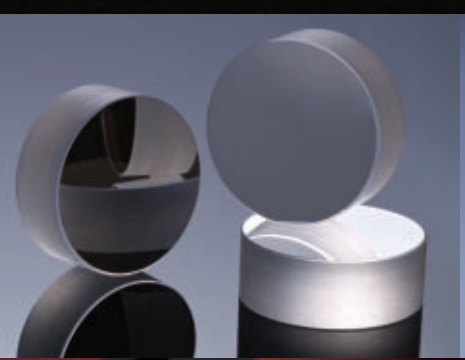

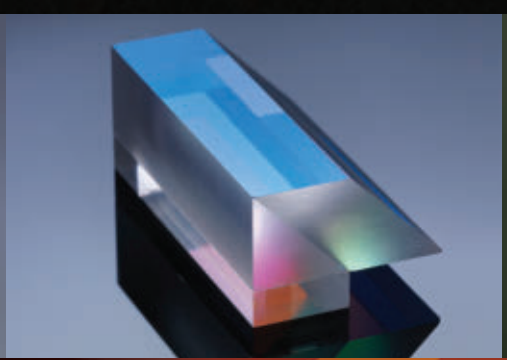

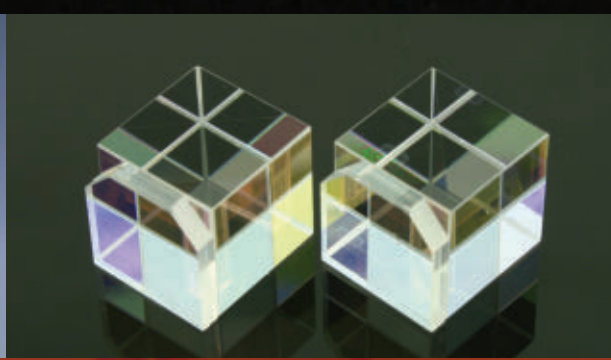

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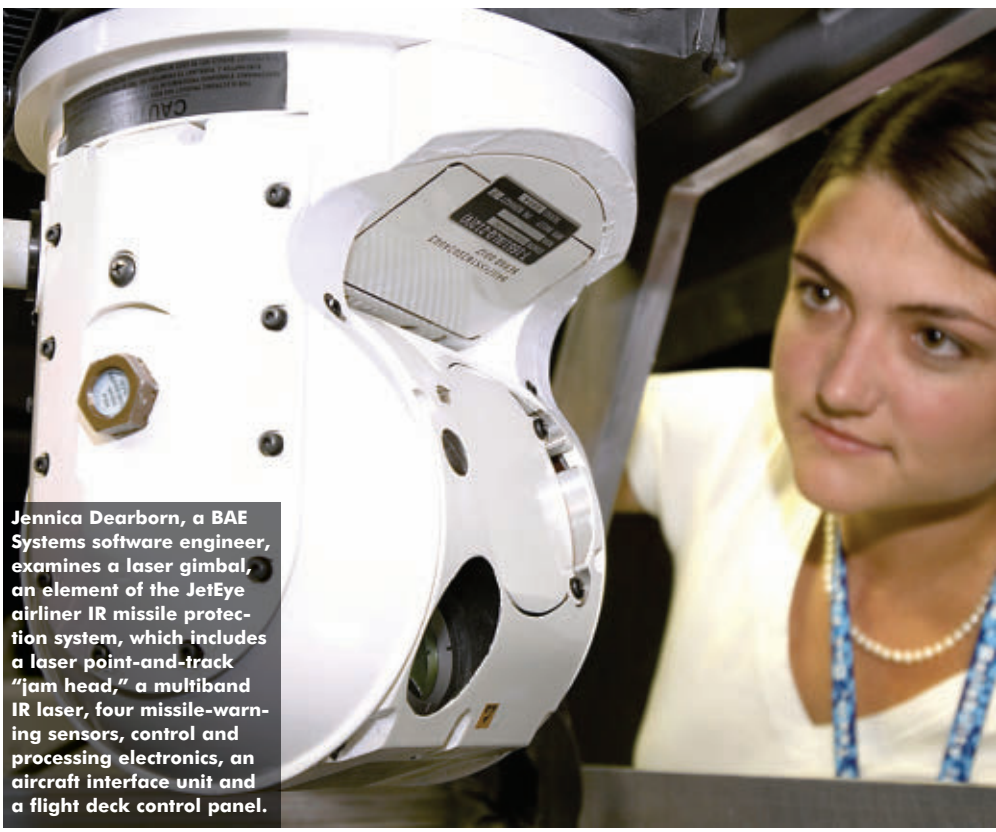
Protecting aircraft with photonics technology

SANTA MONICA, Calif. – Shoulder-fired missiles, or man-portable air defense systems (MANPADS), have been used by terrorists, criminals and other nonstate actors to take down civilian aircraft.

In 2003, the US Department of State estimated that, since the 1970s, more than 40 civilian aircraft had been hit by shoulder-to-air missiles, causing about 25 crashes and more than 600 deaths worldwide. In 2002, for example, terrorists fired two missiles at an Arkia Airlines Boeing 757-300 carrying 271 passengers and crew as it took off from Mombasa, Kenya. Fortunately, both missiles missed their target. In 1998, a Boeing 727 airliner was targeted by rebel forces over the Democratic Republic of the Congo, resulting in the deaths of 40 passengers.

Many state governments and international organizations are working to reduce the probability that these missiles will get into the hands of those who wish to target civilians. In 2005, it was estimated that, to produce the weapons, more 1 million MANPADs had been manufactured by as many as 20 countries. It is believed that, although most of the devices are secure in national inventories, excess and obsolete stockpiles exist that are easily accessible to unauthorized users.

The US government and other countries and organizations continue to study the problems associated with MANPADS, weighing the benefits of potentially saving lives and reducing the economic disruption of an airline attack against the effectiveness and costs of possible solutions, among them, photonics technologies.



Jennica Dearborn, a BAE Systems software engineer, examines a laser gimbal, an element of the JetEye airliner IR missile protection system, which includes a laser point-and-track "jam head," a multiband IR laser, four missile-warning sensors, control and processing electronics, an aircraft interface unit and a flight deck control panel.

An element of the JetEye airliner IR missile protection system, the laser point-and-track "jam head" is fitted to the underbelly of a plane.

An artist's concept of a shoulder-fired missile being defeated by a laser-based IR countermeasure system on an airplane. Photos courtesy of BAE Systems.

What are MANPADS?

Intended for lawful military use, MANPADS are designed to help troops defend themselves against aerial attack. About the size and weight of a full golf bag, the portable short-range surface-to-air missiles can be fired from the ground by an individual to target aircraft at takeoff or landing.

Most MANPADS consist of a missile packaged in a tube, a launching mechanism and a battery. The missiles usually contain homing devices that direct the weapons toward their target. The devices are typically classified by their guidance systems or seekers: IR, which home in on an aircraft's heat source; command line-of-site, where the operator visually targets the aircraft and uses radio controls to guide the missile; and laser guidance.

Countermeasures in progress

The US Department of Defense is working to minimize the threat of shoul-

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der-fired missiles to military and commercial aircraft through the development of onboard IR countermeasure systems. It is developing laser-based directional IR countermeasure systems, which are expected to significantly improve an aircraft's chances against heat-seeking missiles in comparison with the alternative nondirectional IR countermeasure system technology.

In 2004, the US Department of Homeland Security (DHS) launched its C-MANPADS initiative, under which defense industry contractors are developing and testing existing military defense countermeasure systems for use on commercial airlines. BAE Systems' JetEye IR missile defense system, for example, completed its first flight on a scheduled American Airlines aircraft in 2008, beginning the final phase of the DHS program to test the suitability of the equipment for commercial aircraft.

Northrop Grumman Corp.'s Guardian system, which is attached to the belly of a plane, also has undergone initial testing phases and is being tested in commercial cargo flights. Both systems use an IR sensor to detect missile launches and a laser burst to redirect the attacking guidance system.

At the component level

A typical shoulder-fired missile tracks the target airplane by locking onto the signature of the heat given off by the airplane. Alternate IR countermeasure technologies provide for the deployment of chaff and flares by the target to confuse the guidance system of the missile. Although these systems have been moderately successful, the MANPADS can reacquire the target and hit the airplane.

A major innovation in providing improved protection, directed IR countermeasure technology moves away from the chaff-and-flares approach. The new technology involves an IR laser mounted on a target airplane. The laser activates when a MANPADS firing is detected and confuses the eye and brains of the incoming missile. Various types of lasers in the 4- to 5-µm range, such as optical parametric oscillators and optically pumped semiconductors, have been used, with varying degrees of success.

Pranalytica Inc. of Santa Monica, Calif., recently introduced a turnkey 2-W fully packaged, CW room-temperature quantum cascade laser emitting at 4.6 µm for incorporation into IR countermeasure systems. Four tier-one aerospace/defense contractors have purchased the company's 1-W versions since 2008, according to C. Kumar N. Patel, president and CEO.

Because multiple lasers can be incorporated into the directional IR countermeasure systems, the 2-W components provide simpler, smaller and more cost-effective technology for the task, while providing a greater range of protected area. The components offer high reliability and are energy-efficient.

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Night-vision goggles no longer just for military

TEMPE, Ariz. – Pilots flying aircraft at night and during low-light conditions know how difficult it can be to perform flight operations when visibility is limited. Not seeing clearly can seriously affect what could already be a dangerous task. Medical responders and search-and-rescue units, law enforcement teams, and others who must fly in the dark near offshore oil rigs, power lines or high rises, for example, are especially at risk.

Now, in an attempt to alleviate the dangers, the Federal Aviation Administration has approved certified military-use-only night-vision aviator goggles (NVAG-6) for civilian pilots.

Shown is a pilot looking through the NVAG-6 goggles. Inside an aircraft, the pilot must shift his eyes below the goggles to see the instrument panel because the binoculars allow visibility only in the near-infrared spectrum. Courtesy of Nivisys Industries.

"Night vision is a phenomenal asset to be using," said Lee A. Stephens, senior technical applications manager at Nivisys Industries LLC. "They help any night operation in the form of greater visibility and situational awareness."

The goggles are made by Nivisys, a manufacturer of thermal and night-vision equipment specializing in Aviator Night Vision Imaging Systems (ANVIS), which feature high-resolution, lightweight, easy-to-operate binoculars designed to fit helmets worn by helicopter pilots and fixed-wing aircraft aviators.

According to Stephens, the equipment must go through environmental performance requirements to gain Technical Standard Order (TSO) certification, a minimum performance standard issued by the FAA for civil aircraft equipment. "The NVAG-6 meets TSO-C164 approval," he said. "We're the only night-vision goggle manufacturer to receive this certification." A C164 order is specific to head-mounted, binocular, night-vision goggles.

NVAG-6

The NVAG-6 binoculars operate from a wavelength of approximately 600 to 900 nm. Image intensifier tube performance

The night-vision goggles, which can be mounted on the helmets of fixed- or rotary-wing aircraft pilots, can be adjusted for each individual. Distance from the eye, alignment and tilt can be adjusted. Courtesy of Nivisys Industries.

levels provide the system with high resolution for sharper imaging, higher gain, brightness control and low-distortion output optics.

When the helmet mount is flipped up, by a button release, the goggles shut off to preserve power and to prevent the tube damage that would occur if the unit were exposed to bright light.

Basic vision specifications include a 40° field of view, a focus range set at 25 cm to infinity, a 1× magnification, an optical lens diopter range of +2 to −6 and full-field eye relief of 25 mm. According to Stephens, there is no distance rating for night-vision goggles because atmospheric conditions such as clouds or dust may reduce visibility.

An advantage to the system is that the goggles can be configured to the pilot's face. Because interpupillary distance can be adjusted from 52 to 72 mm, the eyepieces can be centered directly in front of both eyes. A 27-mm fore-and-aft adjustment of the flip-up base moves the lenses closer to, or farther from, the eyes, and the module also has a 25-mm up-and-down adjustment and minimum tilt angle of 10°, enabling pilots to look beneath the goggles to see the instrument panel. Illumination within the cockpit must be viewed without the goggles, which do not operate at the visible wavelength. The equipment also can be adjusted for those who wear contacts or glasses.

Stephens said the goggles are made of anodized aluminum, as opposed to plastic, such as those of other ANVIS night-vision goggles, making them lighter in weight at only 514 g. "Pilots bear the weight of the helmet and any radio or communication set that he has to wear on his head," he said. During aggressive maneuvers, the goggles' lighter weight will help to lessen any additional *g* force stresses that a pilot may have to endure, given the heavy strain already on the head and neck.

Differences between the NVAG-6 and standard ANVIS equipment are that the battery pack is low-profile – it is ear-mounted and protrudes only half as far from the back of the helmet, although it is slightly wider than on standard models; the curved housing conforms to the back of the helmet, eliminating any obstruction or interference with equipment inside the aircraft; and the rear-mounted battery is connected to a cable that extends over the top of the helmet.

The dual-battery power module, which takes regular AA batteries, has a lifetime of more than 40 h; with the reserve pack, the user has a total of more than 80 h of operation.

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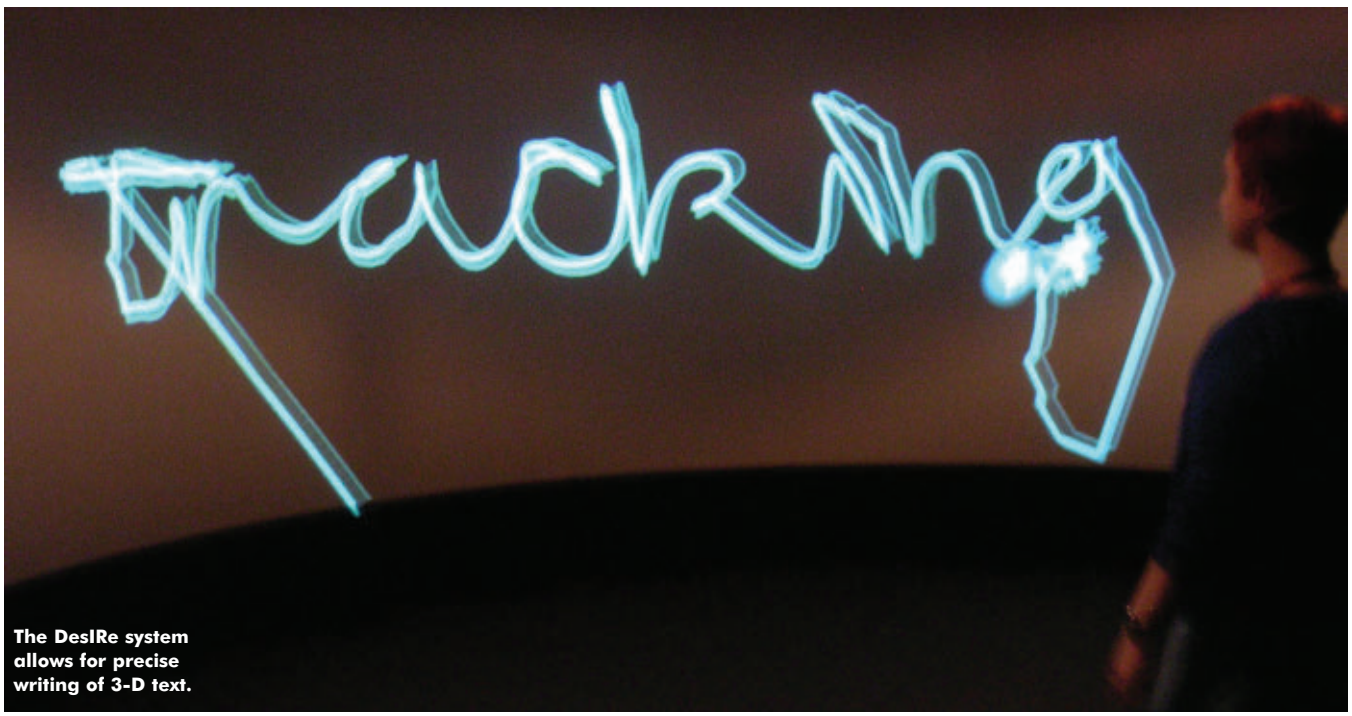
Controlling a computer with a gesture



The DesIRe system allows for precise writing of 3-D text.

SYDNEY, Australia – A very simple principle is at the heart of Dr. Manolya Kavakli's high-tech computer interfacing technologies: Less is more.

Kavakli, founder of the Virtual and Interactive Simulations of Reality Research Group at Macquarie University, did not start off in the virtual reality field. Trained as an architect at Istanbul Technical University in Turkey, she was an associate professor of architectural design at her alma mater for 10 years.

"I have always had an interest in using high technology in the field of design," she said. When she officially switched fields, she began by looking for ways to make computers more intelligent and more creative, and she soon realized that the definition of intelligence was unclear and creativity not yet understood.

Kavakli's goal became making it easier for anyone to be creative. "I wanted to design platforms to support everyone to express their creativity freely."

Teaching architectural design, she learned what kinds of tools inspire creativity and how novice designers learn to use them. "When I was a postdoctoral fellow in the UK and Australia," she said, "I explored the nature of the design process, especially how designers externalize their design ideas and what tools would best support this early conceptual design phase without interfering with their creativity and cognitive processing.

"As we all know, motor skills are quite important in this externalization, which puts some highly creative people in a disadvantaged situation, just because they do not have the necessary drawing or sketching skills. This also led me to think about the physically disabled people, who are more disadvantaged than all of the others.

"Existing tools are too complex to use, and they all require a considerable amount of training."

So, for the past five years, Kavakli and her research team have been working on interaction and visualization using virtual reality technology, always keeping the "less is more" mantra in mind.

"The best user interface is a nonexistent one," she said. "The user interface has to be intuitive and transparent. Interaction shouldn't interfere with our cognitive processing. As a natural consequence of this, I came up with the idea of gesture recognition that would remove the interface totally from the scene."

She and her team developed two gesture-recognition systems: DESigning In virtual Reality, or DesIRe, and DRiving for disabled, aka DRive.

"DesIRe allows any user to control dynamically in real-time simulators or other programs" using finger movements, Kavakli said. To operate DesIRe, the user dons a data glove with LEDs, and two

With DesIRe, users can communicate with game characters.

The interface used in the DRive system has been tested in a game-like virtual environment.

pairs of webcams capture the gestures.

"Using one hand, they can draw, and using the other, they can give commands and perform a number of transformations on the object designed," she noted.

"DRive allows a quadriplegic person to control a car interface using input from just two LEDs on an over-shoulder garment," she said. "We have tested DRive in a virtual environment similar to the ones used for racing games, and it works well. We have plans to integrate a sensor jacket with this system in the near future."

There are numerous applications for the DesIRe system.

"Many design professions, including architecture, fashion and engineering, can benefit from the outcomes of this project, since they heavily rely on sketching in the conceptual design process," Kavakli said. "Other areas, such as films, computer games, user interface design that involves storyboarding and visualization, may also benefit from sketching in virtual reality."

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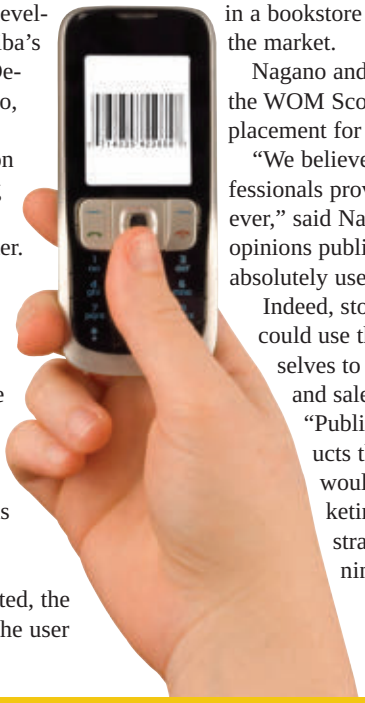
Product reviews in the palm of your hand

TOKYO – With so many options to choose from, how do you pick the best digital camera? You could close your eyes and point, ask your friends for recommendations, or stand there in the store while the salesperson drones on and on. But how can you be sure your index finger, your friends and your friendly neighborhood sales associate are reliable?

You also could try checking blogs for product reviews, but it can be daunting to face the massive amounts of information available online. And if you're already in the store, blog-surfing might not be an option.

But you could use the WOM Scouter, which would do the surfing for you.

"WOM" stands for "word of mouth," and the system, developed by scientists at Toshiba's Corporate Research and Development Center in Tokyo, "extracts and summarizes word-of-mouth information from Weblogs," according to Shinichi Nagano, research scientist at the center.



All you have to do is take a photo of a product's bar code with your cell phone, and the WOM Scouter program sends the bar code information to a server, which determines the product name and manufacturer. Then it finds blogs commenting on the product.

Once the blogs are located, the WOM Scouter returns to the user with information that is vital to decision-making, including an overall product rating, positive or negative, of the target product; a list of competitive products getting buzz on the blogs; and selected useful blogs worth reading in full.

You can even specify which features are most important to you, and the system will return results based on your input. "For instance, you can find the car that has the best reputation for fuel efficiency among Weblog communities," Nagano said.

To run the WOM Scouter, cell phones would have to be equipped with either embedded Java runtime or BREW runtime, Nagano said, and they would have to be able to take pictures. The system has been tested in a consumer electronics store and in a bookstore but is not yet available on the market.

Nagano and associates don't expect the WOM Scouter to be a complete replacement for sales associates.

"We believe feedback that sales professionals provide to be as important as ever," said Nagano. "That's because opinions published on Weblogs are not absolutely useful for every end user."

Indeed, store owners and operators could use the WOM Scouter themselves to aid in stocking decisions and sales campaign planning.

"Public evaluation of the products that the retailers deal in would be helpful for their marketing activities like sales strategies and product planning," Nagano said.

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Industrial lasers shine at Photonics West

SAN JOSE, Calif. – According to Tesko Laser, a company in the Chicagoland area that provides laser cutting and metal fabricating services, industrial lasers can slice through the hardest materials and make the most precise cuts with the narrowest heat-affected zones and with burr-free edges.

However, they typically cost more than plasma, oxy-fuel (that is, burns oxygen with gaseous fuel) and waterjet systems and have trouble cutting reflective materials such as aluminum and copper. They also have problems cutting thick materials, although this is not necessarily a disadvantage because the majority of sheet metal is less than 2 mm thick.

Traditionally, Nd:YAG lasers have been used for detail work, and CO_2 lasers have been used for big jobs. Both have proven track records, but diode lasers offer greater energy efficiency and substantially lower costs.

Laser cutting options

In January at Photonics West, Coherent showed a 1-kW direct-diode laser called the Highlight 1000F. The laser is coupled to a fiber and has a small, slender profile that can fit on a tabletop, so it can be moved to work around tight spots. It can be cooled with tap water.

According to Marcus Noble, who markets products on behalf of Coherent, the laser is designed "to cut the sheet metal of our daily lives." It also works well for welding, cladding and heat-treating.

Disk lasers are another alternative to traditional industrial lasers. This type of laser literally has a thin disk as the lasing medium. These lasers are powerful. In fact, Boeing recently used one in a military demonstration to shoot down an unmanned aerial vehicle.

Trumpf displayed its disk laser, the TruDisk 4002, at the recent Photonics West. This laser incorporates a new cooling system based on constant circulation of water through microchannels. Because of this cooling system, the laser is more compact, the diodes have changed, and it can be offered at a lower price, according to a company representative. Previously lasting 20,000 hours, it now lasts more than 50,000 hours. The representative said that it can run off tap water or even antifreeze for welding pipelines in Alaska.

The laser provides a maximum power of 16 kW. The diodes are sold in stacks of 4 kW, so that customers can choose to use more or less power, depending on the application, or save money by buying only one or two stacks to begin with, with the idea in mind that they can always buy more stacks later if they need to upgrade.

It has four outputs with fiber optic cables, which is a feature that the auto industry wanted. This enables factory workers to move the fiber to another output if one breaks.

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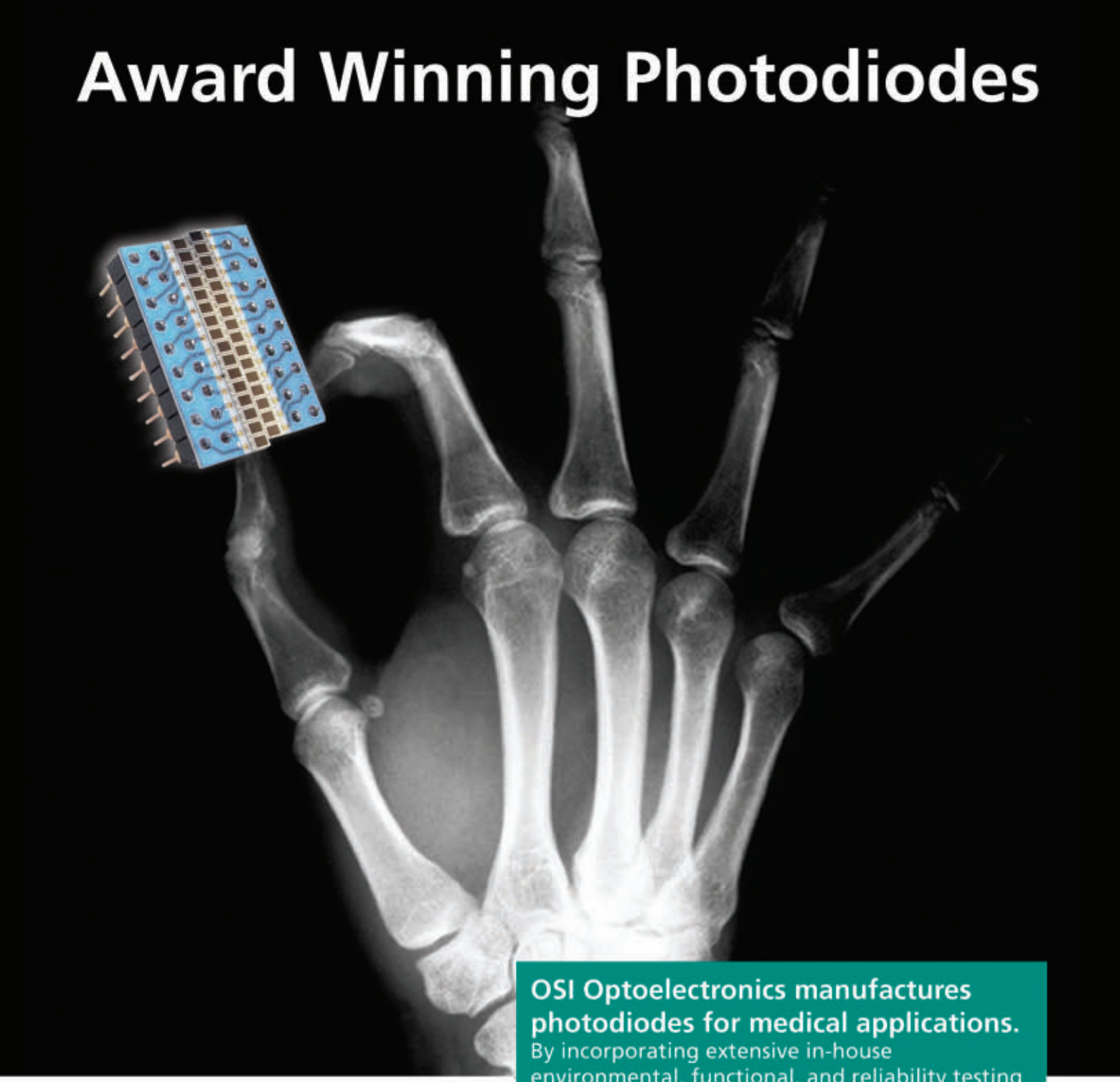
Award Winning Photodiodes



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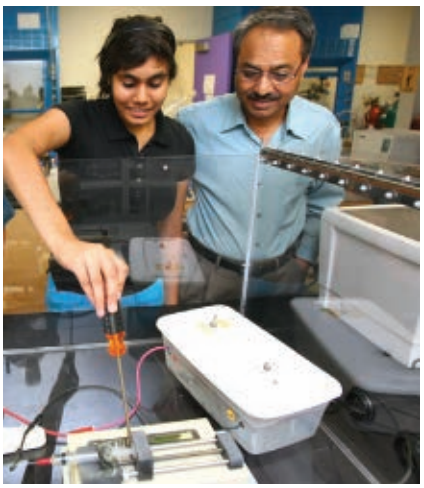
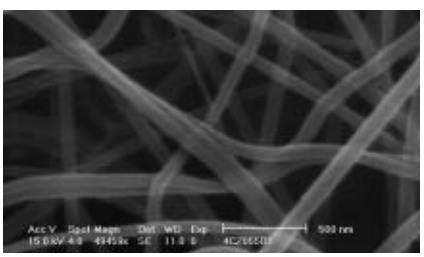
Next-Gen researcher

TOLEDO, Ohio – The life of the stereotypical 14-year-old girl revolves around friends, fashion and boys. However, Zainab Al-Firdaus is anything but typical. A sophomore at Perrysburg High School in Ohio, she is a co-author of a published scientific paper.

Zainab worked on the research and the paper with her father, Dr. Abdul-Majeed Azad, an associate professor of chemical and environmental engineering at the University of Toledo, and his undergraduate intern Sara L. McKelvey. The trio researched the fabrication of nanofibers of titanium dioxide, a photocatalyst that has antimicrobial properties when activated, and wrote a paper titled "Fabrication of Antimicrobial Titania Nanofibers by Electrospinning," which appeared in the Fall 2008 issue of *Advanced Materials, Manufacturing and Testing Information Analysis Center Quarterly*, published by the US Department of Defense.



Zainab Al-Firdaus and Dr. Abdul-Majeed Azad work together in the laboratory.



Nanofibers of titanium dioxide.

Azad is a proponent of introducing and encouraging young women to the sciences and making them passionate about the field, especially in laboratory settings. He suggests that the best way to increase the number of women in the science is to start young, eliminating the belief that math and science are "scary" or too difficult and providing mentoring and encouragement at home and in school.

As for Zainab, she says that she has learned a lot from this experience. Working in the laboratory not only emphasized how time-consuming designing and performing experiments can be, but also showed her how science can affect, and be incorporated into, daily life.

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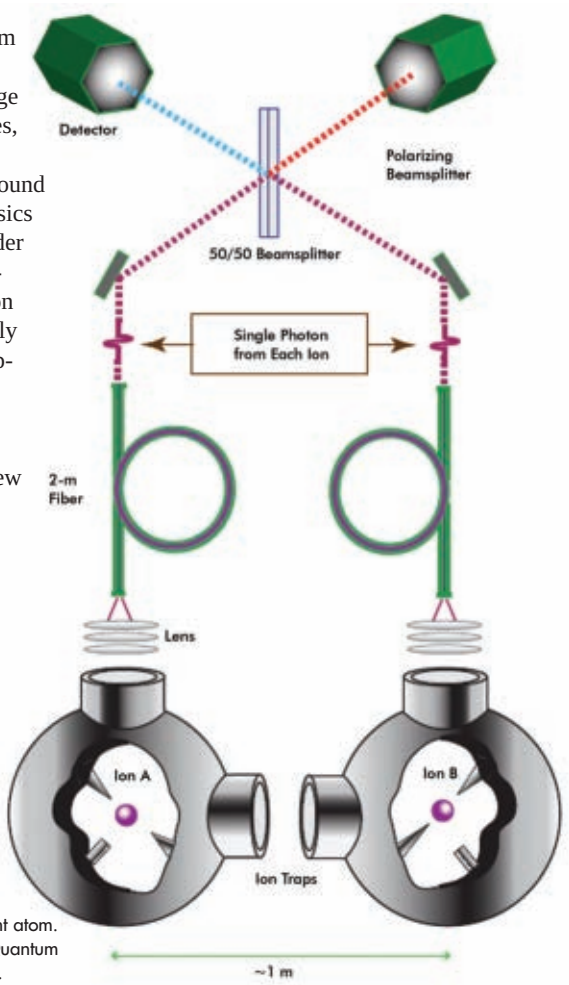
Teleporting a step closer to quantum computing

COLLEGE PARK, Md. – It's not "Star Trek," but it does seem like science fiction. Researchers from the Joint Quantum Institute at the University of Maryland have for the first time teleported information from one atom to another at a distance of 1 m, without the data passing through any physical medium. Because atoms can store quantum bits – or qubits – the technique could be used to hold and manage quantum data over long distances, something not feasible before.

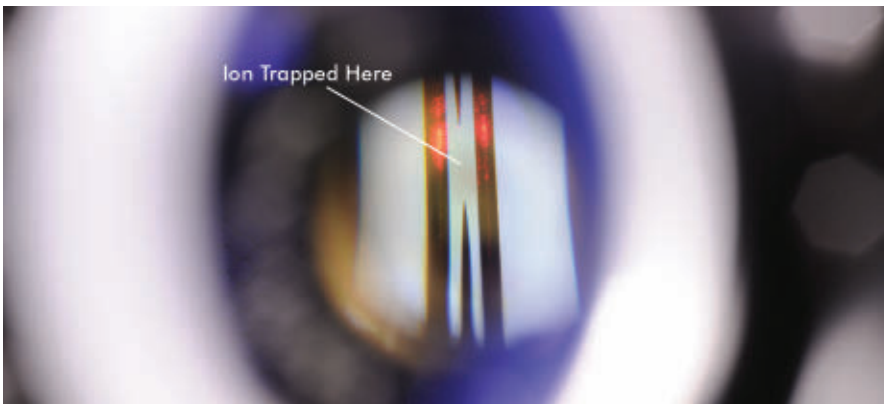
"This is a new way to pipe around quantum information," said physics professor and research team leader Christopher Monroe. Such long-distance quantum communication theoretically would be completely secure and immune to eavesdropping. Attempts at quantum communication are in their infancy, limited in part by short-range capabilities. Other uses of the new technique include multiparty communications in something akin to a quantum Internet or in quantum computing, which, because of its nature, can solve certain problems that classical computing cannot handle practically.

These applications are possible, in part, because a qubit, unlike a classical bit, is a superposition of two or more states. A qubit remains in this combination of yes and no until a measurement is made.

In demonstrating its scheme, Moore's team used two ytterbium ions, holding them in unconnected vacuum traps sepa-

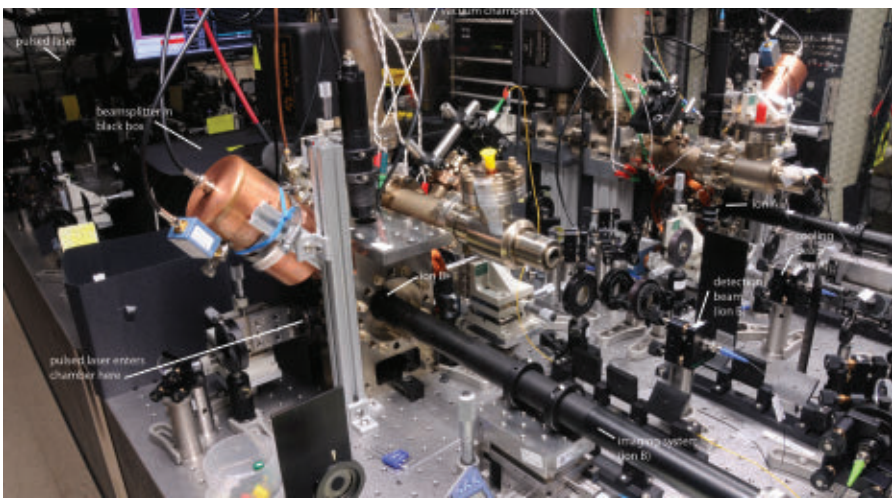


For the first time, researchers have stored information in one trapped atom (below), then teleported it across a distance of 1 m (diagrammed on right; setup shown on next page) to a different atom. Images courtesy of Curt Suplee, Joint Quantum Institute and the University of Maryland.



rated by about 1 m. At the start of the process, the investigators initialized each ion using a microsecond-long pulse of 369.5-nm light from a frequency-doubled amplified diode laser. They applied a resonant microwave burst of a controlled phase and duration to put the first ion in the qubit state to be teleported to the second ion.

They then fired a picosecond-long laser pulse at both ions. Each ion emitted a single photon correlated to the originating atom's qubit state. After capturing the emitted photons and routing them through a 50/50 beamsplitter, they recorded their arrival at one or both of two detectors. The latter case signaled when the two atoms were entangled, with their properties intertwined. When that happened, the researchers measured the qubit state of the first ion, which provided them the ability to recover information from the second ion that had been stored in the first.



Given the entanglement signal, the method faithfully teleports information with 90 percent accuracy, the group reported in the January 23 issue of *Science*. A drawback is that the entanglement signal occurred only a little more than twice every hundred million attempts. The researchers overcame this low probability by repeating the entire procedure tens of thousands of times per second. Even with that, entanglement was detected only every 12 minutes.

In scaling up to a larger number of atomic nodes, the likelihood of detecting entanglement must be increased, and Monroe said the group is working on this. "We have some ideas [about] how to add several orders of magnitude to the success probability of getting those photons into fibers and detected."

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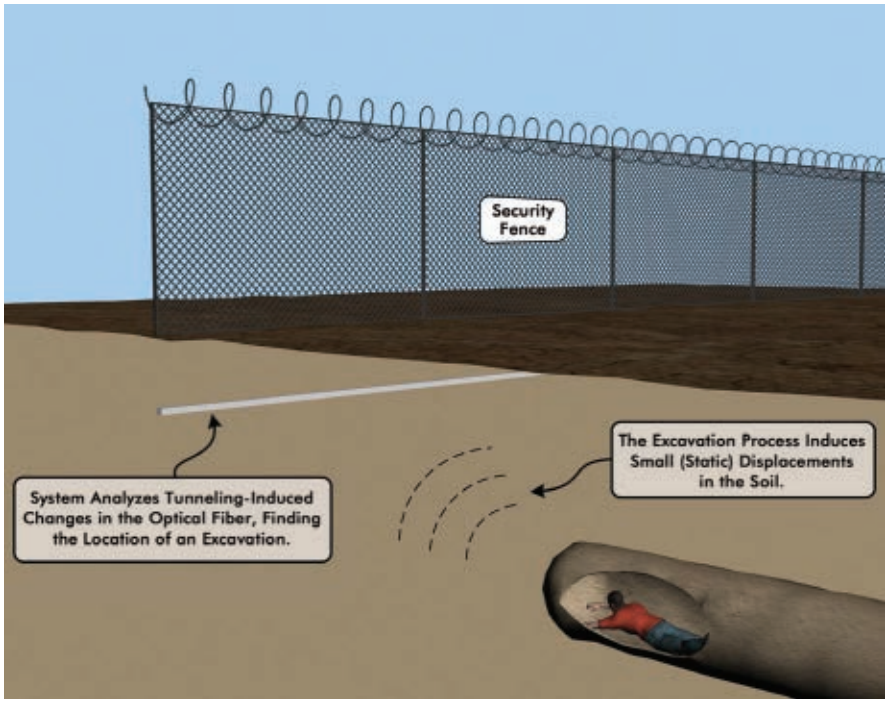
An underground fiber optic fence

HAIFA, Israel – Tunneling to circumvent borders could be a thing of the past, thanks to a fiber optic-based technique developed here. Researchers Dr. Assaf Klar and Dr. Raphael Linker of Technion, the Israel Institute of Technology, have devised a system that monitors buried fiber for the telltale soil displacements associated with tunneling activity.

The technology can detect tunnels many feet below ground, with the limit dependent upon tunnel size and the distance between fiber and tunnel. “But when the distance is smaller than about 20 meters, the detection rate is high, regardless of tunnel size,” Klar said.

The method makes use of Brillouin optical time-domain reflectometry, a fiber optic strain-monitoring technology that measures the Brillouin shift of the back-



By monitoring tiny soil displacements along a fiber optic cable, researchers say they can detect tunneling performed by smugglers. Image courtesy of Technion, the Israel Institute of Technology.

scattered light wave. This shift is affected by longitudinal distortion along a cable, which, in turn, is affected by strains in the fiber arising from interaction with the surrounding soil. The system delivers continuous information from the fiber, and a single device can monitor up to 30 km of fiber optic line. That makes for low-cost detection because the cost of standard single-mode communication fiber runs a fraction of a dollar per meter and one-third that per foot.

> "...the detection rate is high, regardless of tunnel size."

However, the data from the analyzer, by itself, does not distinguish aboveground activities such as rain or soil loading from underground ones; e.g., tunneling. To make the distinction, the researchers decomposed the complex measured signals into simpler wavelets. They used analytical solutions and numerical simulations to train an automatic detection system based on a neural network, training and validating it with about 50,000 simulations. The resulting system requires no special expertise to operate and does not need a constant presence of personnel along the perimeter, unlike alternatives such as ground-penetrating radar.

The scientists adjusted the neural net to avoid false alarms, a key criterion if the system is to be implemented in a dangerous situation. The trade-off is a greater likelihood of not detecting a tunnel.

In practice, the fiber fence could be arranged in two configurations: buried at a shallow depth of a meter or so, perhaps running parallel to an aboveground fence, or buried in shafts, separated by less than 20 m.

According to the researchers, a prototype tunneling detection system could be deployed within a few months. Moreover, the technique could be used for other applications after refinement and further development. The researchers are investigating some of these alternative uses.

"We have been working on a similar system to detect sinkhole development, which is a major problem in the Dead Sea area," Klar said.

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Flat panel displays: Green expectations

AUSTIN, Texas – By 2012, 70 percent of flat panel display shipments are expected to feature environmentally friendly characteristics, up from 20 percent in 2008, and by 2014, "green" shipments will dominate the market, according to a report from DisplaySearch, a market analysis firm based in Austin.

Titled *Green Technology in Flat Panel Displays: Market Technology and Trends*, the report addresses three kinds of flat panel displays: plasma, organic LED and thin-film transistor liquid crystal. DisplaySearch considers displays to be eco-compatible if they meet one or more of several conditions; that is, if they have environmentally friendly components and materials; achieve lower power consumption by using new components or technologies; are compliant with environmental regulations, such as for waste disposal; use production processes that reduce the amount of energy and materials consumed; are completely or partially recyclable; or incorporate eco-friendly concepts into their design, packaging, methods or materials.

According to DisplaySearch, green flat panel displays, which were in development in 2008, are expected to move into the implementation phase in 2009 and into marketing promotion in 2010, to pass the 50 percent mark in widespread adoption in 2011 and to achieve 100 percent adoption in 2014.

Participants in the flat panel display supply chain are interested in the greening of the displays because of drivers such as environmental regulations, including EnergyStar; cost reduction, which should happen as green technology improves and more suppliers join the effort; reduced liability, by preventing future damages or customer claims; and, finally, because of social responsibility.

Long-term benefits of green tech

The cost and performance balance is the main challenge facing green flat panel display makers, according to David Hsieh, vice president of Greater China Market at DisplaySearch. Green technology is not always a cost saver, he said, adding that new green components may be more costly than their nongreen counterparts, or a new green manufacturing process might hurt the production efficiency or yield rate in the short term, even though it could be more cost-effective and environmentally friendly in the long term.

Many people in the industry question the necessity for an emphasis on green technology during the current economic situation, in which there is an oversupply of panels in a slow-demand-growth market, Hsieh said. Sometimes there are higher costs initially, but in other cases, such as the replacement of backlight lamps with cheaper optical films, there can be savings.

Paths to savings

DisplaySearch analysts believe that all green technology will save costs in the long run for both flat panel makers and their customers, the latter of whom will save in electricity costs by using more energy-efficient panels. Customer demand for these green products will help the industry gain new momentum, according to Hsieh.

LCDs are still the dominant technology in the television and personal computer industry, he said. Alternatively, organic LED technology is naturally greener than LCD and plasma display panel technology because of its simpler structure and lower power consumption. Greener plasma technology can be brought about with high luminous efficiency, eco-friendly material with lower electromagnetic interference, and new manufacturing processes that reduce the amount of materials used.

There currently are four approaches to achieving greener thin-film transistor LCDs, according to DisplaySearch analysts.

The first is to adapt greener panel designs, such as new cell structures that increase panel transmittance, or new technologies, such as polymer sustained alignment, color filter-on-array, superhigh-aperture ratio or AU Optronics Corp.'s advanced multidomain vertical alignment.

The second is to use energy-saving production processes, such as photomask reduction and ink-jet printing of color filters. The third is to incorporate green components such as glass, color filters, liquid crystal, optical films and LED backlights. And the fourth is to redesign packaging using recyclable materials and space-saving containers for transportation efficiency.

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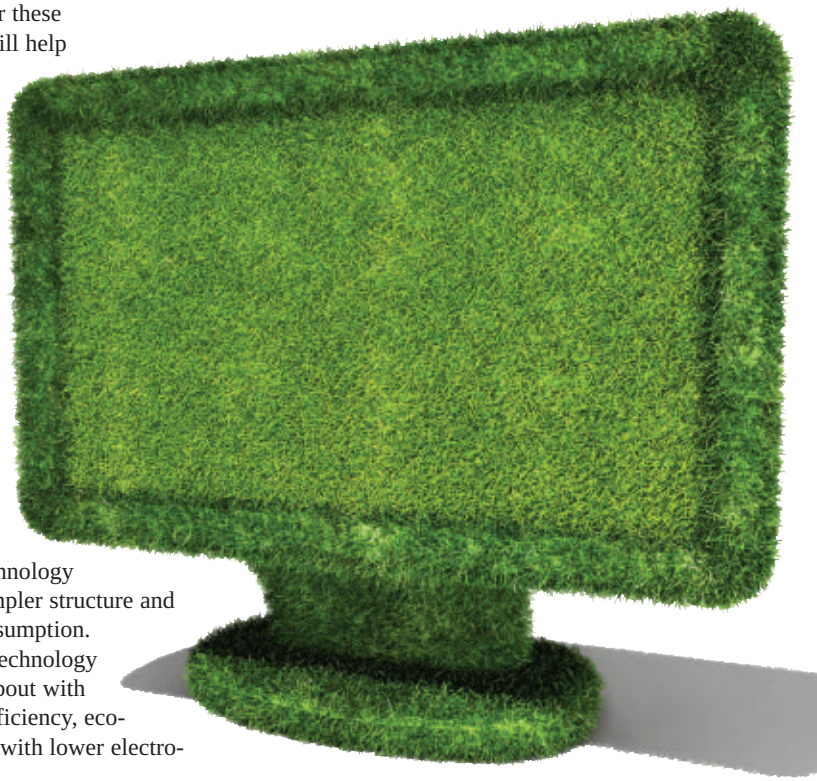


Expansion seen for UV LED market

LYON, France – Considering the strong potential of the UVA LED business in UV curing, augmented by the growing market demand for UVC LEDs in air and water purification, Yole Développement of Lyon, France, forecasts a cumulated $250 million UV LED market in 2015. Because UVA LEDs are compact, cost-effective and environmentally friendly, they are expected to replace the traditional UV lamp business – a market estimated to be worth $500 million in 2008 – and to make way for new applications, particularly portable ones, according to the market analysis company's *UV LED Market Report – 2009*.

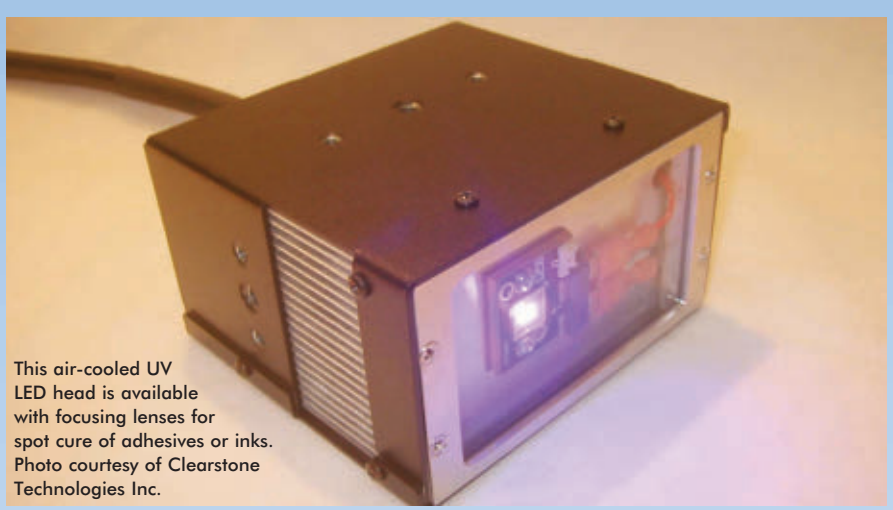
UVA LEDs to shine this year and next

Focused on UV LEDs based on GaN and AlN technologies, the report indicated that, in 2008, LEDs in the UVA/B spectrum (400 to 280 nm) held the largest share in sub-400-nm applications. It notes that more than 90 percent of the UV LED market was allocated to applications that required UVA/B sources, including UV curing, banknote counterfeit detection and medical instrumentation. The remaining 10 percent included a large segment of UVA-based LED sources (400 to 315 nm) for photocatalytic air purification.

UV LED light sources definitely can compete with traditional mercury lamps in the UV curing business, according to Yole Développement. Compared with mercury lamps, UV LEDs are smaller, nontoxic, more resistant to breakage, have longer lifetime expectations and shorter warm-up times, and easily can be adjusted for system integration.

In the area of heat management, backsided heat extraction is needed with UV LED devices, while traditional UV lamps have homogeneous heat distribution. UVA LEDs' long lifetimes, lower maintenance costs and power supply cost reductions have contributed to overall lower costs that are competitive with the traditional UV lamp sources. The power output of LEDs has greatly increased, and several watts per square centimeter are expected to be available this year and in 2010. According to the report, many new companies have emerged at the system and LED packaging level.

Today's UV LED market is oriented mostly toward UVA-emitting diodes because of their similarity to blue GaN diodes, according to Dr. Philippe Roussel, project manager of compound semiconductors and advanced materials at Yole Développement. The major difference in the UVA emitting diodes is a higher aluminum content in the AlGaN compound active layer and specific packaging that is resistant to UV light – enabling applications in UV curing, banknote detectors and photocatalytic air purification, he said. The improvement of UVA LEDs' performance (lumens per watt and output power) will enable them to gradually assume market share over the traditional UVA light sources, he added.



This air-cooled UV LED head is available with focusing lenses for spot cure of adhesives or inks. Photo courtesy of Clearstone Technologies Inc.

UVC LEDs to bloom later

The next booming market is expected to be related to the use of LEDs in the UVC short-wave, or germicidal, range (280 to 100 nm), which will open the door to water- and air-purification applications, according to Roussel. He added that we can expect to see the introduction of commercial air and water disinfectant products by 2010 and 2011 and to see UVC LED applications covering more than 50 percent of the UV LED market by 2013 and 2014. The growth of the UVC LED market is connected strongly to the availability of AlN bulk substrates that theoretically could multiply by 100 the LED chip optical power output, according to Yole Développement. It expects that several companies will provide AlN wafers in volume at the end of 2009. Roussel said that AlN bulk substrates probably are key to achieving highly efficient UVC LEDs. The substrates will improve their emission power greatly, he added.

Portable water purification

Miles Maiden, founder, CEO and chief technology officer of Hydro-Photon Inc. in Blue Hill, Maine, said that his company demonstrated the use of UV LEDs in water purification in 2004 with funding provided by the US Office of Naval Research and with support by DARPA's Semiconductor Ultraviolet Optical Sources program. Maiden invented the SteriPen, a portable water purifier that uses UV light to destroy waterborne microbes. The company does not have a model that uses UV LED technology, but one is in development. Maiden said that deep-UV LEDs hold promise for even smaller, lighter and faster SteriPen water purifiers, eventually at significantly lower prices.

The inherent advantages of UV LEDs could make them particularly suitable for water purification within a humanitarian context, he added.

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Searching for a smoother ride

BOSTON – Potholes had better watch out. Their days of delivering jarring jolts to cars could be shortened if sensor technology being developed under a grant to Northeastern University pans out. The goal is to develop inexpensive sensors that will be attached to common vehicles. A combination of acoustics and radar will monitor conditions below and on the surface of roads. When a problem is detected, global positioning technology will fix the general location of the vehicle.

But the precise determination of where a pothole or other problem is located will be the purview of cameras and perhaps lasers, said Dr. Ming L. Wang, a professor of civil and environmental engineering at Northeastern and principal investigator of the Versatile Onboard Traffic Embedded Roaming Sensors project. "[The sensors] will be used to pinpoint the exact location of the abnormality while the vehicle is moving at regular speed."

The project recently received a $9 million federal research grant that will fund

its five-year run. The goal is to develop techniques and products to monitor the nation's roads and infrastructure, which the American Society of Civil Engineers recently estimated needs $2.2 trillion in repairs.

The multisensor technology envisioned as a result of the project will ride on delivery trucks, buses, and possibly even passenger cars, if the cost of the technology can be held low enough. From these moving perches, the sensors will collect data on roadway conditions, transmitting the information wirelessly to processing locations, where the nature of specific problems and the appropriate responses will be determined.

For the scheme to work, the sensor modules cannot be costly – a challenge given that they must detect problems, pinpoint their locations and communicate this information. Furthermore, the monitoring must be done without distracting drivers or burdening vehicles. Such requirements are one reason why radar and acoustics are current front-runners for the sensing technology, but Wang said that the group would consider a video camera with the right characteristics.

He added that current camera technology is not up to the task. Research into and development of the sensor modules is under way. The first products resulting from these efforts are expected in about three years.

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Semiconductor Certification Presto Engineering Inc. of San Jose, Calif., a provider of product engineering services to the semiconductor industry, has received ISO 9001 certification.

Failure Analysis Viking Automation Tools LLC of Santa Clara, Calif., a manufacturing and engineering design company, has signed an agreement with Nippon Scientific Co. Ltd. of Tokyo. The contract gives the American company exclusive service and installation rights for Nippon's semiconductor failure analysis systems in the continental US, Mexico and Canada.

Camera Distribution Chelmsford, UK-based e2v has announced an agreement with Physimetrics Inc. of Roswell, Ga., enabling the latter to distribute the British company's line-scan cameras throughout the US. Physimetrics also will supply products to support the cameras, including frame grabbers and software.

Faster Fruit Labeling Intense Ltd. of Glasgow, UK, and Sinclair Systems International of Fresno, Calif., are working together to develop a fully integrated module that will incorporate a laser diode array for use in labeling fresh fruit. The companies believe that the system will decrease the time needed to label the produce.

Semiconductor Distributor Dilas of Mainz, Germany, has selected a distributor for its semiconductor laser components and modules. ES Technology Ltd., based in Abingdon, UK, will provide sales and support for the devices throughout the UK and Ireland.

Fiber License An agreement has been signed by Imra America Inc. of Ann Arbor, Mich., and Teem Photonics SA of Meylan, France, regarding the American company's fiber technology as it relates to the French company's products. The license gives the latter access to a portfolio of patents related to fiber lasers and amplifiers.

Record Efficiency Scientists at the University of Florida in Gainesville have achieved a peak efficiency of 50 lm/W with their blue organic LEDs. The device is a step toward the researchers' goal of producing white light with efficiency greater than 100 lm/W.

E-Paper Displays Nemoptic, an e-paper company based in Magny les Hameaux, France, and Seiko Instruments Inc. of Chiba, Japan, have entered into a licensing agreement for Nemoptic's bistable BiNem technology. The LCD technology will be used by the Japanese company to produce competitively priced e-paper displays in large quantities.

Nano Solar Cells Kopin Corp. of Taunton, Mass., has received a contract from NASA worth $600,000. The two-year project will attempt to produce a more efficient nanostructured solar cell composed of indium gallium phosphide. The company hopes to create cells with 20 percent higher efficiency than currently available multijunction versions.

Software Company Purchased Hexagon Metrology of London has acquired Technodigit SARL of Lyon, France, a developer of 3-D software. The latter company's products will be used to enhance its purchaser's 3-D point cloud offerings in systems including the ScanShark laser probe.

Moving to Cologne Koheras GmbH of Birkerød, Denmark, a manufacturer of white light fiber lasers, has announced the relocation of its German headquarters from Kleinostheim to Cologne. The move was completed in January.

Partnership for PCM An agreement to cooperate on the qualification of atomic vapor deposition process technology for scaling phase change memory (PCM) products has been signed by Aixtron AG of Aachen, Germany, and Ovonyx Inc. of Rochester Hills, Mich. The companies will work on accelerating the commercialization of the technology.

Thin-Film Acquisition Ocean Optics Inc. of Dunedin, Fla., has acquired the Golden, Colo.-based business unit of Oerlikon Optics. The latter will be completely absorbed into the thin-film division, adding its expertise and manufacturing capabilities to those of its new owner.

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Light pollution: the good, the bad and the just-too-bright

BY ANNE L. FISCHER
SENIOR EDITOR

Four hundred years ago, Galileo made his first astronomical observation through a telescope. Today he wouldn't recognize the skies because light pollution prevents us from seeing the stars clearly from the most populated areas of the world. Most people in North America and Eastern Europe are familiar with an orangey glow in the sky over populated areas. In fact, according to the Tucson, Ariz.-based International Dark-Sky Association (IDA), the orangey sky glow over Los Angeles is visible from an airplane 200 miles away.

Besides sky glow, there are other forms of light pollution: glare, an overly bright point of light; light trespass, light shining on a location where it is not needed or wanted; and light clutter, the presence of too many bright light sources in one area.

Why it's bad

Although light has many advantages, allowing people to work and study into the night, enjoy recreation in the evening, be safe in dark areas and more, studies show that excessive lighting has several drawbacks. First, according to David L. Crawford, co-founder of IDA, it's a waste of energy.

Light pollution also is having deleterious effects on human health. In 1987, Dr. Richard G. Stevens, a professor at the University of Connecticut School of Medicine in Farmington, proposed that electric lighting at night disrupts circadian rhythms, causing hormonal changes that could contribute to breast cancer.

Just as it creates problems for humans, excessive light also harms wildlife. Biologists warn that a kind of cascading effect can take place, with light pollution affecting animals, their habitat and so on, to result in devastation of entire ecosystems.

The US Air Force's Defense Meteorological Satellite Program (DMSP) has taken satellite images of the Earth since the 1970s; from these, researchers have determined that about two-thirds of the world's population and about 99 percent of the US population (excluding Alaska

Full-cutoff lighting reduces light trespass, sky glow and other light nuisances. Photo by Bob Crelin.

Images taken by satellite show the extent of light pollution across the globe. Photo courtesy of NASA. Data courtesy of Marc Imhoff of NASA Goddard Space Flight Center and Christopher Elvidge of NOAA National Geophysical Data Center. Image by Craig Mayhew and Robert Simmon, NASA Goddard Space Flight Center.

The Milky Way is visible only in the most rural areas. Photo by Bob Crelin.

and Hawaii) and the European Union live in areas where the night sky is considered polluted. Seeing the heavens and the Milky Way has become a thing of the past for the majority of the world's population.

Addressing the issue

Fortunately, something is being done about light pollution. Many states and countries have lighting ordinances in place that regulate lighting levels. The IDA and the Illuminating Engineering Society of North America are developing a model lighting ordinance to help states, countries and even condominium associations protect the dark sky. Christian Monrad, president of the IDA's board of directors, pointed out that what is at the core of any ordinance should be "warranted" use – "meaning only put the light where and when it's needed."

With the focus on sustainability and green building practices, building codes often have limitations on how many watts per square foot can be installed in various lighting task areas. The good news, according to Monrad, is that "energy codes continue to ratchet down to where irresponsible overlighting of outdoor projects is starting to be curtailed."

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Lights Out

One attempt by the International Dark-Sky Association (IDA) to educate the public about light pollution is the observance of National Dark-Sky Week slated April 20 to 26. This event will be preceded by the World Wildlife Fund's Earth Hour, which is Saturday, March 28, at 8:30 p.m. local time.

Designing a fix

Shielding outdoor lighting fixtures can make a huge difference. "Without shielding it, you end up blathering light all over," said David Crawford of the IDA. In its recommended practice guidelines, the Illuminating Engineering Society of North America (IESNA) offers optimum illumination levels for various outdoor lighting applications. By observing these well-researched standards, lighting installers can illuminate efficiently, lighting only what is necessary. In addition, specifying the use of fully shielded, or "full cutoff," fixtures dramatically controls the trespass onto neighboring properties.

Many full-cutoff fixtures are now on the market, including the GlareBuster, which was designed specifically to reduce light pollution from residences. Patented by Connecticut-based Lighting by Branford, this fixture uses a compact fluorescent in a full-cutoff fixture. The purpose of this product, company founder Bob Crelin stated, is to replace the common floodlight that spews light in all directions. The GlareBuster is an Energy Star product that is approved by the IDA. It recently won a 2008 award in the American Lighting Association's Lighting for Tomorrow Competition.

Defining lights path

The definition of full-cutoff lighting, as specified by the IESNA, is light distribution where the candela per 1000 lamp lumens does not exceed 25 at an angle of 90° above nadir, and does not exceed 100 at an 80° vertical angle above nadir. Light sources also play a role in light pollution. Crawford gave the astronomer's perspective, indicating that low-pressure sodium is best because it is monochromatic, with all the light at one yellow wavelength. High-pressure sodium is next best, he said, "and any white or bluish source is the worst." More important than light color, he emphasized, is how and when it is used.

Even with shielding, light pollution can occur from downward-directed light bouncing off whatever it is directed on, such as pavement or snow. So, besides a full-cutoff design, lights should be equipped with "occupancy" sensors so that they light up only when someone or something is in their path. Lights also can be on timers so that they turn on at dusk and off at dawn or – better yet – turn off when not needed.

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A marine turtle hatchling's orientation to the sea is guided by light cues. Cues from man-made lighting can lead them away from the water. Photo courtesy of Blair E. Witherington.

Looking for light in all the wrong places

CAREN B. LES
NEWS EDITOR

Creatures in the wild that follow natural light cues to negotiate their environment are sometimes misguided by man-made polarized light sources, such as asphalt roads, oil spills, black gravestones, glass panes on buildings, dark-colored paint work on automobiles and black plastic sheets used in agriculture, according to a study done by a group of ecologists, biologists and biophysicists.

These miscues lead the animals away from their natural habitat and into environments where they sometimes become permanently trapped, highly susceptible to predators and sometimes unable to feed, migrate or reproduce successfully. The failure of any species to thrive is known to affect the wider ecosystem.

At least 300 species of dragonflies, mayflies, caddis flies, tabanids, diving beetles and other aquatic insects orient themselves using horizontally polarized light sources to find water in which they can feed and breed, according to the report, which was published in the journal *Frontiers in Ecology and the Environment*.

Artificially polarized light can be even more attractive to them, diverting them from their natural habitats into areas such as waste-oil pools, where they are likely to become trapped and die. Dragonflies and mayflies lay eggs on surfaces including shiny cement, glass panes and black plastic sheets, which, as with water, reflect horizontally polarized light. Male dragonflies often establish their territories on car antennas, and females lay their eggs on the shiny surface of the hood, where hatching fails.

According to the report, humans can lessen the effects of these ecological perils in a variety of ways, including painting white hatch marks on asphalt, using rough instead of shiny building materials, using lighter-colored building materials, and minimizing night lighting and/or directing it away from buildings, asphalt and cars near aquatic areas. The report also notes that photovoltaic solar panels are a possible source of polarized light pollution and that increasing numbers of them may be installed in response to rising energy costs.

Ambient lighting for sea turtles

The Florida Fish and Wildlife Conservation Commission (FWC) is working to protect sea turtles from the hazards of artificial lights on or near beaches. These lights are the source of mortality for many thousands of sea turtles each year in Florida and represent an important conservation challenge for the endangered species, according to Dr. Blair E. Witherington, a scientist with the FWC's Wildlife Research Institute.

Female sea turtles come ashore to lay their eggs on the beaches at night. They are sensitive to artificial lighting visible from the beach and tend to shun the brightest beaches, said Witherington, who is an expert on sea turtles and lighting. He added that, when the hatchlings emerge from their nests at night, they have their orientation to the sea guided by light cues. When artificial light sources are visible from the beach, hatchlings become disoriented or are led away from the sea into the dune, where they often die from exhaustion, dehydration, predation or crushing by cars in parking lots and roadways.

Hatchling sea turtles orient toward the center of the brightest horizon as if brightness were measured by a detector with a broad, flat acceptance cone and a sensitivity to wavelengths between the near-UV and the yellow-green, according to Witherington. He added that, because a hatchling's assessment of "brightness" is spatially comparative, highly anisotropic light fields – such as those produced by artificial light sources – create an overwhelmingly bright direction that more than competes with natural light cues from the night sky over the open sea.

Experiments have shown that sea turtles show no preference for vertically, horizontally or unpolarized light sources of equal radiance, Witherington said.

Roadway, security, parking lot and balcony/porch lighting all cause problems for the turtles, as does interior lighting through windows. Both direct and indirect illumination – e.g., sky glow – also can be hazardous. Witherington said that lamp types with the greatest harmful effects include broad-spectrum sources such as mercury vapor, metal halide, fluorescent, incandescent and high-pressure sodium vapor. Lighting that is more turtle-friendly includes near-monochromatic long-wavelength sources such as low-pressure sodium vapor, amber and red LEDs, and some sources to reduce insect attraction.

Not only sea turtles but also other types of beach wildlife suffer the consequences of artificial lighting, Witherington said, adding that a species of tiger beetle that lives only on beaches and is drawn to lighting has been eliminated from artificially bright beaches. Endangered beach mice, sensitive to lighting, restrict their foraging in artificially bright dune areas. Shorebird nesting and migration can be disrupted by unnatural light as well.

One state's efforts to lessen light

The state of Florida has engaged in research to learn more about how artificial lighting negatively affects sea turtles and how shielding and filtering of light sources and how choices of light-managed fixtures can reduce the problem. It is involved in ongoing education to promote light management for sea turtles through publications, workshops and direct assistance with lighting plans.

Florida requires approval of coastal lighting plans for new development and maintains records of turtle hatchling and adult orientation events. It also conducts

site visits to detect lighting changes following permitted lighting plans. Witherington said the state has promulgated a model lighting ordinance that specifies how lighting near beaches should be managed to protect sea turtles. The majority of coastal counties and municipalities with sea turtle nesting have adopted ordinances similar to this model, he noted.

Companies involved in the development of light fixtures and lamps are showing an interest in providing options that provide minimal harm to marine turtles and other wildlife while still contributing to the safety and needs of the human population. The FWC works with light manufacturers to provide them with information on the appropriate types of fixtures and wavelengths as well as on correct siting to minimize the impact on coastal turtle nesting habitats. The staff then can provide coastal property owners and local governments with information on these fixtures and how to use them properly.

Beachfront development

Despite the continuing and extensive development of Florida's beaches, individual beaches have achieved striking reductions in lighting effects on sea turtles following light-management efforts, and overall rates of hatchling disorientation have not increased, Witherington said. Statewide success in these efforts is difficult to assess, he added.

The solutions to these lighting problems are not complex and do not require new levels of understanding or technology, Witherington said, noting that continued vigilance and effort will lead to improvements today and in the future.

Partners in lighting

Conservation of threatened and endangered species such as marine turtles depends on cooperative partnerships that consider and address the needs of both humans and wildlife, Witherington said. He added that Florida's efforts to offer lighting options to coastal communities that create a safe, attractive environment for both beachfront properties and marine turtle nesting habitats can succeed only through partnerships such as between the biologists who study these species and the engineers and architects who provide appropriate lighting solutions.

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A water beetle is attracted to a shiny red car. Photo courtesy of György Kriska.

A stonefly lays eggs on granite. Photo courtesy of György Kriska.

Female sea turtles can be disoriented by artificial beach lighting. Photo courtesy of Blair Witherington.

Greening the Great White Way

Broadway, long known for its egregious use of lights, launched the "Broadway Goes Green" initiative in November. Significant progress has been made by its 39 theaters, all of which are doing their part to meet the city's commitment to reduce its carbon footprint by 30 percent by 2030.

Part of the process involves changing marquee and lobby lights to low-energy lamps. There probably is no one who has changed more of those lights than Jennifer Hershey, director of operations for Jujamcyn Theaters LLC, a New York City-based company that owns five theaters and is deeply involved with greening the Great White Way.

Broadway theaters have a huge number of lights both inside and out, and, as Hershey noted, "It's a tremendous step to change as many as we can." To date, the company has changed 9000 lightbulbs in five theaters.

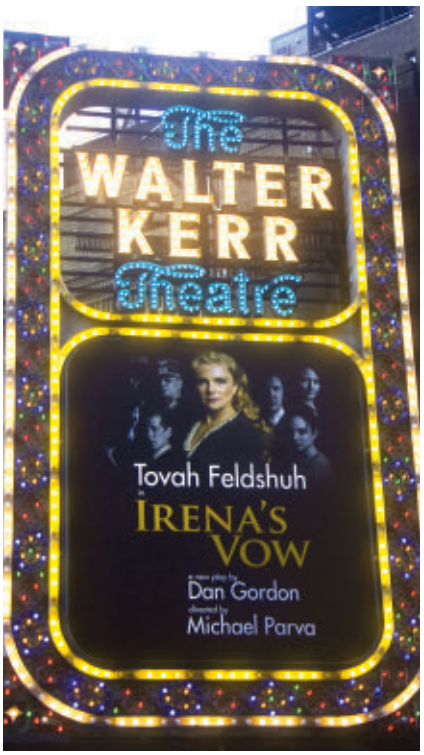
Meeting the challenge

The Walter Kerr Theatre is a "picture of exterior lighting," but, Hershey recalled, it was a challenge to make its sign green. Jujamcyn used a combination of LEDs with cold-cathode lights. One problem was getting LED and cold-cathode bulbs in the specified colors. They can be custom-dipped, but special orders are time-consuming. She hopes that, with growing demand, LED manufacturers will broaden the color range.

Another problem has been greening the interior lights. Everything inside has been switched to energy-efficient lamps (compact fluorescent lights, or CFLs; cold cathodes; LEDs; and standard fluorescent strips) except the old chandeliers. CFLs don't fit in the old fixtures and don't dim smoothly, Hershey explained, so the company is holding out for LED replacement bulbs at an affordable price.

When asked to quantify the energy savings, Hershey said that Jujamcyn is working on that. "Theaters use a lot of electricity, and each show has a different load, so it's difficult to break out just the lighting."

To date, 25 theaters have changed their exterior lighting. The goal is that, by November of this year, every exterior marquee from the three major theater chains will be changed. Other theaters also are getting onboard, Hershey said. "All of us are making tremendous progress in changing lightbulbs in dressing rooms, hallways – everyplace where it's not a decorative fixture."



The marquee outside the Walter Kerr Theatre in New York City went green when its 2800 lights were switched to energy-saving LEDs, and to compact and cold-cathode fluorescents. Photo by Jennifer Hershey.

Besides swapping out lightbulbs, Broadway is taking a holistic approach to going green. A recycling effort encourages reuse as much as possible, from sets and costumes to rechargeable batteries. Instead of applying chemical ice packs to sore muscles, actors are using bags of frozen peas. Green-friendly cleaning supplies are in use. Paper-based communication is replaced with e-mail. And so on.

The Great White Way is making a grand performance of going green – an example duplicated by theater groups worldwide.

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Environmental signage: the great oxymoron

As ad budgets are cut, what better way to broadcast a message than to install a large flat panel display where it will reach a captive audience? These advertisements are popping up in railway stations, airports and shopping malls – anyplace where busy professionals will get the message at a single glance. The sign industry remains strong, possibly as a result of these tough economic times – with analysts predicting growth of more than 40 percent in 2009. The massively lit displays are signs of the times in more ways than one. These electricity hogs are joining the trend toward green – albeit, in this case, light green.

Historically, outdoor electronic signs have moved from incandescent to neon to fluorescent – and now to LEDs. Pamela Thompson, vice president of marketing at Folsom, Calif.-based Sugarman Consulting, said that the biggest savings in electricity in the signage industry occurred "when we moved from incandescent to LEDs." One benefit of the new high-brightness LEDs, she pointed out, is that you need fewer diodes and less power to achieve the same brightness levels compared with just a few years ago.

These electricity hogs are joining the trend toward green – albeit, in this case, light green.

The move to LEDs

In New York City, it's not just the New Year's Eve ball that's lit by energy-saving LEDs. "More than a million people pass through Times Square each day, and it's important for advertisers to know their branding efforts, utilizing spectacular LED displays, are stopping people in their tracks

The 65-ft-high Coca-Cola display in Times Square is hard to miss with more than 2 million LEDs. Photo courtesy of Daktronics.

Lighting up the night

Light pollution from electronic signs has negative health effects on people and wildlife (See articles in this issue), and many towns and states have ordinances regulating the amount of light that can be displayed at night. While Antes said "the rule of thumb in Times Square is to produce spectaculars on an awe-inspiring scale," he indicated that, in some communities, sign and billboard companies do have to contend with restrictions as to light intensity and content motion on signs. The beauty of LED technology is the unlimited flexibility over visual content that is displayed and the ability to change it instantly. Content is fully controlled by the computer that runs the display. "You can easily ramp up or tone down the intensity, color and motion of the content, Antes said. "It's all configured on a case-by-case basis and can be designed with consideration of respective community standards."

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and making them take notice," commented Randy Antes, director of digital projects in New York City for South Dakota-based Daktronics. The company has designed and manufactured many of the large displays in Times Square. He's found LED displays to be more energy-efficient than the old incandescent bulbs, once the standard lighting element in Times Square displays, as well as more dynamic due to brightness and color clarity.

The famous Coca-Cola sign, a Times Square landmark since 1920, is a good example. Measuring 44 ft wide by 65 ft tall, it was converted to LEDs in 2004. According to Antes, what appears to be a sign is really a sophisticated video screen run by two control systems that include four processors and six servers, which can store up to 120 hours of content. Data and graphics are sent over a T1 line at 60 fps. The display has 2,646,336 LEDs in 4000 modules of various sizes.

The transition to LEDs has not been without its challenges, however. As with other LED applications, power management and ventilation/cooling techniques have been employed to dissipate the heat. One of the big green changes here is controlling airflow through the sign rather than relying on massive air conditioning units.

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Going solar?

One would think that a giant billboard would be a great spot for a solar collector – and in theory, it is. Regular billboards that don't have electronic displays can be power generators, as demonstrated in San Francisco by the solar billboard sponsored by Pacific Gas & Electric, which displayed the message, "This is not a billboard, it's a power plant." The 20 solar panels installed on the billboard provided 3.4 kW of power in full sun, ran the LED lights above the display and fed unused power back to the grid. Times Square now has a solar- and wind-powered sign, but again, it's not an electronic sign. But providing solar power to huge digital signage is not yet practical for most applications. According to Pamela Thompson of Sugarman Consulting, to fully power a 14- by 48-ft digital billboard, you'd need almost an acre of solar panels. Sugarman Consulting has done some projects with solar, but, as Thompson pointed out, unless the advertiser has very deep pockets and a whole lot of vacant land (for the solar collectors), solar just isn't a viable option for large, power-hungry digital signage.

Thompson adds, "We are developing secondary solar power systems that augment the primary power source. Keeping the LED display cool is critical, often requiring a forced-air ventilation system or, in some cases, air conditioning. Using just a few solar panels mounted on the back of the sign, we can power a supplementary ventilation system that kicks in during the hottest and brightest part of the day."

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NEW Solutions for working with Solutions

BY LYNN SAVAGE
FEATURES EDITOR

When creating a new technology – or tweaking an old one – you always end up starting from the bottom and working your way up. No, not your position in the company, the basic nature of the materials with which you are working.

It doesn't matter whether you are looking to make a high-efficiency solar collector, artificial neurons or a better mousetrap, you must have as complete an understanding of the components as possible. Once, that meant having only a good knowledge of macro materials; now, you need to know what's going on at the molecular level.

For the most part, materials research at this level involves shunting nanoclusters of molecules, such as cadmium selenide, or of individual elements, such as silver, around a flat substrate. Types of this research include quantifying the electro-optical properties of carbon nanotubes and quantum dots.

More recently, scientists have become interested in how particles of various sorts operate in aqueous environments, such as living cells or solutions in which nanoparticles may be formed or other chemical reactions may be induced. Tracking minute particles in solution (even, in some cases, as they are precipitating out) can provide important clues to the dynamics underpinning the device in which the particles ultimately may be used.

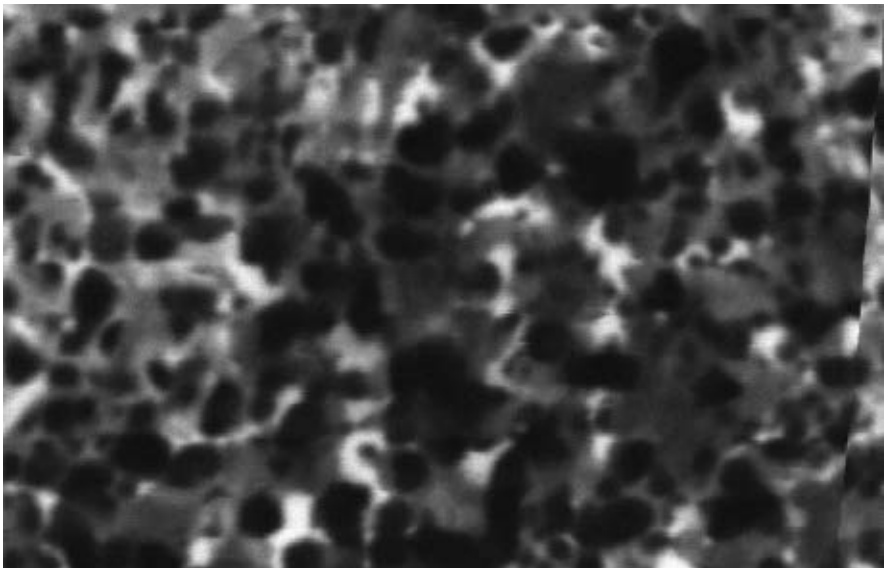
Breaking down

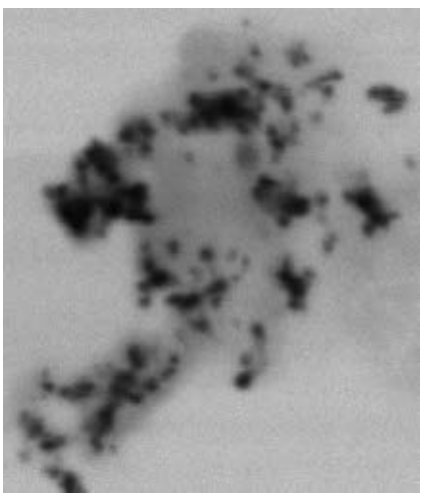
One set of researchers recently reported that a typical method for preparing samples for inductively coupled plasma optical emission spectroscopy (ICP-OES) has room for improvement. In ICP-OES – the gold standard for studying minute particles in liquid environments – a relatively large material sample is broken down into tinier and tinier bits. These particles, sometimes as small as single molecules, are then scanned by a probing laser beam for spectroscopic analysis.

A new direction, developed by E.V. Muravitskaya and her colleagues at B.I. Stepanov Institute of Physics in Minsk, Belarus, uses such a laser beam more directly. Because acids or other substances used to break down a sample typically do their jobs incompletely, the scientists used a 1064-nm Q-switched Nd:YAG laser to ablate their target samples.

They tested their system on several alloys that were alike in composition – comprising zinc, iron, aluminum, copper and magnesium – but differing in concentration of these elements. They placed samples of the alloys into distilled water and used the laser to irradiate them with 10- to 12-ns pulses at 10 Hz (8 µs between pulses). Each pulse provided 50 mJ of energy at the sample surface. After 3 s, they moved the sample to ablate a different part. After about 80 s, ablation was complete, with the original samples left pitted and cratered and nanometer-scale particles clouding the solution. They compared their laser ablation results with a standard chemical digestion method as well.

The investigators noted in the February issue of *Spectrochimica Acta Part B* that using laser ablation to divide large particles into a size fit for ICP-OES has several advantages. First, compared with chemical erosion, laser ablation does not waste sample material because it more completely breaks down the mass. Second, ablation does not cause the suppressive effect that acids have on signals picked up by the





Images acquired with a JEOL Ltd. scanning transmission electron microscope show silver nanoparticles with an average size of 15 nm (left) and 45 nm (top). The smaller particles provide greater enhancement of the Raman signal in SERS experiments. Courtesy of the *Journal of Physical Chemistry C*.

spectrographic equipment. Furthermore, laser ablation produces more uniform particle sizes and apparently works with materials that are not greatly affected by typical acids used in chemical erosion techniques.

Another solution

ICP-OES is not the only form of spectroscopy performed on materials in solution. Once relegated to testing particles splayed out on wide-open metal substrates, Raman spectroscopy now also is being used to explore substances in aqueous environments. In traditional surface-enhanced Raman spectroscopy (SERS), investigators use a silver or gold film to enhance the otherwise very weak Raman signal that is emitted by a test material. Performing SERS on a flat substrate is one thing, but using it to study particles in cells or other aqueous solutions requires getting the metal particles into place and understanding how they will act.

A number of researchers are starting to extend the utility of SERS-like signal enhancement by inverting the relationship between the test subject and the substrate.

Creating metal nanoparticles and placing them near the particles of interest in their liquid home environment provides as much Raman signal enhancement as using a metallic substrate. This knowledge, however, was not enough for Caryn S. Seney and Brittany M. Gutzman of Mercer University in Macon, Ga., and their colleague, Russell H. Goddard of Valdosta State University, also in Georgia. They wanted to know whether the size of metallic nanoparticles had an influence on the Raman enhancement effect.

The group created silver nanoparticles ranging from 15 to 160 nm across, placed them in solution with BPE, a standard compound used in Raman studies of solutions, and applied an argon-ion laser made by Coherent Inc. to excite them. As the scientists reported in the Jan. 8 issue of the *Journal of Physical Chemistry C*, the Raman effect is indeed tied to the size of the silver particles.

According to the researchers, SERS activity generally is inversely proportional to particle size – the smaller the particle, the higher the Raman signal. In their study, they found that the 15-nm silver particles had the highest signal enhancement, and that the highest effective laser wavelength to obtain the SERS signal was 390 nm.

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- A research & development
- B design
- C application
- D manufacturing or production
- E measurement (testing, quality control or safety)
- F other engineering or science function (please specify) _____

Management- or Business-Related
- G corporate
- H engineering/technical
- J manufacturing or production
- K purchasing
- L other management function (please specify) _____

Other
- M consultant
- N educator
- P other functions (please specify) _____

2 ☐ Please indicate the primary end product or service of your company at this location. (Please insert one letter/number only.)

- A aerospace/aviation systems
- B agriculture, food, forestry & mining
- C analytical, test or measurement instrumentation
- D automotive or transportation
- E cable TV/video/broadcasting
- F cameras, detectors, sensors & electro-optical components
- G chemical or pharmaceutical products
- H communications equipment or services (incl. telcos, RBOC & other carriers)
- J computer displays, peripherals, office & business equipment
- K consumer electronics & appliances
- L electronics, semiconductors & IC
- M environmental monitoring
- N fiber optic components or systems
- P hospital/medical university or office
- Q industrial control systems & robotics
- R laboratory, government
- S laboratory, industrial
- T lasers/laser systems
- U manufacturing equipment, machinery or metal products
- V medical & biotechnology equipment
- W military equipment
- X navigation & guidance systems or equipment
- Y optical components, materials or systems
- Z plastics, polymers, rubber
- 1 printing, publishing, graphic arts
- 2 university/institution/college
- 3 utilities, energy, petroleum & coal
- 4 government personnel not classified elsewhere
- 5 industrial company or commercial user incorporating photonic products not classified elsewhere
- 6 other _____

Principal Product or Service _____

3 Which of the following publications do you read regularly? (Please check all that apply.)

- A ☐ Advanced Imaging
- H ☐ Laser Focus World
- K ☐ Lightwave
- M ☐ NASA Tech Briefs
- N ☐ Nature
- P ☐ OLE
- R ☐ Physics Today
- S ☐ Science
- T ☐ Semiconductor International
- V ☐ Vision Systems Design
- X ☐ None of the above

4 ☐ The number of employees at this location is: (Please insert one letter only.)

- A 1-10
- B 11-25
- C 26-50
- D 51-100
- E 101-500
- F 501-1000
- G 1001-5000
- H over 5000

5 Which of the following technologies/sciences do you and/or your organization work with? (Please check all that apply.)

A.
- A ☐ aerospace/aviation
- C ☐ astronomy
- D ☐ automotive
- E ☐ biotechnology
- G ☐ chemistry, chemical engineering
- J ☐ chromatography
- L ☐ communications
- N ☐ computer engineering
- P ☐ displays
- R ☐ environmental monitoring/sensing
- T ☐ forensic science
- V ☐ holography
- W ☐ lighting/illumination
- X ☐ imaging
- Z ☐ inspection/identification

B.
- A ☐ machine vision
- C ☐ materials processing/production
- E ☐ materials research
- G ☐ medical/biomedical
- J ☐ microscopy
- L ☐ military/tactical
- N ☐ nondestructive testing
- P ☐ optical character recognition
- R ☐ optical computing/data storage
- T ☐ photonic component mfg.
- V ☐ process control
- X ☐ quality control
- Z ☐ remote sensing/lidar

C.
- A ☐ reprographics/printing
- C ☐ robotics
- E ☐ semiconductor processing
- G ☐ simulation/modeling
- J ☐ signal processing
- L ☐ spectroscopy
- N ☐ test & measurement
- P ☐ ultrafast/time-resolution studies
- R ☐ other _____

6 Which of the following products do you buy, use, recommend and/or specify? (Please check all that apply.)

A. Optical Components & Software
- A ☐ coatings
- C ☐ filters & beamsplitters
- E ☐ gratings
- G ☐ infrared optics
- J ☐ laser optics
- L ☐ lenses
- N ☐ mirrors & reflectors
- P ☐ optical design software
- R ☐ polarizing optics
- T ☐ prisms
- V ☐ ultraviolet optics
- X ☐ windows & domes

B. Lasers
- A ☐ semiconductor, diode
- C ☐ solid-state, diode-pumped
- E ☐ solid-state, Nd:YAG
- G ☐ solid-state, Ti:sapphire
- J ☐ solid-state, tunable
- L ☐ solid-state, VCSELs
- M ☐ fiber lasers
- N ☐ gas lasers, CO_2
- P ☐ gas lasers, excimer
- R ☐ gas lasers, HeNe
- T ☐ gas lasers, ion
- V ☐ gas lasers, other
- X ☐ dye
- Z ☐ other lasers _____

C. Laser Systems
- A ☐ biometric/forensic
- C ☐ biotechnology
- E ☐ communications
- G ☐ industrial (cutting/welding/marking)
- J ☐ entertainment
- L ☐ environmental monitoring
- N ☐ holography
- P ☐ materials processing
- R ☐ medical
- T ☐ military
- V ☐ remote sensing
- X ☐ reprographics (printing/graphic arts)
- Z ☐ spectroscopy & photochemical analysis

D. Fiber Optics
- A ☐ cables
- C ☐ communications lasers
- E ☐ connectors or couplers
- G ☐ detectors or receivers
- H ☐ fiber
- K ☐ gratings
- M ☐ lightguides
- N ☐ network components
- O ☐ optical amplifiers
- Q ☐ optical switches
- S ☐ splicing & polishing equipment
- U ☐ test equipment
- W ☐ transmitters
- Y ☐ WDM or DWDM
- Z ☐ other fiber optic components

E. Cameras
- A ☐ CCD or CID
- C ☐ CMOS
- E ☐ high speed
- G ☐ infrared
- J ☐ line scan
- L ☐ other camera _____

F. Detectors/Sensors
- A ☐ CCD or CID
- C ☐ CMOS
- E ☐ detector arrays
- G ☐ infrared
- J ☐ photodiodes
- L ☐ photomultipliers
- N ☐ semiconductor

G. Imaging Equipment & Software
- A ☐ frame grabbers
- C ☐ image intensifiers
- E ☐ imaging software
- G ☐ infrared imagers
- J ☐ illumination equipment
- L ☐ vision systems
- N ☐ x-ray imaging

H. Manufacturing Equipment for Photonic Components
- A ☐ assembly or packaging equipment
- C ☐ cleanroom equipment
- E ☐ coating equipment
- G ☐ cooling & cryogenic equipment
- J ☐ diamond machining equipment
- L ☐ grinding & polishing equipment
- N ☐ optical design software
- P ☐ photonics test equipment
- R ☐ vacuum equipment
- T ☐ other manufacturing equipment _____

J. Positioning/Vibration Isolation Equipment
- A ☐ benches, rails & slides
- C ☐ micropositioners
- E ☐ mounts for photonic components
- G ☐ positioning equipment
- J ☐ position-sensing equip.
- L ☐ stepper motors & drivers
- N ☐ tables, optical
- P ☐ vibration-isolation equipment

K. LEDs and Displays
- A ☐ CRTs
- C ☐ flat panel
- E ☐ LCDs
- G ☐ LEDs
- J ☐ light valves
- L ☐ OLEDs
- N ☐ plasma

L. Test & Analysis Equipment
- A ☐ interferometers
- C ☐ microscopes, optical
- E ☐ microscopes, other
- G ☐ monochromators
- J ☐ optics testing equipment
- L ☐ power/energy meters/wavelength meters
- N ☐ radiometers/photometers
- P ☐ spectroscopy equipment
- R ☐ spectrum analyzers
- T ☐ telescopes

M. Electronics & Signal-Analysis Equipment
- A ☐ amplifiers
- C ☐ oscilloscopes
- E ☐ power supplies
- G ☐ pulse & signal generators
- J ☐ signal analyzers
- L ☐ time-delay generators

N. Laser Accessories
- A ☐ beam analysis
- C ☐ flashlamps
- E ☐ laser chillers
- G ☐ laser dyes, gases or rods
- J ☐ laser power & energy meters
- L ☐ laser power supplies
- N ☐ laser safety
- P ☐ laser scanners

P. Light Sources
- A ☐ arc sources
- C ☐ flashlamps
- E ☐ infrared
- G ☐ LEDs
- J ☐ ultraviolet

Q. Materials & Chemicals
- A ☐ cements, adhesives & epoxies
- C ☐ coating materials
- E ☐ crystals
- G ☐ grinding & polishing materials
- J ☐ transmissive materials, IR
- L ☐ transmissive materials, UV
- N ☐ transmissive materials, visible

R. Computers & Software
- A ☐ computer hardware (PCs, servers, workstations, mainframes)
- C ☐ data acquisition
- E ☐ scientific/engineering software

S. Nanophotonics
- A ☐ microscopes
- C ☐ nanophotonic devices
- E ☐ nanophotonic materials
- G ☐ quantum dots

T. A ☐ Other _____

X. ☐ None of the above (6A-6S inclusive)

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For microscopes, a new way is at hand

BY HANK HOGAN, CONTRIBUTING EDITOR

Sometimes a picture is worth more than a thousand words – or a thousand dollars. That's the case for CGI, a company based in Eden Prairie, Minn., which sells proprietary inspection systems for small, plastic injection-molded parts. CGI's systems slice through these parts and take high-resolution pictures, repeating the process to capture a complete three-dimensional image. That data provides vital information about the manufacturing process, which is why businesses all over the world buy the company's inspection tools.

But the usefulness of the data depends on the quality of the cut, and that involves trade-offs. A diamond-tipped cutter, for instance, might yield a cleaner slice than a more standard cutter, but it does so at greater cost. CGI president Craig Crump noted that conveying the difference between those cuts is now easier, thanks to handheld microscopes.

"You can describe it verbally, but you don't capture it nearly as well as you do with one of these little handheld devices," he said.

That's just one example of what handheld microscopes are being used for. For those who need a close-up look at something away from the lab, the solution may be at hand – literally. Thanks to advances in imagers, algorithms and optics, handheld microscopes are now available that allow the inspection of components, circuit boards, coins, stamps and skin, meeting the needs of industry and consumers.

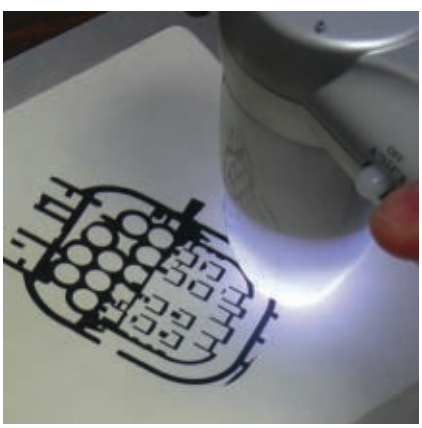
These devices likely won't replace conventional microscopes, but already they have proved to be useful. A look at offerings from Bodelin Technologies of Lake Oswego, Ore., Keyence Corp. of Osaka, Japan, and Celestron LLC of Torrance, Calif., reveals where handheld microscopy is now and where it'll be in the future.

With the click of a button

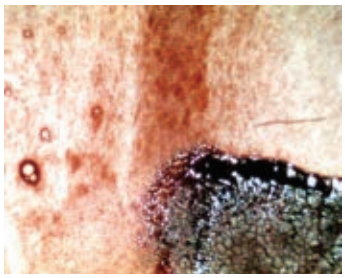
According to CGI's Crump, the company uses the Bodelin ProScope only for qualitative images. Actual inspection data is captured by digital cameras at a resolution of 1000 pixels per linear inch. The handheld microscope, in contrast, enables easy capture and e-mailing of illustrative images to customers worldwide, thereby showing how one cutting option compares to another. The fact that the handheld microscope captures a visible image is important, since the high-resolution cameras used for the actual 3-D reconstruction also image across the same range.

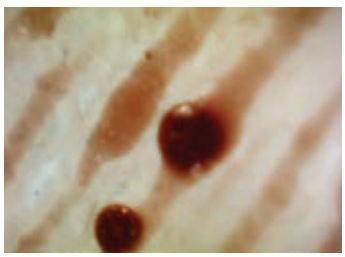
The ProScope has been around for a decade and has experienced changes in its usage patterns and audience, said Bodelin director of sales and marketing Peter White. It originally started off in science education but has since found a home in manufacturing and law enforcement. Those last two categories now account for the bulk of sales.

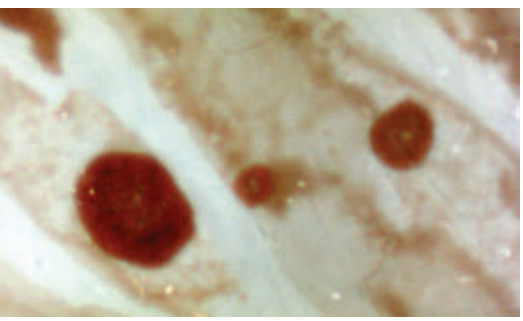
"Interpol is one of our customers," said White, who noted that the FBI and military intelligence likewise use the device



A Bodelin ProScope handheld microscope captures a close-up of a part being sliced by a CGI plastic parts inspection system. The image from the microscope illustrates the quality of the cut. Image courtesy of CGI.







Shown is a study determining the sequence of multiple layering of blood for forensic analysis, done using a handheld Bodelin ProScope microscope. Image courtesy of BPA Consulting.

for crime scene and other investigations. "We're also used extensively by private investigators."

As the market has changed, the ProScope, which White said is manufactured in the US, has undergone technical evolution. Today it has a 1.3-megapixel imager, offers up to 400× magnification and can attach to other optics, making it a possible substitute for the eyepiece found in a conventional desktop microscope. The ProScope takes images with the touch of a button, working with any computer that has a standard USB port. White noted, however, that the best performance comes with a higher-speed USB 2.0 port.

"It's a UVC plug-and-play product. So there's no driver," he added, claiming that to be a key advantage. "It can actually be used live over the Internet."

The company currently makes a lens set that ranges from 10× to 400×, with another lens of 1000× available to law enforcement only. That restriction may eventually be lifted, in which case the higher-magnification lenses will be sold to the public.

The device includes a mount so that it can be held steady. It also has two imaging modes, one where the focus is fixed at a point such that the device has to touch the object being examined. The second mode provides imaging at a distance of roughly half an inch.

According to White, future possibilities for the product include a device that connects wirelessly to a PDA or handheld computer, which would increase the system's overall portability. The same flexibility could be achieved by incorporating a computer and display into the microscope. There is a device like this available today from the original developer of the ProScope, Scalar Corp. of Tokyo. Scalar's DG-3 combines a monitor, a 2.3-megapixel imager and a memory card in a completely untethered digital microscope. However, its cost is much higher than for the ProScope, White said.

The butler did it

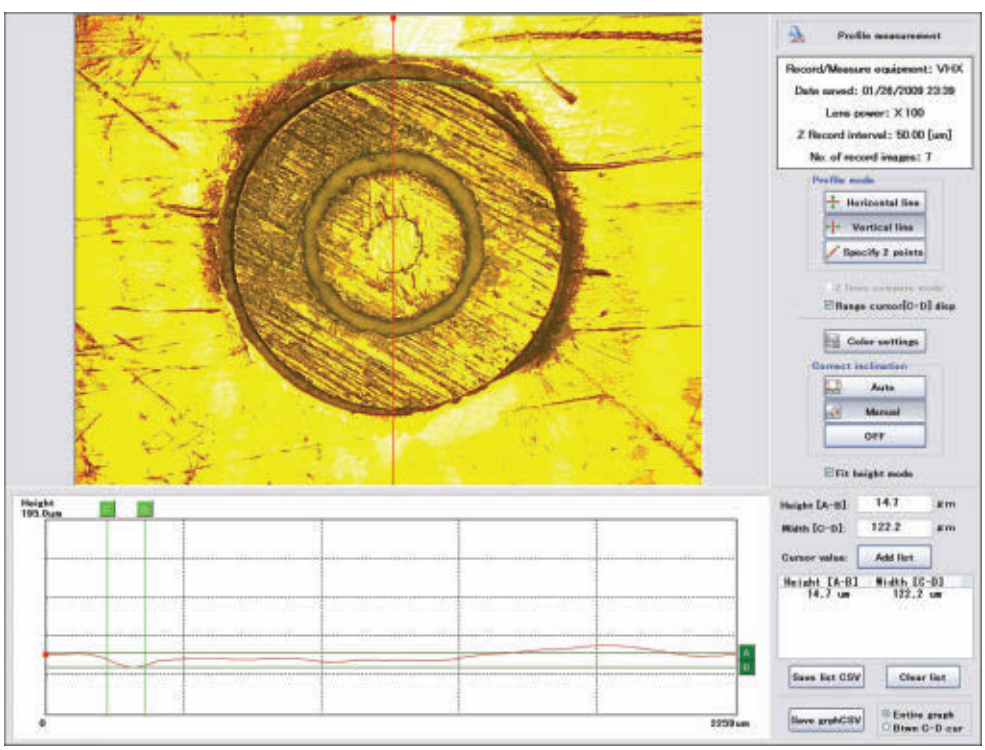
One of the applications for current handheld microscopes is in criminal forensics, with uses ranging from fraud to murder investigations. Bodelin recently announced that its product had won the seal of approval of Frank W. Abagnale, one of the world's leading document fraud investigators and the subject of a Hollywood movie.

Norman Reeves, a forensic expert who heads Tucson, Ariz.-based BPA Consulting, hasn't had that kind of publicity, unless you count fictional depictions on crime shows. Reeves specializes in bloodstain pattern analysis, interpreting the shape, location, size and directionality of bloodstains found on clothing and elsewhere. That information can help in defining the location of victim or assailant, as well as in establishing the actions of either or both.

At one time, Reeves did these investigations using conventional microscopes, but these instruments suffered from a lack of portability and often from inferior image quality as well. Today, he works with a handheld microscope. "I can take this with me, lay the evidence out on a table and go to work on it. That's a great feature."

Because the data is viewable immediately, he can determine when a particular image should be retaken. He can also quickly send it to a computer, where it can be analyzed later or put into a report. He typically works on a flat surface and uses a stand to eliminate movements that would blur the image.

As is the case with other investigators who have to work with unknown substances,



Using a handheld Keyence microscope, NASA researchers profiled a flush-mounted pressure gauge (top) and determined its height relative to a nose cone (bottom), information important in understanding in-flight testing data. Image courtesy of NASA.

Reeves would like to have the widest possible range of wavelengths available for inspection of material. The ability to image in the infrared and ultraviolet ranges would be useful, as would being able to look with polarized light. For the most part, though, he's happy with the current technology.

Holding steady

Keyence is another supplier of handheld microscopes. According to project manager Brian Gaehring, the company has been making these products for two decades, with the latest incarnation appearing last year. These systems, according to Gaehring, offer better imaging than those adapted from something intended to be viewed by eye. "The optics and CCD detector work together to provide sharp and clear observation," he said.

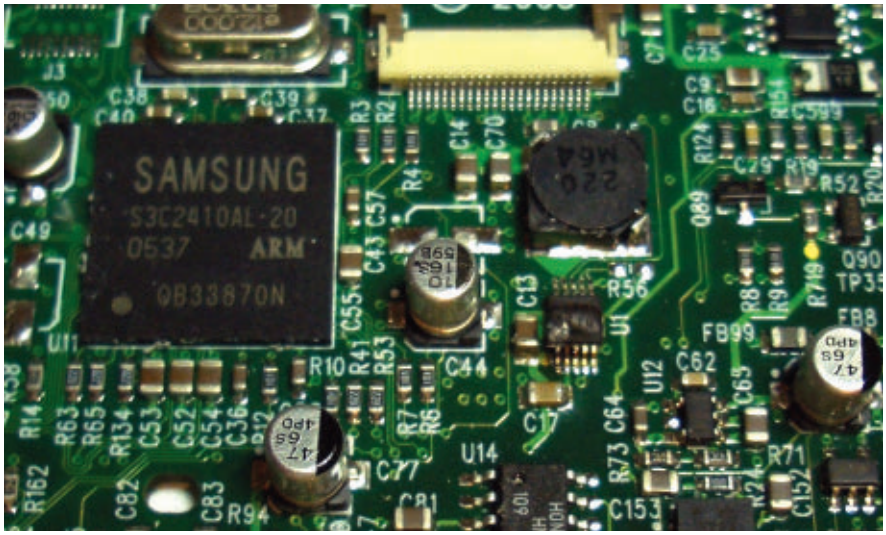
That detector is a single-chip, 2.1-megapixel device, but Keyence wrings out of the setup the equivalent performance of up to a 54-megapixel, three-CCD chip. This feat is accomplished with an actuator that moves the chip in the dead time while images are being captured. This approach does have its drawbacks, among them the requirement for a very accurate actuator. But the benefit is substantial in that the technique eliminates the need for an actual three-chip camera or color filter. The former would make the device more cumbersome and expensive. The latter would reduce resolution.

Another feature of the Keyence handheld microscope is a very large depth of field, with the company claiming a depth 20 times that of a conventional optical microscope. This can be useful when inspecting parts because such things as recessed markings, protruding features and complex structures can all be in focus at the same time.

In addition to a stand, the system also has a software solution to combat the shaking that blurs images. Proprietary pattern recognition algorithms distinguish between image movement due to motion of the object being studied and that caused by movement of the microscope itself. Software then corrects for the motion caused by the microscope, thereby stabilizing the image. Gaehring said that the algorithms do this correction well enough to eliminate any apparent motion during handheld inspection. He noted that this adjustment is possible only because of a powerful graphics processor in the system.

Keyence product sales director Sean Gasparovic pointed out that the lighting is controlled by the system and travels over fiber optics to the lens itself. That

handheld microscopes



Portable microscopes are used for circuit board inspection, as seen here using 20× magnification. Image courtesy of Celestron.

configuration enhances the microscope's capabilities, he said. "We can actually create oblique lighting with the touch of a button to help create shadows to capture the texture on the surface."

Upon closer inspection

The portability of handheld microscopes plays a key role in their use for product inspection and quality assurance. In the case of work done at NASA's Langley Research Center in Hampton, Va., portability and depth of field were important reasons for using a Keyence handheld microscope.

Margaret Holloman, a NASA quality assurance specialist, was charged with determining the exact profile of a nose cone studded with a large number of flush-mounted pressure gauges. Engineers wanted the instruments to gather data in flight and needed to know the relationship of each gauge to its surroundings.

The situation demanded certain capabilities, Holloman said. "Making noncontact measurements as well as being able to take 3-D images was crucial."

A conventional microscope couldn't handle the approximately 3-ft-wide by 6-ft-long wedge-shaped nose cone. In addition, a standard microscope lacks the depth of field necessary for the angled point of view required to determine heights accurately. So Holloman modified a heavy-duty camera tripod and mounted a handheld microscope on it, thereby obtaining the needed 3-D measurements. She also captured a permanent record of the depth and contour of each pressure gauge and its relationship to its surroundings.

Although the nose cone project is done, the system is still in use, with the depth of field an important advantage. "There are times that researchers request complex geometries be measured on a wide variety of flight hardware," Holloman said.

A final example of handheld microscopy comes from Celestron. Known as a telescope maker, Celestron entered the microscope market with a new line of products last year, part of an effort to increase the company's revenues in this area. One of the items was a handheld microscope capable of 150× magnification. It has a 1.3-megapixel digital camera and connects to a computer through a USB port.

Unlike some other handheld microscopes, Celestron's products are aimed at consumers and hobbyists. Some of the uses there include inspection of coins, stamps and other collectibles. There are also both formal and informal educational uses for these handheld microscopes. As with similar products, Celestron's devices have found application in industrial settings, noted Alan Hale, the company's vice president of product development.

At Celestron itself, occasional problems with a circuit board have led to an examination using the company's own products. In those cases, the portability of the microscope was important in that the inspection could occur in place.

Equally important, though, was the device's ability to make the information visible. It thereby rendered something that was physically small, but that in manufacturing was having a large impact, big enough for a group to diagnose and fix. Recalling the situation, Hale said, "We've had three or four engineers standing around, looking at this thing on the screen."

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LOOKING TO ATTRACT VENTURE CAPITAL?

Green is where it's at

BY LAURA S. MARSHALL, FEATURES EDITOR

If you want venture capital this year, it would be wise to consider going into clean technology. "The area that is growing most is clean technology, which includes alternative energies like solar, wind, biofuels; conservation companies; even companies extending life of batteries," said Emily Mendell, vice president of strategic affairs at the National Venture Capital Association (NVCA) in Arlington, Va. The NVCA is an advocacy group for entrepreneurs and innovators whose members consist of approximately 450 venture capital firms in the US.

Venture capital investments were down overall in 2008, marking the first yearly decline since 2003, according to the 2008 "MoneyTree" report, produced by PricewaterhouseCoopers LLP and the NVCA based on data from Thomson Reuters. The $28.3 billion invested in 3808 deals represents an 8 percent decrease in dollars and a 4 percent decrease in total deals from 2007. Fourth-quarter investments in 2008 totaled $5.4 billion, which is the least amount of dollars invested since the first quarter of 2005; it's also 26 percent less than the $7.3 billion invested in 2008's third quarter.

The 2008 fourth-quarter investment drop affected sectors nearly across the board, from life sciences to software to Internet companies to media and entertainment – most saw percentage declines in the double digits for both dollars and deals.

"At this point, venture capitalists are doing what everyone else is doing: assessing and reassessing their capital outlays and each and every investment carefully in order to make prudent decisions on what companies have the brightest outlook for the long term," said Tracy Lefteroff, global managing partner of the venture capital practice at PricewaterhouseCoopers.

Life sciences, with 28 percent of all investments, saw investing dip 15 percent, down to $8 billion from $9.3 billion in 2007. However, the number of deals dropped only 3 percent, from 883 in 2007 to 853 in 2008.

"Well, no one is necessarily immune to the recession," Mendell said. "The most direct impact that the recession has had on venture capital is what we call the exit market."

When a venture capitalism firm puts money into a project, she explained, it funds that project for five to 10 years; after that, the company exits onto the public exchange or through acquisition by another company. But the current economy has created fewer opportunities in the exit market.

"Now, many companies aren't able to get out of their (investment) portfolios," she said. "That's the most immediate impact.

"Venture capitalists are still investing, but there's pressure to invest at a somewhat slower pace."

Green-powered growth

In spite of all this, investments in clean technology grew more than 50 percent last year.

"That area is growing exponentially, despite the recession," Mendell said. "For instance, in 2008 venture capital firms put about $4.1 billion into clean-tech companies – that's up from $2.7 billion in 2007." Indeed, seven of the ten largest deals of 2008 took place in the clean-tech sector.

Clean, or green, appears to be where it's at. "Clean tech is an area that's been hot for a little while," said Mike Dauber, a senior associate in the Menlo Park, Calif., office of Boston-based Battery Ventures. The firm invests venture capital in Internet and digital media, financial services and tech-enabled businesses; software; semiconductors and components; infrastructure technologies; and communication services. "We're careful in [the clean-tech] space, too," Dauber noted, "but it's certainly a market that's going to have potential going forward."

There are a number of reasons why investors are excited about clean technology, Mendell said. "For one thing, the government recognizes how important it is to move these technologies forward – the government is very supportive of these

technologies. And consumers are ready to adapt to new behaviors, new products.

"It's a perfect storm of innovation in these areas. And that's what venture capitalists do: take innovation and bring it to market."

But where do venture capitalists get the capital to bring innovation to market? Whose money are they using?

"A lot of people get this wrong," Mendell noted. "Venture capitalists invest money from large institutional players like pension funds, endowments and so on. They take some individual money, but only on a large scale. A mom-and-pop operation, or you or me – we can't put our money in." But, she added, it's possible for the regular Joe to invest in venture capitalism through a pension fund, for example.

> "The most direct impact that the recession has had on venture capital is what we call the exit market."

There are various ways for fledgling companies to find venture capitalists to fund their projects, she said: "The Internet is a very powerful tool. You can find venture capital firms and submit business plans online today. Google 'venture capital,' Google your industry." The NVCA even has an online directory of venture capitalists at www.nvca.org.

"It's good to talk to other entrepreneurs in your region – people working in innovative areas tend to know each other," Mendell said. Word of mouth helps direct the search, and references from other entrepreneurs in your region or your industry can narrow down a list of potential investors.

At Battery Ventures, new companies are found in all kinds of ways. "Anything from someone looking us up on a Web site to a friend of a friend," Dauber said. "We also go to trade shows, meet with entrepreneurs – you talk to friends of yours, and you find out who's looking for funding, who's starting companies. "It's interesting how, once you enter the VC (venture capitalism) community, people tend to find you."

He cautioned that venture capital firms need entrepreneurs to do their homework before pitching their ideas. "You always want to understand someone's business model," he said. "Often you get the business plan, and you walk through: Here's the team, here's the technology, here's the market we're going after, here's how we differentiate ourselves."

But Battery has been known to help people start companies from the very beginning, too, helping them to fine-tune their ideas. With Redwood Systems of Fremont, Calif., "we were working side-by-side with the CEO – pre-ground floor," Dauber said. Redwood makes energy-control systems for green buildings.

And if you're just starting out, there's good news: The "MoneyTree" report pointed out that seed-stage investments grew to $1.5 billion into 440 companies in 2008, a 19 percent jump from the $1.3 billion funneled into 450 companies in 2007. "Seed stage" refers to a company's starting point, when founders create a business plan and work on prototype development and testing. The $1.5 billion amount is the largest investment in seed-stage companies since 2000. Later-stage and expansion-stage investments saw declines.

"The stability of seed- and early-stage deals as a percentage of total deal volume suggests that venture capitalists are continuing to fund very young companies," said Mark Heesen, president of NVCA, "giving credence to the philosophy that an economic downturn is a time ripe with opportunity."

Mendell expects the coming year to be challenging, but she isn't pessimistic. "I think it's going to be tough on everyone," she said, adding that a number of venture capital firms could go out of business this year.

Dauber's advice for new entrepreneurs is to keep a level perspective. "You certainly have to have the stomach for it," he said. "I think for any entrepreneur, you have to be prepared for a certain level of rejection. You can't take it personally; people are being very, very cautious.

"As you're constructing your business plan, it's also important to think about how the investors are going to make money. This will help you both in your interactions with VCs and in determining how much money you can raise. "

And enthusiasm doesn't hurt. "You need to have an idea and market it so people are excited about it," Dauber said. "If the entrepreneur isn't excited about the project, they can't expect the VC to be.

"All it takes is one great team and one great idea, and you can make a good company out of it."

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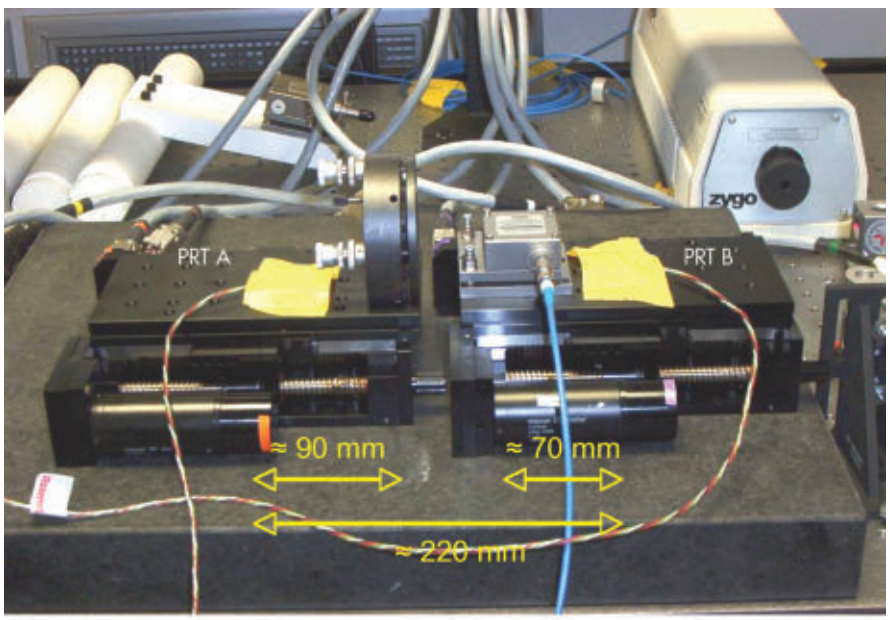
Heat & Motion
DUKE IT OUT

Temperature changes hold the key to precision positioning applications.



[(0.16 m * 23 µm/m/°C) – (0.22 m * 7 µm/m/°C)] * 0.08 °C = 0.17 µm

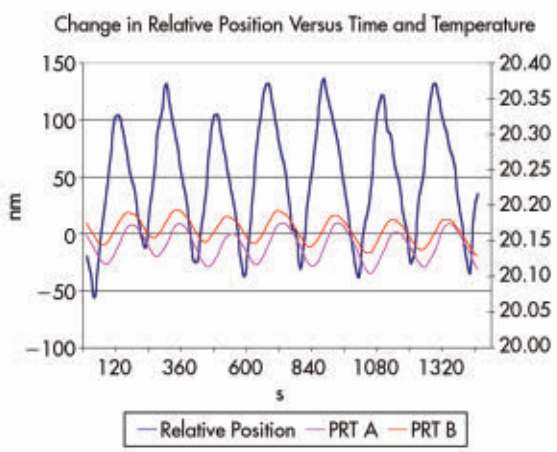


Figure 1: Depicted here is the relative position change between two linear stages mounted on a granite table. Note that the stages are not powered. The position change is entirely the result of the different thermal expansion coefficients of aluminum and steel.

BY THOMAS BARTHOLOMÄUS
AND BEDA ESPINOZA, NEWPORT CORP.

The dominant cause of error in most motion applications is temperature or, more precisely, temperature change. Temperature alone affects the accuracy of any position measurement, and this error – linear – is either irrelevant or can be compensated for easily. However, temperature changes cause drift and affect repeatability or reproducibility, very real concerns for most high-precision motion applications. It is much more difficult to control or compensate for this.

Any experimental setup or machine is made of materials such as steel, granite or aluminum, all of which inherently have different linear thermal expansion coefficients. Because any position is always measured between two points, one typically a stationary reference – for instance, from an optical table or an overhead granite bridge – and the other on a motion stage, the dissimilar thermal expansion of different materials in the setup causes length changes between the two points, eventually seen as drift or error in reproducibility in the application. Therefore, the position of a motion stage may be perfectly stable and accurate, but the position relative to the reference may change because of nonuniform material expansion within the setup.

A perfect correlation

To illustrate this point, in Figure 1, the distance between the edges of two aluminum linear stages is monitored with a laser interferometer. The stages are

mounted on a granite table using screws at the center of the stages. The stages are screwed onto a granite table. They are not powered, so any position drift is entirely the result of thermal expansion and the granite. The relative position fluctuation of 170 nm every three minutes correlates perfectly to the temperature fluctuation of the stages of 0.08 °C – a result of the air-conditioning system – and can be explained by the thermal expansion coefficients of aluminum (23 µm/m/°C) and of granite (7 µm/m/°C) used in the setup. Hence, the position drift is not caused by the performance of the stages but by the inhomogeneous materials in the setup.

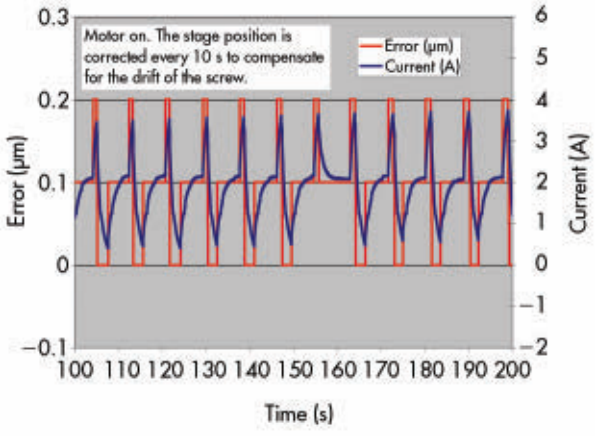
But temperature changes also have many other effects. For example, in a linear stage, the temperature of a steel leadscrew increases as it is cycled through its travel, lengthening the screw by ~10 µm/100 mm/K change. If the position of the stage is controlled by a shaft encoder or the steps of a stepper motor, or if the motor is turned off after the motion, the screw will expand slowly, resulting in a slow drift or in an error in repeatability if the same position is approached many times (Figure 2, bottom).

However, when a direct encoder is used – e.g., a linear scale – the heating of the screw does not affect stage position, and high repeatability is achieved. Repeatable positioning is the primary advantage of direct encoders over shaft encoders or open-loop steppers. Also, in steady position, a stage with a direct encoder will correct for the length changes of the screw as the screw cools down after the motion. However, these corrections will be viewed as position instabilities from the outside world (Figure 2, top). The preferred behavior – continuous drift or correction – depends on the application.

Dissimilar materials used inside a motion stage also can introduce significant motion system errors. Figure 3 shows schematically the cross section of a Newport FEM optimized U-channel design used on the ILS and IMS series linear stages (left) compared with a linear stage with a box design (right). In the U-channel design, the center of stiffness of the steel parts (green) is in the same plane as the center of stiffness of the aluminum parts (blue). In the box design, the center of stiffness line does not bisect all dissimilar materials the same way, creating bimetallic bending that introduces a considerable pitch error on the stage. In many applications, pitch error is a major contributor to positioning errors, particularly for long travel, multiaxis positioning systems and any application where the "point of interest" is far from the position-sensing device; e.g., the bearing plane.

Users should be cognizant of temperature, especially changes normally encountered in a lab or manufacturing environment, which can be the main cause of errors in many high-precision motion applications. Also consider that flatness of the mounting surfaces, large distances of the "point of interest" from the position feedback systems, off-centered loading and nonoptimum motion electronics can introduce errors.

But that's a different story.



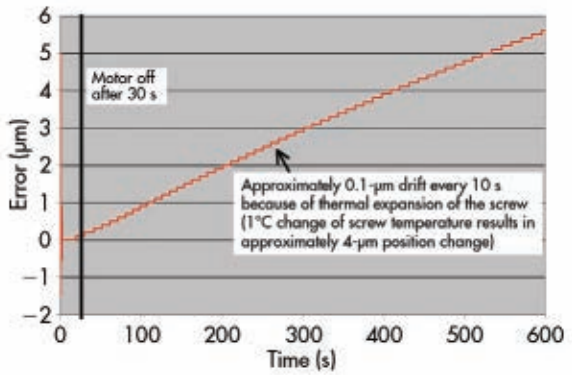
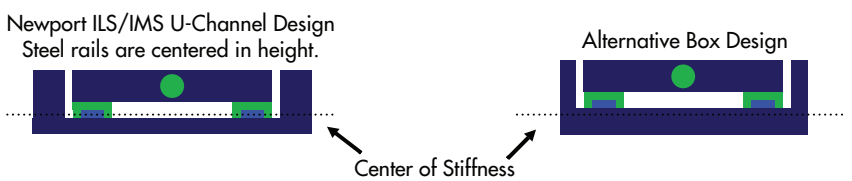


Figure 2: The position change of a vertical linear stage with 45-kg axial load is pictured after some continuous motion with motor on (left) and motor off (right). With the motor off, the stage position drifts because of the heat dissipation of the screw after the motion. The stage features a direct encoder (not coupled to the screw) with motor on, so the stage position is continuously corrected for. However, this continuous position correction yields to sudden position changes rather than a continuous drift.



	Alternative Design	ILS200
Pitch at 20 °C*	130 µrad	70 µrad
Pitch at 30 °C*	300 µrad	110 µrad
Thermal Induced Pitch*	17 µrad/°C	4 µrad/°C

* Stages mounted on four points on an adapter plate, no load

Figure 3: The thermally induced pitch of an athermal Newport design is compared with an alternative box design.

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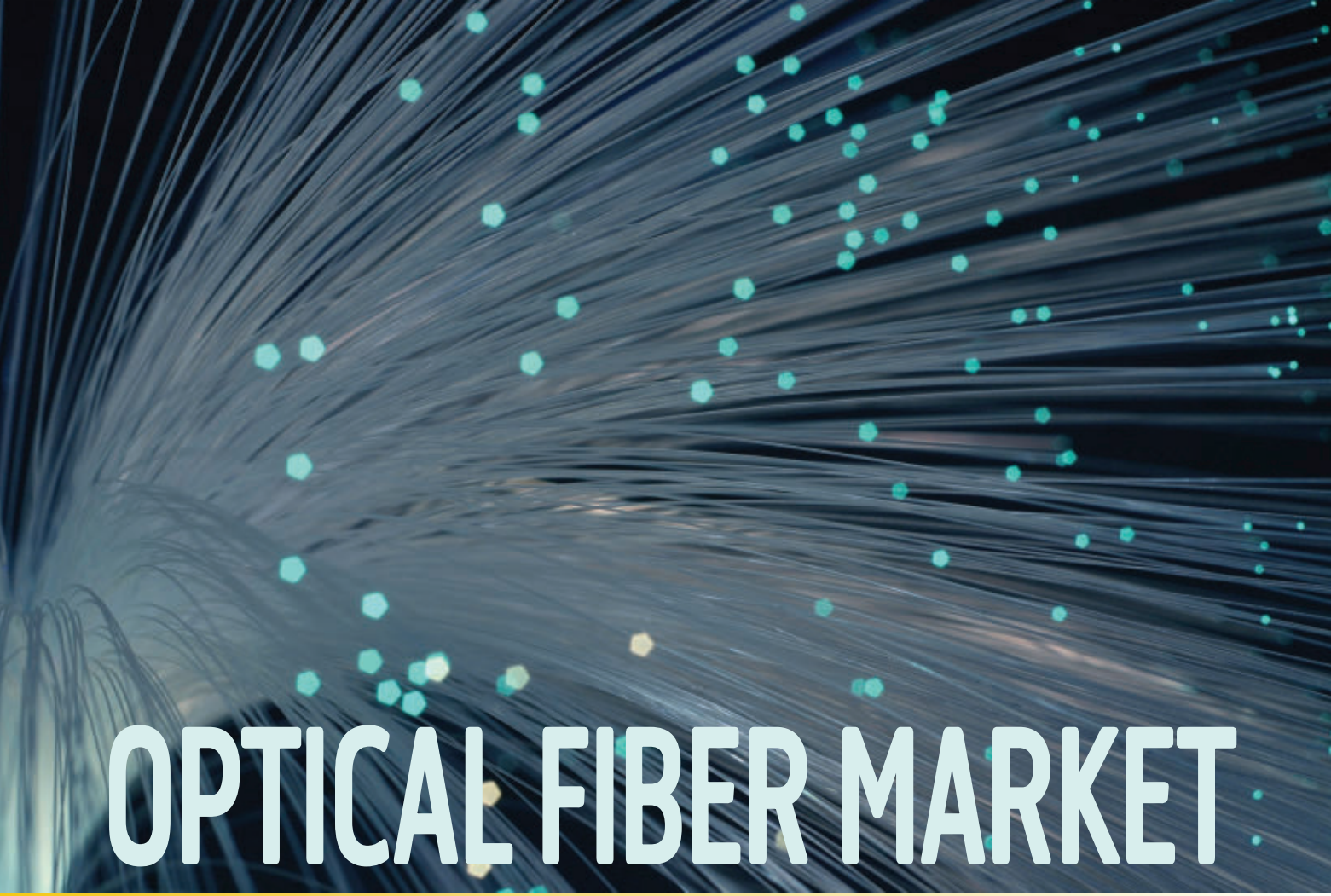

OPTICAL FIBER MARKET

Keeps Plugging Away Despite Recession

BY DAVID L. SHENKENBERG, FEATURES EDITOR

According to the *FttH Fact Book 2009* by BuddeComm and Chiltern, more than 40 million people worldwide currently subscribe to fiber optic networks including FttH, or fiber to the home. Although DSL has more market share of broadband customers around the world, some experts say that optical fibers could overtake it within five to 10 years.

The optical fiber market could reach this level of growth even sooner, but certain obstacles could prevent this. For example, some technologies are extending the life of DSL, which will make telecoms more resistant to switching to optical fibers. At the local level, project managers need to plan the installation of fiber optic network infrastructure without disturbing other underground systems. The populace may complain about the impact of the construction on community appearance, the environment and public safety. People also might vandalize or steal the equipment.

However, these issues are relatively minor. The three primary factors affecting the optical fiber market are cost, regulation and competition.

A discussion of the market cannot begin without addressing the elephant in the room: the global recession. However, despite the economic downturn, the optical fiber market is moving forward.

Some countries help roll out fibers

In Europe, broadband access has been viewed as a matter of public welfare. This outlook has helped promote the expansion of fiber optic networks. Competition between countries also has spurred growth.

In Sweden, Denmark, Finland and the Netherlands, governments have helped telcos roll out fiber optic networks. In response, France, Italy, Germany, Portugal, Spain and the UK have been rolling out fiber networks as well. However, these countries have favored hybrid fiber-copper networks due to the cost of optical fibers.

In Australia, a 2007 initiative of the Labor Party would have helped optical fiber rollout, but this measure was resisted by Telstra, which controls the largest market share on the continent.

As one might expect, growth is slower in poorer continents such as Africa and South America. However, there are opportunities in relatively wealthy and politically stable countries such as Brazil and Algiers.

"Asia is the one region in the world where FttH has started to emerge as a seri-

ous broadband platform," states the *FttH Fact Book*.

A report from the market research firm Infonetics Research emphasizes that there is room for telecom growth in China. Out of the 1.3 billion people in China, only about 500 million subscribe to mobile services and 51 million to broadband services. The Chinese government views broadband access as a necessity for global competitiveness and, during the time leading to the 2008 Beijing Olympics, it spent a lot of money on next-generation telecommunications.

The *FttH Fact Book 2009* notes that fiber to the home is growing rapidly in the US, thanks in large part to Verizon's FiOS, an all-fiber-optic network. In its full-year report to investors for 2008, Verizon stated that it had gained 303,000 net new FiOS TV customers and 282,000 net new FiOS Internet customers, the largest increase in customers so far for the company.

Optical fibers still overtaking copper

In February, AT&T announced that it plans to invest approximately $1 billion in 2009 to build its global network and add services for businesses. The expansion will include new undersea fiber optic cables to Alaska, Australia, Asia, India and Puerto Rico. The company also will offer private enterprise networks to 18 more countries.

Although the optical fiber business unit of Corning Inc., Corning Cable Systems, has reported slower than expected growth in 2008 because of the global recession, its president and CEO, Clark S. Kinlin, said, "The substitution of fiber over copper lines continues as bandwidth requirements in individual homes grow."

The company's 2008 report of the telecom market noted worldwide growth of 12 to 15 percent in terms of volume sold. Fiber to the home grew by 15 percent, while DSL declined by 25 percent. Growth in data centers offsets slower demand from other businesses.

Corning forecasted that the telecom market will be down 10 to 15 percent in 2009 versus 2008, with public carrier networks down by 10 percent and private enterprise networks down by 20 percent.

Similarly, the Dell'Oro Group forecasted that fiber optic equipment will decline 9 percent in 2009, with growth resuming in 2010. However, the group forecasted that the market for optical fiber equipment for wavelengths compatible with 40 Gb/s data rates will grow at least 50 percent in the next five years. The report also indicates that shipments of equipment for 100 Gb/s wavelengths are expected in late 2011.

Jimmy Yu, director of optical transport research at the Dell'Oro Group, explained, "There continues to be an opportunity for technologies that will help service providers reduce their capital expense while still expanding their network capacity. We think that 40 Gigabit is one of those technologies as the price per bit of a 40 Gb/s wavelength starts to be lower than that of a 10 Gigabit wavelength in a DWDM long-haul system."

According to the *Plastic Optical Fiber Market and Technology Assessment Study 2008*, plastic optical fibers have been doing well in the recession because they are relatively cheap, and technical developments and the adoption of standards have enabled them to compete with glass fibers. The report noted that new companies are entering the field from China, Taiwan, Japan, US, Canada, Europe, Korea, Australia and Ireland.

David L. Shenkenberg
david.shenkenberg@laurin.com

Beware patent trolls

Entity	Patent Families	Litigations
Intellectual Ventures	10,000-12,000 (est.)	—
Interdigital Inc.	2633	39
Wisconsin Alumni Research Foundation (WARF)	1806	28
Rambus	850	11
Tessera Technologies Inc.	816	20
Jerome H. Lemelson	513	28
CSIRO	511	12
Acacia Technologies	493	319
Mosaid Technologies Inc.	389	9
Scenera Research LLC	324	18
Papst Licensing GmbH	272	60
Altitude Capital Partners	261	6
Cheetah Omni LLC	201	4
Trontech Licensing Inc.	191	31
St. Clair Intellectual Property Consultants Inc.	177	13
Innovation Management Sciences LLC	175	0
Rembrandt IP	146	26
Washington Research Foundation	124	2
AmberWave Systems Corp.	121	9
Wi-Lan	118	12
Alliacense	118	25
Technology Patents & Licensing Inc.	103	1
WIAV Solutions LLC	98	6
Autocell Laboratories Inc.	98	1

Nathan Myhrvold of Intellectual Ventures is considered a troll because he owns roughly 10,000 to 12,000 patent families. His tactic is not to sue large corporations for infringement but instead to intimidate them with his distinction of being the largest patent holder in the US. Courtesy of PatentFreedom.

		Number of Litigations					
No.	Company Name	2004	2005	2006	2007	2008	Total
1	Samsung	5	3	8	13	9	**38**
2	Microsoft	3	5	6	11	9	**34**
2	Motorola	1	6	4	12	11	**34**
4	HP	6	3	4	9	10	**32**
5	AT&T	2	2	6	14	6	**30**
6	Sony	3	7	4	8	7	**29**
6	LG	—	7	3	11	8	**29**
8	Apple	4	3	3	11	7	**28**
8	Dell	4	3	7	9	5	**28**
8	Nokia	2	7	3	9	7	**28**
11	Matsushita Electric	5	8	4	6	4	**27**
12	Toshiba	4	5	4	9	4	**26**
13	Time Warner	—	6	6	8	5	**25**
14	Verizon	1	3	3	13	4	**24**
15	Sprint Nextel	2	2	3	11	4	**22**
16	Palm	1	3	3	5	9	**21**
17	Cisco	—	3	—	12	5	**20**
17	Intel	1	9	2	1	7	**20**
17	T-Mobile	—	5	2	11	2	**20**
20	Kyocera	3	6	3	4	3	**19**

These trolls may not be the characters you read about in fairy tales, but their intentions are nevertheless familiar as they seek out vulnerable companies or inventors for patents or pursue multiple large conglomerates for million-dollar licensing deals.

Patent trolls, also known as nonpracticing entities (NPEs), are rising considerably in number. According to a report from PatentFreedom – an organization launched in April 2008 to provide up-to-date information on NPEs to companies needing patent protection – more than 220 patent trolls are currently in operation.

NPEs do not make or manufacture products that require patents but instead buy others' intellectual property and target companies perceived as breaching them. The aim of NPEs is to buy patents from small ventures that are not actively enforcing them and to make operating companies pay outstanding royalties for using them. Trolls are also notorious for filing costly infringement lawsuits against those who don't seek patent licenses.

An ad hoc organization of companies that is lobbying for reforms to the US patent system, the Coalition for Patent Fairness, states that infringement cases have increased more than 404 percent since 1990, with a 30 percent increase in 2007 alone. Corporations such as Sony, Samsung, Hewlett-Packard, Microsoft and Time Warner have all been accused of patent infringement, and most of these companies typically go to court several times a year.

NPEs operate on the premise that most companies will fold rather than spend millions of dollars at trial in their defense. Typical trial expenses can total millions of dollars, plus the settlement charge afterward, if the company is found accountable.

Companies such as Samsung, Microsoft and Motorola have been continuously threatened by trolls. Without a patent reform act, a company infringing on a single patent could face court settlements for the entire operating system to which the patent belongs. Courtesy of PatentFreedom.

The troll

Nathan Myhrvold, founder of Intellectual Ventures LLC, has acquired more than 20,000 patents from universities, bankrupt corporations and independent inventors. The patents cover a wide variety of technologies ranging from lasers to computer chips.

Myhrvold is considered a patent troll because he is the largest owner of intellectual property in the US and has put together the most expensive patent-licensing deals ever made. Recently, he strong-armed individual corporations into agreeing to payments between $200 million and $400 million.

Yet, unlike most patent trolls, Myhrvold hasn't filed an infringement claim against a company since Intellectual Ventures began in 2000. Instead, he uses his stature to force businesses like Verizon Communications, Cisco Systems, Sony, Nokia, Microsoft and others into paying royalties so they won't be sued.

> *"Corporations … want to avoid an expensive infringement trial (and) protection for valuable patents …"*

However, obtaining patent rights from Myhrvold does not necessarily protect a licensee completely from infringement. If only a limited set of patents are bought, or if they're only licensed for a short time and not renewed promptly, expanding on them could still result in litigation.

The opposition

RPX Corp. of San Francisco is a business founded in March 2008 to protect intellectual property from patent trolls. Labeling itself a "defensive patent aggregator," the company buys patents to keep trolls from obtaining them solely for the purpose of lawsuits and royalty fees. RPX vows never to assert a member's patents.

Companies pay a fixed annual membership fee ranging from $35,000 to $4.9 million, based on their operating incomes, and they're given full rights to all of RPX's patents, regardless of value. However, RPX chooses which intellectual properties to buy without consulting its members. Currently the company, backed by Kleiner Perkins Caufield & Byers and Charles River Ventures, owns more than 150 US patents and more than 60 US applications in areas of mobile technology, the Internet, radio-frequency identification and digital media. So far, the company has invested more than $40 million.

Another NPE opponent is Allied Security Trust (AST) of Poughkeepsie, N.Y. The company's members include Verizon

SLICES FROM THE BREADBOARD

Communications, Google, Cisco Systems, Hewlett-Packard and Ericsson. Unlike RPX, AST is a nonprofit company and consults with its members on which patents to buy. The membership fee is put into an escrow account so the money can contribute to the purchase of more patents. AST also promises not to assert any patents, and members are given rights to all intellectual properties owned. According to its Web site, the company has 11 members and a goal of 30 to 40.

Many corporations are involved with these types of intellectual property managers because they want to avoid an expensive infringement trial, but they also want protection for valuable patents that have not yet been bought by NPEs. In an effort to repair this malfunctioning system, an amendment is being considered that could change US patent law for the better.

Patent reform act

Because of the increasingly large number of lawsuits filed by patent trolls, tech industries, along with the Coalition for Patent Fairness, are proposing the Patent Reform Act of 2008. Section 284 of Title 35 emphasizes compensation, limitations and measures for damages resulting from an infringement. Currently, even if a patent makes up only a small portion of a company's operating system, royalty amounts are based on the entire value of an invention.

If the bill, which has been cleared by the House of Representatives, is accepted by the Senate, those costly damage settlements would be discontinued and, alternatively, the court would assign an apportioned fee that is appropriate to the infringed patent under debate. The objective is to reduce unnecessary litigations, which, in turn, could decrease the revenue that patent trolls rely on most to operate. And, in the case of Intellectual Ventures, it may help to lessen Myhrvold's power to exact multimillion-dollar licensing deals from corporations.

Amanda D. Francoeur
amanda.francoeur@laurin.com

3M, EV Group Settle Patent Infringement Suit
3M of St. Paul, Minn., a product research and development company, and EV Group of St. Florian, Austria, a wafer-processing solutions provider, have agreed to settle patent infringement litigation related to temporary wafer bonding brought by the latter against the former in US District Court. Under terms of the settlement, the Minnesota company, its customers and licensed suppliers of its wafer support system will continue to make, sell and use the system in global semiconductor and packaging markets. The Austrian company will continue to defend and protect its patent portfolio and intellectual property.

Surface-Mountable LED Chip Patented
Sunnyvale, Calif.-based Bridgelux Inc., an LED technology supplier, has been awarded a US patent for its surface-mountable chip design. By eliminating the need for traditional LED packaging, this architecture is anticipated to change how the devices will be deployed. The design will offer high flux density with an ultrasmall footprint and thin profile as well as the ability to closely pack multiple chips in space-limited applications, including camera flash, LCD display backlighting, and general or specialty lighting.

Crimson Trace, LaserMax Patent Infringement
In Oregon, Crimson Trace Corp. Inc. of Wilsonville, a handgun laser sighting systems manufacturer, has filed a suit in US District Court in Portland against LaserMax Inc. of Rochester, N.Y., for its infringement of four US patents. The Oregon business cited patent infringement against the New York company's J-Max, Sabre and Uni-Max products. Crimson Trace seeks court-ordered injunctive relief and unspecified damages for patents related to laser sighting devices for firearms.

COMPACT REMOTE-HEAD CAMERA

JAI Inc. has extended its C3 Camera Suite with the introduction of a 0.3-megapixel industrial camera with a remote-head lens and a Power-over-Camera-Link digital interface. The CM-030PMCL-RH is based on a ⅓-in. Sony monochrome progressive-scan CCD with 656 × 494 active pixels at 8- or 10-bit depth. The remote-head configuration enables operation at 120 fps, and higher rates can be achieved with the camera's vertical binning and partial scan modes. Applications include robotics, surface mounting and inspection, and semiconductor inspection.

JAI
camerasales.emea@jai.com

FIXED-FOCAL-LENGTH LENSES

Edmund Optics Inc. has introduced TechSpec, compact fixed-focal-length lenses for use in industrial machine vision applications. The lenses have a broadband antireflection coating for increased transmission and are available in focal lengths of 8.5, 12, 16, 25 and 35 mm. They support up to ⅔-in. sensors, feature a locking iris and include a focus adjustment with recessed set screws. Packaged in rugged housings, they are suitable for use in factory automation, inspection and qualification.

Edmund Optics
medmund@edmundoptics.com

NANOPOSITIONING PIEZO STAGES

For microscopy, imaging, lithography, interferometry, surface profilometry, laser tuning and beam steering applications, Newport Corp. has announced a line of nanopositioning piezo stages. The NPX linear stages are available in X, Y-Y and X-Y-Z configurations. The latter two use an advanced parallel motion principle that provides accurate parallel and straight motion at up to 400-µm travel. The frictionless guide design renders all of the stages maintenance-free. The NPO nanofocusing stages are mounted between the microscope and the objectives, enabling a 250-µm focusing range.

Newport
newproduct@newport.com

DIGITAL VIDEO CAMERA

Photron Inc. has released the Fastcam SA5, a digital video camera that operates at 7500 fps with 1024 × 1000-pixel resolution. Available with a 12-bit monochrome or 36-bit RGB color sensor, it offers 1-µs global shuttering. The remote-control keypad has an RS-422 interface and is included with the built-in 5-in. LCD screen for computer-free operation. Three memory configurations are offered: 8, 16 and 32 GB. The company's Fastcam Viewer freeware and a software developer's kit are available for users who want to integrate camera control, replay and download into existing software.

Photron
abridges@photron.com

FIBER OPTIC ROTARY ENCODER

Unveiled by Micronor Inc., the MR316ZapFree fiber optic rotary encoder is designed for heavy-duty industrial motor drive applications that require electromagnetic interference immunity, Atex compliance, IP66 ingress protection, and operation in hazardous locations and in extreme temperatures ranging from −60 to 150 °C. The all-optical and totally passive design of the rotary speed/position sensor offers immunity to lightning and atmospheric static. The encoder uses wavelength division multiplexing technology, assigning each internal optical path to a wavelength so that all wavelengths/paths can be combined onto a single fiber.

Micronor
sales@micronor.com

PIEZO LINEAR ACTUATORS/MANIPULATORS

The N-380/N-381 Nexact ceramic linear motor actuators from PI (Physik Instrumente) LP are for use in micro- and nanomanipulation, nanotechnology, microscopy and optics, laser tuning, semiconductor test and production equipment, and bio- and medical technology applications. They offer 1-kg push/pull force, 30-mm travel, 10-mm/s speed, millisecond responsiveness and <1-nm resolution. They can be controlled via USB, RS-232 or with a joystick. They operate in stepping mode for long-distance motion and in sweep mode for shorter distances.

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

b BRIGHT IDEAS

OPEN FRAME DIODE

Lumics GmbH has introduced the U-mount, an open-frame laser diode that operates in continuous-wave mode with 9 W of output power at 808 nm and 16 W of output power at 980 nm. In pulsed mode, it offers a 13-W peak pulse at 808 nm or a 30-W peak pulse at 980 nm, both at less than 30 µs. The laser chip and bond wires are enclosed on three sides, allowing the device to be handled safely while being screwed to a printed circuit board.
Lumics
sales4@lumics.com

LASER CUTTING SYSTEM

Titan, a 10-kW fiber laser cutting system from Laser Photonics LLC, is supplied with a 1.2 × 2.4-, a 1.5 × 3.0- or a 2 × 4-m manual single-pallet shuttle system, a PC/NC base control with a conversational graphical screen, and a 381-mm thin-film transistor color display. It has three standard USB ports and an RJ-45 LAN connection for networking. The laser safety starter kit includes an optical cartridge tool

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Laser Photonics
fiber@laserphotonics.com

STRAIN ANALYZER

The DiTest Sta-R from Omnisens is a strain analyzer used for quality control, testing and troubleshooting in optical fiber and cable manufacturing, and for telecommunications, defense and geotechnical engineering applications. Working with the company's DRM distance range extension modules and using a Brillouin-based technique, the fiber optic sensing system monitors strain and temperature over 125 km with 1-m resolution and 0.5-m spatial resolution. Operating temperature is from 0 to 40 °C. Autoconfiguration capabilities adjust the measurement settings to the monitoring conditions.
Omnisens
info@omnisens.ch

CHIP SET

Luminus Devices Inc. has released the PhlatLight LED PT-121 chip set, designed for use in lamp-free data projectors. The device comprises a red, green and blue LED and is best-suited for data projectors using microdisplays ranging in size from 0.65 to 1 in. It does not require a startup or cooldown period, and, with a wide color range exceeding NTSC standards, it has a lifetime surpassing 60,000 h.
Luminus Devices
sales@luminus.com

HIGH-SPEED LENSES

Westech Optical Corp. has released its 6-mm *f*/0.8 high-speed lenses for CCD cameras. Designed for a ⅓-in. format, the lenses offer distortion of less than 5 percent and a fixed iris. The C-mount, 10-element eight-group design provides adjustable focus with a locking pin.
Westech Optical
jcarlino@westechoptical.com

INTERFEROMETER

QED Technologies has unveiled its aspheric stitching interferometer, which measures steep

aspheres with as much as 1000 waves (more than 600 μm) of departure from the best-fit sphere, without the use of dedicated null lenses or computer-generated holograms. The device is based on the company's subaperture stitching technology.

QED Technologies
sales@qedmrf.com

LIGHT SOURCES

The Sōlarc NGX portable high-intensity-discharge metal halide light sources introduced by Welch Allyn Lighting Products are designed for integration into endoscopes, borescopes and analytical equipment. They comprise a lamp and ballast as small as 55 mm long and 35 mm in diameter. The ballast can be configured to a 14- or 9.5-W setting. The former features 1000-lm output, 6900 K color temperature and a median lamp life of 350 h; the latter features 500-lm output, 13,700 K color temperature and a median lamp life of 700 h.

Welch Allyn Lighting
rutand@welchallyn.com

b BRIGHT IDEAS

WAFER ANALYZER

PANalytical has launched the 2830 ZT, a wafer analyzer that performs simultaneous noncontact determination of layer thickness and composition on wafers up to 300 mm. The wavelength dispersive x-ray fluorescence instrument also determines contamination, dopant levels and surface uniformity, and it measures up to 24 elements on stacks of up to 16 layers. It operates at a constant current of 160 mA and is supplied with the company's SuperQ software.
PANalytical
info@panalytical.com

LASER MIRRORS

Saint-Gobain Crystals has unveiled two laser beam delivery mirrors. The Alpine Research Optics brand B-Max mirrors support Ti: sapphire lasers with pulse widths of ≤10 fs and deliver >99.8% reflectivity from 735 to 880 nm. The E-Max models operate from 770 to 840 nm. Both series' coatings are designed to minimize group-velocity and third-order dispersion to maintain close to a transform-limited pulse performance in ultrafast laser systems. The coatings are available for 0° and 45° angle of incidence operation and are supplied on 25- and 50-mm-diameter fused-silica substrates.
Saint-Gobain Crystals
bouldersales@saint-gobain.com

STEREO CAMERA

The smart stereo camera from Vision Components GmbH is a single-board OEM device measuring 2.4 × 4 in. Its two camera heads, which can be installed at various distances and tilt angles, have CCD sensors of similar or different types. Image capture for either head can be triggered externally or internally. Part of the VCSBC64xx family, the camera has applications in 3-D machine vision, robotics and inspection systems.

Vision Components
sales@vision-components.com

PUMPING STATION

Applications for Pfeiffer Vacuum GmbH's HiCube turbo pumping station include vacuum process technology, analysis and surface physics, and electron beam welding. The plug-and-play system has both a turbo pump and a dry or oil-sealed backing pump to satisfy pumping requirements from 35 to 685 l/s. Depending on the application, it also comes with a water cooling or heating sleeve.

Pfeiffer Vacuum
info@pfeiffer-vacuum.de

DIODE LASER

Alfalight Inc. has introduced an 808-nm, 0.65-W single-emitter pump diode laser, packaged on a 3-mm Q-mount. An integrated grating on the laser chip provides a pump wavelength locked on the narrow-absorption band of the gain medium, eliminating the need for temperature control circuitry. The laser's operation and packaging are the same as that of a standard laser diode. The device has applications in pico-projector and laser display systems.

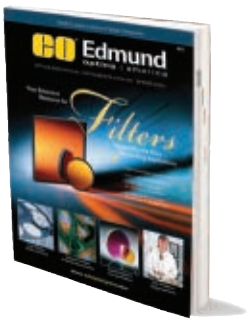
Alfalight
sales@alfalight.com

LED CONTROLLER

The AS3693B LED controller integrated circuit from austriamicrosystems AG manages 16 LED channels, each with a current accuracy of 0.5%, enabling high color and brightness control. Three free configurable dynamic power feedback circuits make it useful for both white LEDs and color backlights. For use in LCD TV sets, the device offers features including "reverse PWM." It is available in an ePTQFP64 10 × 10-mm package.

austriamicrosystems
products@austriamicrosystems.com

NEW MEDIA



MULTIPHYSICS MODELING

Comsol Inc., developer of Comsol Multiphysics software for modeling and simulating physics-based systems, has issued a CD of the proceedings and user presentations from the Fall 2008 Boston and Hannover Comsol Conferences. The resource includes technical papers, downloadable models in Comsol Multiphysics format, and animations and movie clips illustrating multiphysics modeling in disciplines such as science, education, engineering and medical research.
Comsol
info@comsol.com

FILTERS CATALOG

The spring 2009 *Optics and Optical Instruments Catalog* from Edmund Optics Inc. features filters for demanding applications in biotechnology, research and development, test and measurement, machine vision and analytical instrumentation. It presents six new families of filters, including the OD6 rugate notch, nonreflective neutral density and broadband interference varieties. The resource includes application notes.
Edmund Optics
sales@edmundoptics.com

IMAGING OPTICS

Navitar Inc., a supplier of imaging optics technology, has released its 2009 product catalog. Featuring solutions for machine vision, automation, assembly, imaging, measuring, inspection and biomedical sciences, the catalog presents more than 400 items, including high-magnification zoom, telecentric, large-format, motorized and video lenses. Among the new products highlighted are the short-wavelength IR focal length imaging lenses. Diagrams, photos and specifications are provided.
Navitar
info@navitar.com

MICROSCOPE UPGRADES

FEI Co. offers an online catalog of upgrades and accessories for its scanning and transmission electron microscopes, DualBeams and focused ion beams. Designed for instrument owners, the section on the company Web site provides specification and application information for parts and add-ons. Users can browse to see the products available for their instruments and can create a "wish list" to submit to a company representative for a customized proposal.
FEI
www.fei.com/owners

OPTICAL TABLES

A full-color catalog of high-precision motorized optical tables is available from Advanced Design Consulting USA Inc., which offers expertise in precision robotics, submicron positioning systems and optical subsystems. The 32-page document provides information on the Six Degrees of Freedom and Two Degrees of Freedom series products for use by physicists, chemists, biologists, and mechanical and aerospace engineers.
ADC
alex.deyhim@adc9001.com

DIGITAL IMAGING

A supplier of lighting, high-speed digital imaging and integrated solutions, Integrated Design Tools (IDT) Inc. has launched a redesigned Web site to reflect recent milestones, including the integration of the Redlake brand into its family. The portal includes technical product information and a video gallery to provide a glimpse of what the company's cameras offer in the areas of automotive and military testing, machine vision and digital cinema.
IDT
www.idtvision.com

FO REFERENCE

The Fiber Optic Association (FOA) Inc. has created the "FOA Online Fiber Optic Reference" as a Web-based complement to its printed textbook *The Fiber Optic Technicians Manual*. Available to anyone interested in fiber optics, the comprehensive resource is suitable for students preparing for FOA certification or for FOA-certified technicians who need a readily available reference while on the job. The pages can be viewed on small-screen devices and computer screens.
FOA
www.thefoa.org/tech/ref

OPTICS CONTENT

SPIE has launched its Optipedia resource for the optics and photonics community. Available in the "Publications" section of the organization's Web site, Optipedia offers key pages from select SPIE Press books and links them together via key words. Visitors to the site can search for the information using the search box or subject index, or by jumping from topic to topic using embedded key word links. Topics include infrared fibers, material dispersion and fiber amplifiers.
SPIE
www.spie.org

OPTICS REVIEW

The Optical Society of America has launched *Advances in Optics and Photonics*, an online quarterly journal of invited reviews and tutorials that focus on developments in the fields of basic and applied optics and photonics. Published in January 2009, the issue features review articles on the nonlinear optical properties and applications of silicon wires and on the fabrication and application of microwires and nanowires, and a tutorial on leaky modes in slab waveguides.
OSA
www.osa.org

HAPPENINGS

PAPERS

CLEO/Pacific Rim 2009 (August 30-September 3) Shanghai, China
Deadline: abstracts, March 31
Papers are sought for the Eighth Pacific Rim Conference on Lasers and Electro-Optics. Topics to be considered include ultrafast optics and photonics, nonlinear and quantum optics, IR and terahertz technology and applications, optical communications and networking, and laser metrology and remote sensing. Contact Hongxiang Lin, Shanghai Institute of Optics and Fine Mechanics, CAS, +86 21 6991 8005; cleopr2009@siom.ac.cn; www.siom.ac.cn/cleo.

MIPPR 2009 (October 30-November 1) Yichang, China Deadline: abstracts, April 1
Organizers of the Sixth International Symposium on Multispectral Image Processing & Pattern Recognition invite abstracts of 800 to 1000 words on topics such as automatic target recognition and image analysis, pattern recognition and computer vision, parallel processing of images and optimization techniques, and medical imaging and processing. Contact Fa-xiong Zhang, IPRAI, Huazhong University of Science and Technology, +86 27 8754 0131; mippr09@gmail.com; www.mippr.com.

APRIL

Focus on Microscopy 2009 (April 5-8) Krakow, Poland. Contact Jurek Dobrucki, Jagiellonian University, +48 12 664 6382; info2009@focusonmicroscopy.org; www.focusonmicroscopy.org.

Photomask and NGL Mask Technology XVI (April 8-10) Yokohama, Japan. Contact SPIE, +1 (360) 676-3290; customerservice@spie.org; www.spie.org.

SPIE Defense, Security and Sensing 2009 (April 13-17) Orlando, Fla. Contact SPIE, +1 (360) 676-3290; customerservice@spie.org; www.spie.org.

2009 MRS Spring Meeting (April 13-17) San Francisco. Contact Materials Research Society, +1 (724) 779-3003; info@mrs.org; www.mrs.org.

First LED/OLED Lighting Technology Expo – Lighting Japan (April 15-17) Tokyo. Contact Hajime Suzuki, Reed Exhibitions Japan Ltd., +81 3 3349 8568; light@reedexpo.co.jp; www.lighting.jp/english.

CREOL Industrial Affiliates Day 2009 (April 17) Orlando, Fla. Contact Denise Whiteside, CREOL, The College of Optics and Photonics, University of Central Florida, +1 (407) 823-6800; dwhitesi@creol.ucf.edu; www.creol.ucf.edu.

Photonics 2009: World of Lasers and Optics (April 20-23) Moscow. Contact Elena Slomchinskaya, Expocentr, +7 499 795 26 76; es@expocentr.ru; www.photonics-expo.ru.

SAE 2009 World Congress (April 20-23) Detroit. Contact Society of Automobile Engineers, +1 (724) 776-4841; customerservice@sae.org; www.sae.org/congress.

SPIE Europe Optics + Optoelectronics (April 20-24) Prague, Czech Republic. Contact SPIE, +1 (360) 676-3290; customerservice@spie.org; www.spie.org.

Interactive Displays 2009 (April 21-23) San Jose, Calif. Contact Mike Robert, IntertechPira, +1 (207) 781-9631; michael.robert@pira-international.com; www.int-displays.com.

Laser Expo 2009 (April 22-24) Kanagawa, Japan. Contact Optronics Co. Ltd., +81 3 5229 7253; intl@optronics.co.jp; www.optronics.co.jp/en/le.

Mass Spectral Interpretation Course (April 22-24) Orlando, Fla. Contact Henry Nowicki, PACS Testing, Consulting and Training, +1 (724) 457-6576; henry@pacslabs.com; www.pacslabs.com.

Advances in Imaging: OSA Optics & Photonics Congress (April 26-30) Vancouver, British Columbia, Canada. Encompasses the topical meetings Fourier Transform Spectroscopy, Hyperspectral Imaging and Sensing of the Environment, Novel Techniques in Microscopy, Optical Trapping Applications, and Digital Holography and Three-Dimensional Imaging. Contact Optical Society of America, +1 (202) 223-8130; info@osa.org; www.osa.org.

Organic Photovoltaics 2009 (April 27-29) Philadelphia. Contact Jeremy Powell, Intertech-Pira, +1 (207) 781-9610, jeremy.powell@pira-international.com; www.intertechusa.com.

MAY

Nanotech Conference & Expo 2009 (May 3-7) Houston. Contact Sarah Wenning, Nano Science and Technology Institute, +1 (925) 901-4959; swenning@nsti.org; www.nsti.org/nanotech2009.

Clean Technology Conference & Expo 2009 (May 3-7) Houston. Contact Regina Ramazzini, Clean Technology operations director, +1 (774) 249-1341; regina@csievents.org; www.csievents.org.

SPIE Europe Microtechnologies for the New Millennium (May 4-6) Dresden, Germany. Contact SPIE, +1 (360) 676-3290; customerservice@spie.org; www.spie.org.

SPIE Scanning Microscopy (May 4-7) Monterey, Calif. Contact SPIE, +1 (360) 676-3290; customerservice@spie.org; www.spie.org.

FiberFest 2009 (May 11) Boxborough, Mass. Contact Marjorie Katz, New England Fiber Optic Council, +1 (617) 548-6332; info@nefc.com; www.nefc.com.

a ADVERTISER INDEX

Pretty in optical fibers

Attention, contemporary Cinderellas: Lighting up the dance floor may no longer be merely a figure of speech. LumiGram SRL, an haute couture design and manufacturing company based in Paris, makes special-occasion clothing from woven optical fibers that literally glow in the dark.

The synthetic strands are lit along their entire length by an LED module powered by a battery pack. (The material is distinct from the glow-in-the-dark reflective products of the 1980s, the company's Web site emphasizes.) A garment's luminescent color or colors – white, blue, green or red – are determined by the built-in LED module. The hue contrasts with the clothing's nonbattery-powered fabric colors of, mostly, white or black, or, for some items, an option of blue, red, pink, green or gold.

Most of LumiGram's sartorial offerings would not have met with the approval of Prince Charming's parents. Neither the minimalist tops, including the "Butterfly" with its tummy-tickling optical fiber tail, nor the T-shirts with their scrolling programmable messages promote the image of the damsel next door. Nonetheless, with the help of two or three 1.5-V AAA batteries, included with the garment, the clothing does provide a modern knight or lady with 12 hours of party fun. As www.lumigram.com puts it, "Your nights will never be the same."

▲ LumiGram's "Butterfly," which is made of fabric woven from optical fibers and features an optical fiber "tail," is illuminated by an LED module powered by 1.5-V AAA batteries.

Beneath the illusion

But just in case your fairy godmother's dress-conjuring powers are on the fritz, what does this glamorous moment in the spotlight cost? The T-shirts range from €69 to €129, or $90 to $168, depending on the complexity of the technology; party shirts are €139 to €199, or $180 to $259. The long, flowing – and notably more modest – dress dubbed "Sophia" is a pricier €1599 (just under $2100).

And what about common-folk matters such as laundering instructions and possible electrocution from spilled punch? The power required to illuminate the garments is low: 3 to 4.5 V from two or three AAA batteries. According to the company, the fabric does not heat up, and it cannot create an electrical shock. No mention is made of spilled liquid as a hazard. As for washing and handling instructions, water temperature no higher than 70 °C (158 °F) is advised, as is avoiding immersion of the battery box. The garment should be drip-dried, not ironed, and must be folded correctly so as not to break the optical fibers. A nod to eco-friendliness is that, when the original disposable batteries have expired, they can be replaced with 1.2-V AAA rechargeables.

A warning to you, Cinderella – and this caveat may or may not contain a universal truth – at midnight, your gown will still have that magic glow, but once dawn breaks, it will look like any ordinary dress, no matter how fresh the batteries. At that point, you might want to show your fairy godmother where the switch is.

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◀ This dress, named "Sophia," is made of patented Luminex fabric and comes in gold, white or black with a contrasting belt. The LEDs that make it glow have a lifetime of 50,000 hours.

◀ This woman's T-shirt has a 256-character LED display that can be programmed with up to eight messages that scroll at various speeds and brightness levels.

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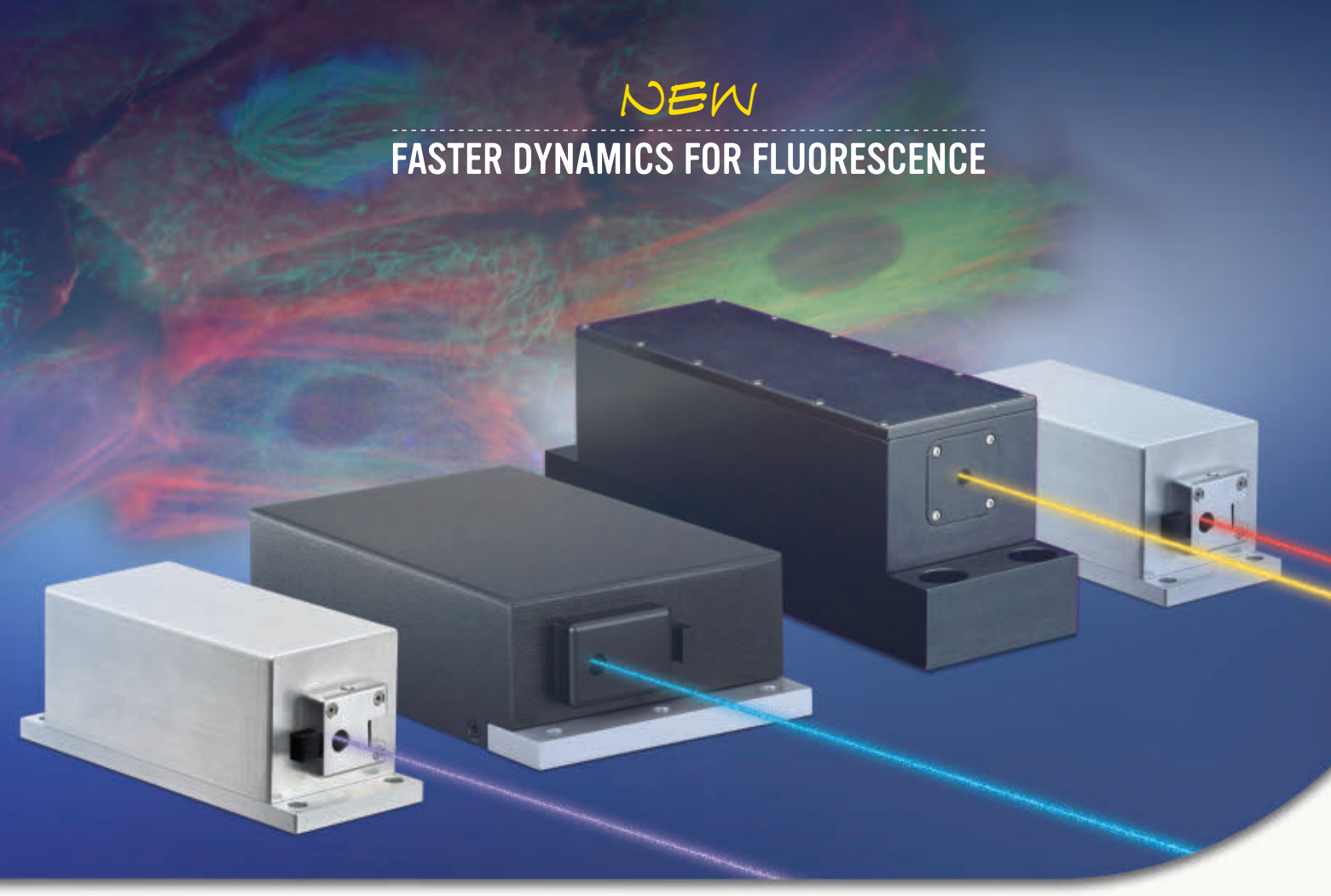

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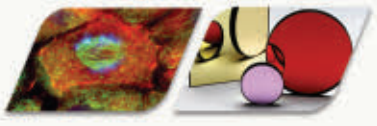

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