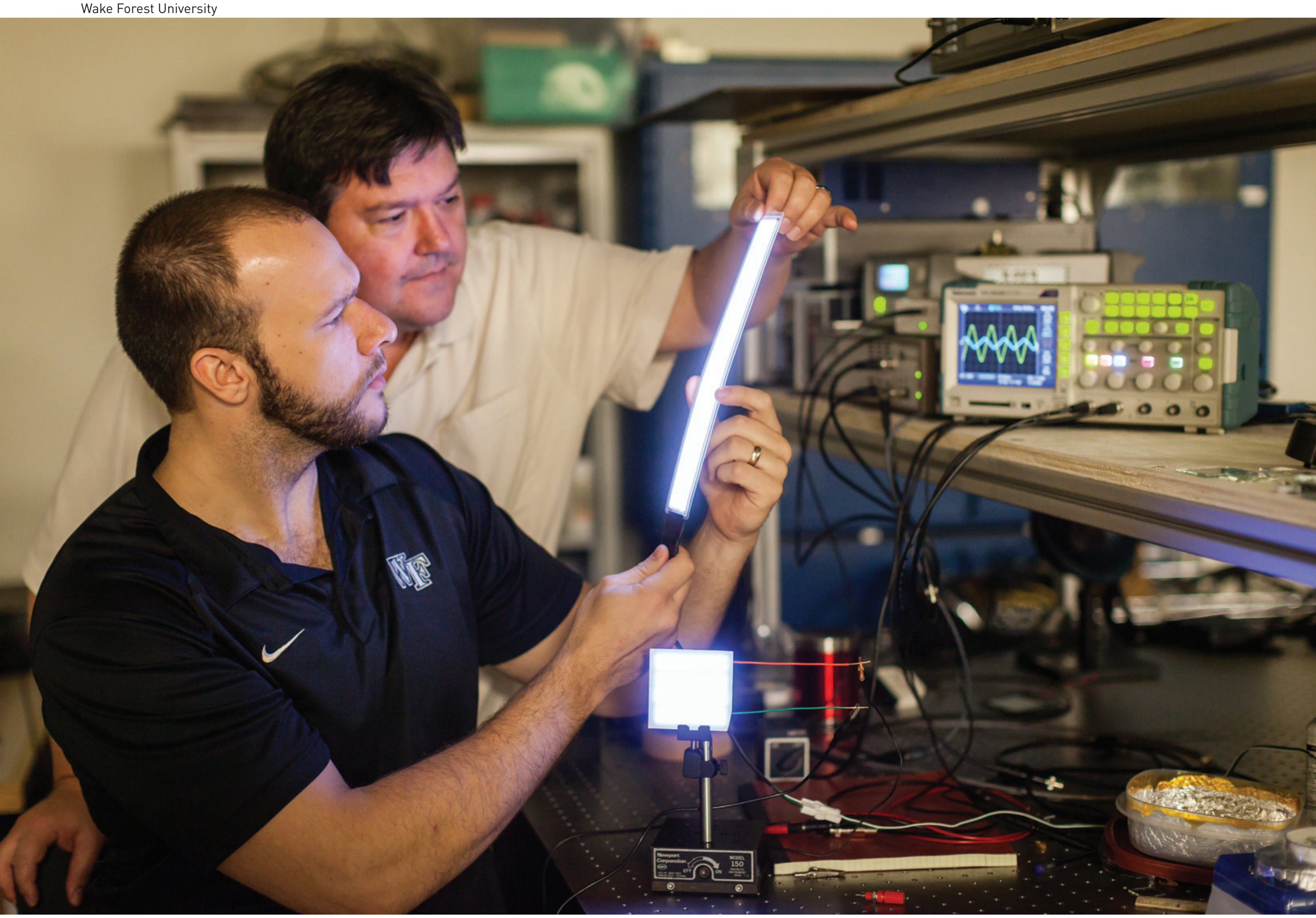
Wake Forest University



A New Light

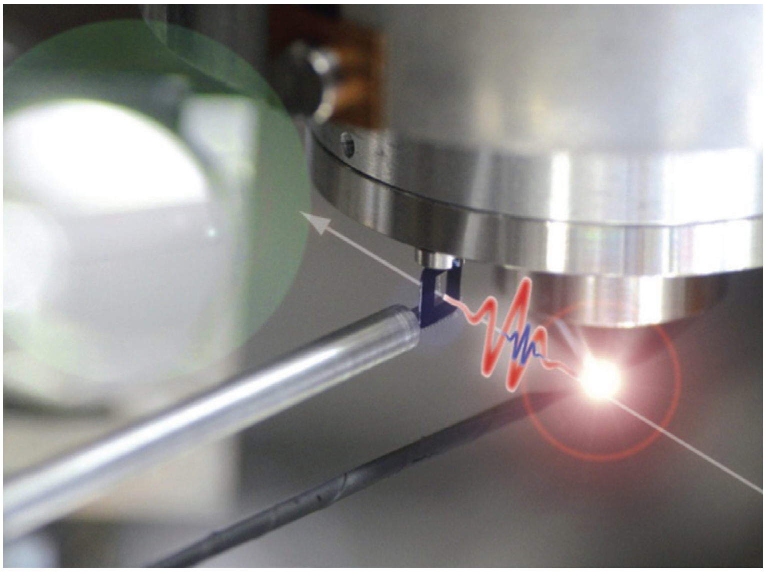
New technology may offer silent, efficient lighting with warm white glow.

A new type of lighting is at least twice as efficient as compact fluorescent bulbs and on par with LEDs, according to a team at Wake Forest University (U.S.A.) and Trinity College Dublin (Ireland). What's more, the soft glow comes without the annoying flicker or buzz of standard fluorescent lights or the bluish tinge of LEDs. The researchers generated the light by adding carbon nanotubes to films that were part of field-induced polymer electroluminescence (FIPEL) devices (Org. Electron., doi: 10.1016/j.orgel.2012.10.017).

Organic materials are attractive for lighting because they can be produced and processed inexpensively, but their short lifetimes are problematic. Thin-film electroluminescent materials appear to have longer lifetimes—researcher David Carroll reports having one that has lasted a decade. Because FIPELs are, essentially, a capacitor with a light emitting layer and one or two dielectric layers between the electrodes, the dielectric layers may be able to reduce the reactions between the active layer and electrodes, as well as protect the active layer from atmospheric degradation from oxygen or moisture.

Wake Forest is working with a company to manufacture the technology and plans to have it ready for consumers in the next year.
—Yvonne Carts-Powell

David Carroll and Greg Smith (black shirt) work on lighting technology based on field-induced polymer electroluminescence.



The electronic properties of silica changed from an insulator to a conductor when hit with an intense femto-second laser pulse.

Thorsten Naeser, LMU

Ultrafast Light
Turns Insulator into a Conductor

Laser may allow semiconductors to work at petahertz rates.

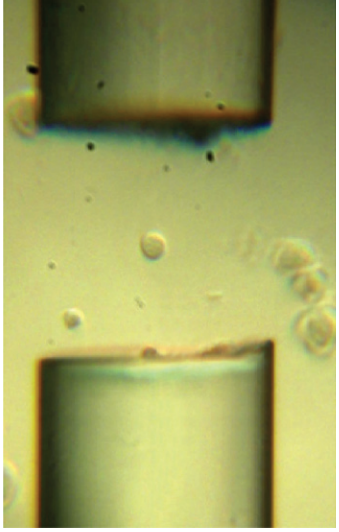
If you blast enough light into an insulator, it will blow up quickly or break down slowly. However, a pair of *Nature* papers describe using intense femtosecond laser pulses that not only do not damage the material, but that induce electrical currents into an otherwise insulating dielectric—specifically, a fused silica prism (Nature, DOI: 10.1038/nature11567; Nature, DOI: 10.1038/nature11720).

The work is exciting because insulators that can quickly change into conductors (and back into insulators again) could be used for signal switching. Today's fastest semiconductor switching is measured in terahertz, but light-induced switching in insulators could work at petahertz rates—more than 10,000 times the rate of current electronics. In the near-term, it could also make possible petahertz metrology.

The team, led by Ferenc Krausz's group at the Max Planck Institute of Quantum Optics (Germany), first investigated whether a small silica-glass prism could conduct current when hit with a few-cycle femtosecond pulse. Varying the time between pulses resulted in changes in the direction of the induced current.

The second experiment tackled the turn-off speed. A thin film of silica was exposed to the same pulses. The strong optical field changes the electronic states in the glass with each oscillation cycle. These variations were tracked by a series of "snapshots" recorded by attosecond light pulses passed through the sample. The results showed that field-induced changes follow both the turn-on and turn-off behavior of the driving laser field; thus, they point to the reversibility of the field-induced effects. —*Yvonne Carts-Powell*

Cold lasers can be used for acupuncture instead of needles.



Optics Letters

World's Smallest Wrench Puts a New Twist on Micro-manipulation

Researchers have created the fiber-optic equivalent of the world's smallest wrench by harnessing laser light's ability to gently push and pull microscopic particles (Opt. Lett. **37**, 5030). This virtual tool can precisely twist and turn the tiniest of particles, from living cells and DNA to microscopic motors and dynamos used in biological and physical research. The authors describe their new technique, which they dub a fiber-optic spanner (the British term for a wrench).

The innovation that distinguishes this technique from other optical tools is that it can spin or twist microscale objects in any direction and along any axis without moving any optical component. It's able to do this because it uses flexible optical fibers rather than stationary lasers to do the work. This has the added benefit that the optical fibers can be positioned inside the human body, where they can manipulate and help study specific cells or potentially guide neurons in the spinal cord.

(Above) Fiber optically trapped and rotated human smooth muscle cell in the center of two transversely offset fibers (20 mW in each arm).

Surgeons performing lead extraction.

David Ahntholz Photography

X-Ray Marks the Spot

A team from the Sulpizio Cardiovascular Center at the University of California, San Diego (U.S.A.), has performed its 100th lead extraction surgery, a delicate procedure that uses X-ray and laser technology to replace the thin wiring of lifesaving heart devices such as pacemakers or implantable cardioverter-defibrillators (ICDs). The collaborative program, pioneered at U.C. San Diego, has a 100 percent success rate.

Pacemakers and ICDs deliver energy to the heart through thin, flexible wires, or "leads." When leads don't work properly, the wires need to be removed and replaced.

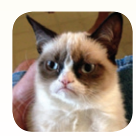
"Lead extraction" is a minimally invasive procedure that involves first accessing the leads through a small incision at the site of the device, just above the heart. The surgeon slides a tube or sheath with a long wire inside the vein and over the lead that needs to be removed. Using X-ray guidance, the surgeon then applies laser energy to dissolve the scar tissue around the lead. This allows the lead to be freed from the blood vessel wall and eventually from its attachment inside the heart. Once the old lead has been removed, it can be replaced with a new one.

tweeted

Heather Williams @alrightPET I'm often asked how I combine a career in physics with being Mum to two small kids. The answer is: just fine, until they're ill.

Dr Frickinlasers @frickinlasers Hazelnut instant coffee tastes like thesis writing :'(

Grumpy Cat @VeryGrumpyCat



How do we not have lightsabers yet? It's like scientists aren't even trying.

The 'Glasses Apostle' by Conrad von Soest (1403).

EVOLUTION OF THE MICROSCOPE

Recently Enzo di Fabrizio and his team directly imaging of DNA with a transition electron microscopy, here's a history of microscope technology:

12th Century
First eye glass

1609
Compound microscope with convex and concave lenses

1674
Lenses ground for increased magnification

1860
Abbe's sine condition

1931
Transmission electron microscope

1936
Field emission microscope

1937
Scanning electron microscope

1951
Ion microscope—first to image atoms

1953
Phase contrast microscope

1981
Scanning tunneling microscope

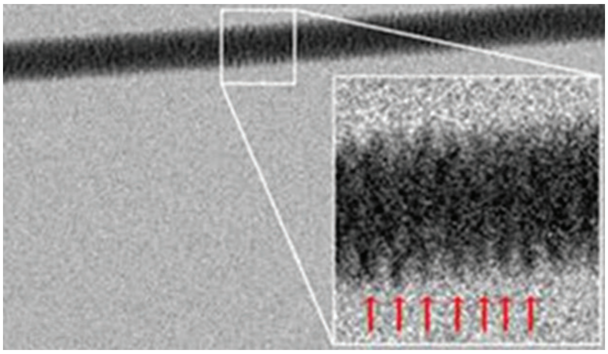
1986
Atomic force microscope

1991
Kelvin probe force microscope

2012
DNA imaged with transition electron microscopy

Gilbert Lewis coined the term **"photon"** in 1926 to describe the smallest unit of radiant energy.

Nano Lett. 2012, **12**(12), 6453–8



Getting DNA in the Picture

Researchers from the University of Genoa, Italy, recently used an electron microscope to take a remarkably detailed picture of a tightly packed bundle of DNA. While the first image of a single strand of DNA was produced using X-ray crystallography over 50 years ago, this work marked the first time that DNA was imaged with an electron microscope.

Contrary to early press reports that stated that the image was of a single strand. It in fact, it showed entwined DNA strands that coiled in a similar way to a single strand (i.e., in a helix shape).

Producing Steam from Sunlight

Jeff Fitlow/Rice University

Oara Neumann (left) and Naomi Halas.

A technology that uses nanoparticles to convert solar energy directly into steam was recently reported by researchers at Rice University (U.S.A.). Unlike standard methods that involve heating the bulk of the water, this technique heats water enough to turn it to vapor just near the surface of nanoparticles (ACS Nano, doi:10.1021/nn304948h), allowing researchers to produce steam even from cold water.

First, sunlight hits a solution containing broadly absorbing metal or carbon nanoparticles. The energy absorbed by the nanoparticles mostly creates heat at their surface, thus creating steam within a few seconds even though the temperature of the bulk fluid is low. The steam rises above the surface of the solution, but the nanoparticles stay in solution. Naomi Halas, lead scientist on the project, says, "We're not changing any of the laws of thermodynamics. We're just boiling water in a radically different way."

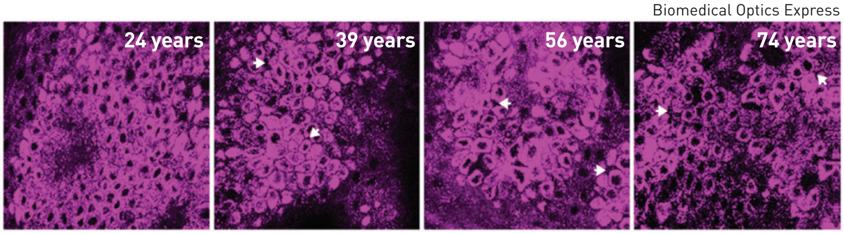
The group's analysis suggests that 80 percent of the energy from absorbed sunlight is converted into steam. While the steam could be used to generate electricity, the first uses are likely to be steam for sterilizing equipment or purifying water.
— *Yvonne Carts-Powell*

New Skin Age Index

A group of Taiwanese researchers has used a specialized microscope to peer harmlessly beneath the surface of human skin to measure natural age-related changes in the sizes of skin cells. The results can be used to study skin aging and may help provide an index for measuring the effectiveness of anti-aging skin products (Biomed. Opt. Express **4**, 77).

Natural aging, the scanning showed, caused a significant increase in the overall size of cells known as basal keratinocytes—the most common cells in the outermost layer of skin—as well as in the sizes of their nuclei. Thus, the relative changes in the two types of cells can serve as an index for scoring natural, or "intrinsic," skin aging—i.e., the aging of skin caused by programmed developmental or genetic factors.

Biomedical Optics Express



Four *in vivo* images of epidermal basal cells obtained from the forearms of (left to right) 24-, 39-, 56-, and 74-year-old volunteers. The skin cells in older subjects were larger and more irregular in shape, and showed spaces between cells (white arrows).

POLICY

U.S. Senate Blocks Measure to Increase Visas for STEM Grads

U.S. visa: Wikimedia Commons

In December, the U.S. Senate blocked a bill intended to increase the number of immigrants with scientific expertise. The bill, called the STEM Jobs Act, was passed in November by the House of Representatives. It had been introduced by Rep. Lamar Smith, a Texas Republican.

The bill would set aside 55,000 permanent residency visas annually for foreign-born graduates of American universities who've earned advanced degrees in science, technology, engineering or mathematics. It would also grant temporary visas for the families of those immigrants for use while their permanent visa applications are being processed.

Senate Democrats opposed the bill in part because the cost of the new visas are offset by eliminating the Diversity Visa Lottery Program, which provides green cards to persons from countries of traditionally lower rates of immigration. While they generally support the premise, many Democrats disagree with the "zero sum" approach and view the measure as too narrow. Supporters counter that it would allow U.S. employers to retain talented science and technology leaders and maintain competitiveness, and that the Diversity program is outdated. While the long-term fate of STEM immigration reform is unknown, it's clear that the STEM Act is not likely to become law in the near future. —*Sarah Michaud*

Courtesy of Njaal Gulbarndsen

Students perform measurements of the aurora in front of the Kjell Henriksen Observatory in Svalbard, Norway.

New Hyperspectral Images of Earth's Auroras

Auroras, which are created when charged particles from the sun penetrate Earth's magnetic field, can reveal information about the Earth's relationship with its nearest star and the way our planet responds to powerful solar storms. Hoping to expand our understanding of auroras and other fleeting atmospheric events, a team of space-weather researchers designed and built NORUSCA II, a new camera with unprecedented capabilities that can simultaneously image multiple spectral bands (Opt. Express 20, 27650). The camera was tested at the Kjell Henriksen Observatory in Svalbard, Norway, where it produced new hyperspectral images of auroras—commonly referred to as the Northern (or Southern) Lights.

Current-generation cameras collect all the light together into one image and lack the ability to separately capture and analyze multiple slivers of the visible spectrum. That means that, if researchers want to study auroras by looking at specific bands or a small portion of the spectrum, they would have to use a series of filters to block out the unwanted wavelengths.

The new NORUSCA II hyperspectral camera achieves the same result without any moving parts, using its advanced optics to switch among all of its 41 separate optical bands in a matter of microseconds, orders of magnitude faster than an ordinary camera.

INDUSTRY

Warren Buffet Acquires World's Largest Solar Development

Clean-energy developer MidAmerican Solar (Phoenix, Ariz., U.S.A.), a company controlled by Warren Buffet's Berkshire Hathaway Inc., recently acquired Antelope Valley Solar Projects in California—the world's largest solar development—from SunPower Corp. (San Jose, Calif., U.S.A.). SunPower will receive between $2 billion and $2.5 billion in the deal. Solar stocks surged as much as 41 percent in response to the news.

The two projects will form the world's largest permitted solar photovoltaic power ranch, generating 579 MW of power and creating 650 construction jobs. The projects will provide renewable energy to Southern California Edison. The first AV Solar Ranch in Los Angeles County will consist of 3.7 million solar modules and provide 230 MW of power, enough to power 75,000 homes. *—Valerie Coffey*

New Venture Capital Firm to Focus on Quantum Tech

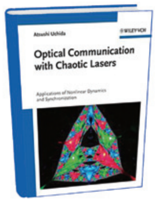
The Boston-based Quantum Wave Fund is the first venture capital firm focused exclusively on emerging quantum technologies. The new fund has raised $30 million in capital and expects that it could raise up to $70 million more t o support companies with novel quantum technology, such as quantum materials, quantum encryption security and quantum devices.

The fund targets early-stage companies with unique quantum-based products, investing from $2 million to $10 million to improve processes in engineering, production and marketing for preparation to enter the global market. Their team of nuclear physicists, computer scientists, and engineers with entrepreneurial experience will provide the knowledge and funds these companies need to scale up to multimillion-dollar technology businesses. *—Valerie Coffey*

Yvonne Carts-Powell and Valerie Coffey are freelance science writers who specialize in optics and photonics. Sarah Michaud is OPN's associate editor.

BOOK REVIEWS

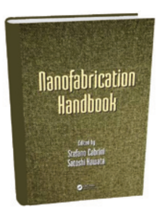
Optical Communication with Chaotic Lasers



Atsushi Uchida; Wiley, 2012; $220.00 (hardcover).

Uchida's text covers the fundamentals of chaos generation and synchronization, and describes many applications, from optical communications to the emerging niche fields of random-number generation, chaos-based telemeters, suppression of chaos fluctuations and blind sorting. However, there are problems missing, and the book's usefulness as a text for M.S. or Ph.D. students is limited. —*Silvano Donati*

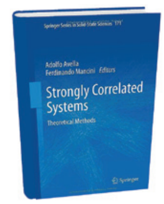
Nanofabrication Handbook



Stefano Cabrini and Satoshi Kawata, eds.; CRC Press, 2012; $129.95 (hardcover).

Nanofabrication is an emerging field, and this volume explores several aspects of its diverse techniques: theoretical considerations, practical implementation and advantages and limitations of each method. The text is expertly integrated with high-quality figures and includes an index. It is suitable for researchers and engineers in a variety of disciplines. —*Barry R. Masters*

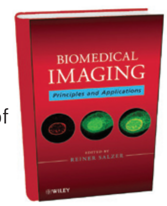
Strongly Correlated Systems: Theoretical Methods



Adolfo Avella and Ferdinando Mancini, eds.; Springer, 2012; $199.00 (hardcover).

This book covers a tremendous amount of material regarding the analysis of strongly correlated systems. It is intended for graduate students, postdocs and faculty who are interested in acquiring the broad background knowledge needed to become successful researchers in this area. Readers will also have the opportunity to learn about computational materials science. —*Christian Brosseau*

Biomedical Imaging: Principles and Applications



Reiner Salzer; Wiley, 2012; $125.00 (hardcover).

Salzer describes a variety of imaging modalities that are used for macroscopic and microscopic imaging. The emphasis is on 3-D medical imaging; however, there are also chapters on imaging at the tissue and cellular level. Unfortunately, the physical description of the imaging modality is often too shallow and concise to be useful as a startup guide for researchers and clinicians. —*Barry R. Masters*

ONLINE EXTRA

Visit www.osa-opn.org for additional book reviews.

Christian Brosseau is a professor of physics at the Université de Bretagne Occidentale in Brest, France, and an OSA Fellow. Silvano Donati is with the University of Pavia, Italy. Barry R. Masters is a Fellow of AAAS, OSA and SPIE; he is also a visiting scientist in the department of biological engineering at the Massachusetts Institute of Technology in Cambridge, Mass., U.S.A.