



January 2011
Volume 11 • Issue 2

In this Issue!

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Just Published

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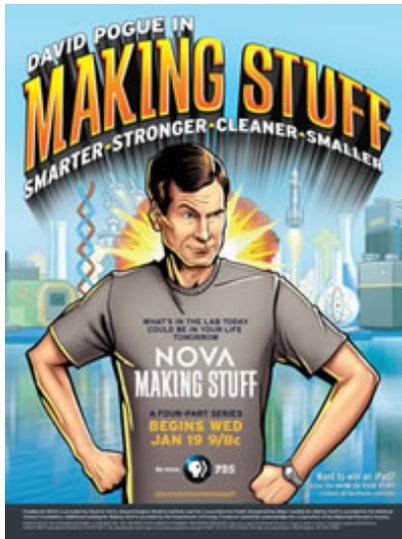


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IN FOCUS



[MAKING STUFF: Stronger, Smaller, Cleaner, Smarter](#)

Cleaner, Smarter (Parts 3, 4): February 2, February 9
9:00 PM Eastern Time (US) (check local PBS listings)

NOVA's four-hour TV series on PBS: "MAKING STUFF: Stronger, Smaller, Cleaner, Smarter," produced in cooperation with the Materials Research Society (MRS) premiered on January 19, 2011. New York Times technology reporter David Pogue takes viewers on a thrilling tour of the material world we live in.

[Visit the NOVA website](#) for more details. The NOVA team welcomes your [feedback](#) on the broadcast and website.

Discuss the program on the [MRS Facebook page](#) and [Twitter feed](#).

NEWS FROM THE WORLD OF MATERIALS

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[Materials in Focus](#)

[Thermoelectric properties of half-Heusler alloys enhanced](#)

(Physics World)



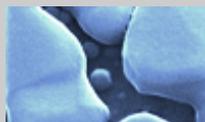
To be of practical use, a thermoelectric material must be good at conducting electricity but poor at conducting heat. "Half-Heusler" alloys have promising thermoelectric properties but they suffer from having relatively high thermal conductivities. One way of reducing their conductivity is to squish together a fine powder of the material to form a nanocomposite containing many small grains. Heat has a hard time travelling across grain boundaries, thereby reducing the overall thermal conduction of the nanocomposite. Researchers have now used this technique on an extremely fine powder of a half-Heusler alloy, producing a nanocomposite with the best ZT (thermoelectric figure of merit) yet for a half-Heusler. [[Nano Letters](#)]

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[Harrick Plasma, Inc.](#)

Surface Cleaning, Activation,
Pre-bond Preparation

[Embedded microvoids make LEDs more efficient](#)

(North Carolina State University)

LED lighting relies on GaN thin films to create the diode structure that produces light. A new technique now reduces the number of defects in GaN films by two to three orders of magnitude by embedding microvoids. This improves the quality of the material that emits light, and for a given input of electrical power, the output of light can be increased by a factor of two - which is very big. This is particularly true for low electrical power input and for LEDs emitting in the ultraviolet range. The researchers started with a GaN film that was two microns thick and embedded half of that thickness with large voids - empty spaces that were one to two microns long and 0.25 microns in diameter. The researchers found that defects in the film were drawn to the voids and became trapped - leaving the portions of the film above the voids with far fewer defects. [[Applied Physics Letters](#)]

[Growth, characterization of LiMnAs: A useful pyramid scheme](#)

(Physics)

All electronics technologies have, at their heart, critical materials that make their function possible. These can be "old" materials such as silicon, whose major materials development was achieved by previous generations, or "new" materials such as gallium-nitride, which has been developed by our contemporaries. If the discovery and development of new materials comes to a stop, then the introduction and growth of new technologies will almost certainly come to a halt as well. Spintronics is an example of such a critical current technology, driving the creation of increased density, faster electronic memories through the electronic manipulation of magnetic moments. Researchers now report the successful growth and characterization of LiMnAs, a new candidate material for spintronic applications. They show convincing evidence of epitaxy and good film quality, and show that LiMnAs is a semiconductor, by performing optical spectroscopy. They also show that it is antiferromagnetic in thin film form by measuring its temperature-dependent magnetization. [[Physical Review B](#)]

[Electrical phenomena in silicon oxide in electronics explored](#)

(Eurekalert/ACS)

Researchers have found that silicon dioxide in computer chips, long regarded as an electrical insulator, can actually be made to act like a switch and take part in electronic processes. They have documented various electrical phenomena such as resistive switching and related nonlinear conduction, current hysteresis, and negative differential resistance, that are intrinsic to a thin layer of SiO_x. This is more crucial in the area of nanoelectronics, wherein researchers thought that switching observed was due to the nano-additive but it turns out that the source of the switching might be from the underlying silicon oxide itself. The work clarifies the possible nature behind switching events in molecular and nano-scale systems investigated so far, that were not well understood. [[J. American Chemical Society](#)]

[Nano Focus](#)

[Silver nanoparticles-coated paper for food packaging](#)

(American Chemical Society)

It is known that silver nanoparticles show excellent microbicidal properties, much better than those of larger particles. Researchers have now demonstrated an effective, long-lasting method for depositing silver nanoparticles on the surface of paper that involves ultrasound waves. The coated paper showed potent antibacterial activity against *E. coli* and *S. aureus*, two causes of bacterial food poisoning, killing all of the bacteria in just three hours. This suggests its potential application as a food packaging material for promoting longer shelf life. [[Langmuir](#)]

[Bio Focus](#)

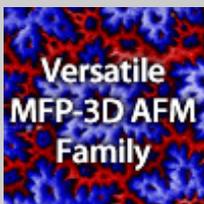
[Nanoparticle divides to penetrate into tumors](#)

(Chemistry World)

Researchers have created a nanoparticle that breaks up into smaller units once it reaches its target, allowing it to penetrate deeper into tumor tissue and deliver treatment more effectively. The new nanoparticles are 100 nm balls of gelatin that contain small particles



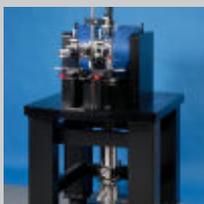
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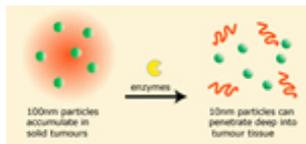
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Capability



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with Electromagnet



that are only 10 nm in diameter. The gelatin nanoparticles get to the tumors, and then tumor enzymes digest the gelatin and release the smaller constituents, that then move through the tumor. *In vitro* studies showed that the particles penetrated tumor tissue much better traditional larger nanoparticles that remain one size. [[Proceedings of the National Academy of Sciences](#)]

[New method for tethering and stretching DNA](#)

(Nanotechweb.org)

Researchers have developed a reproducible surface chemistry technique for tethering DNA molecules onto surfaces and a new way to stretch the molecules to various lengths. DNA can be used as a molecular scaffold to make metal contacts to organic semiconductors. A key step in this process involves being able to tether the DNA to various surfaces and stretch the molecule to varying lengths. The new strategy involves synthesizing hybrid DNA-organic molecule-DNA (DOD) structures, then stretching and tethering the DOD assemblies between two microscopic metal electrodes. The researchers then make metal electrode-organic molecule-metal electrode (MOM) structures by further metallizing the DNA segments within the DOD structures. The team then exploited so-called biotin-Streptavidin linkage chemistry to tether the DNA assemblies to device surfaces. The method could eventually be used to make large-scale nanoelectronic devices based on single organic molecules. [[ACS Nano](#)]

[Nanoscale transistors used to study single-molecule interactions](#)

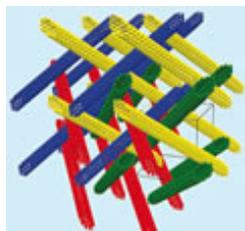
(Columbia University/EurekaAlert)

Researchers have figured out a way to study single-molecule interactions on very short time scales using nanoscale transistors. They show how, for the first time, transistors can be used to detect the binding of the two halves of the DNA double helix with the DNA tethered to the transistor sensor. The transistors directly detect and amplify the charge of these single biomolecules. Previously, scientists have used fluorescence techniques to look at interactions at the level of single molecules. But these techniques require that the target molecules being studied be labeled with fluorescent reporter molecules, and the bandwidths for detection are limited by the time required to collect the very small number of photons emitted by these reporters. The transistors employed in this study were fashioned from carbon nanotubes which are exquisitely sensitive because the biomolecule can be directly tethered to the carbon nanotube wall creating enough sensitivity to detect a single DNA molecule. [[Nature Nanotechnology](#)]

[Energy Focus](#)

[Packings of carbon nanotubes for hydrogen storage](#)

(Chemistry World)



Researchers have designed a 3D carbon nanotube matrix that can store and release hydrogen extremely efficiently. They used a computer-based approach to design a 3D carbon nanotube structure that can store more hydrogen at room temperature than any other carbon-based material. This is a top down approach from advanced mathematics, to geometry, to computer modeling, to chemical properties. The US Department of Energy's target for hydrogen storage materials by 2015 is 6wt% while the new nanotube material has a total hydrogen uptake of 5.5wt% at room temperature. Inspired by natural sponges, the team designed a computer

model that placed carbon nanotubes in the hole positions of a theoretical sponge network. [[Advanced Materials](#)]

[Relativity powers lead-acid battery](#)

(Physical Review Focus)

The lead-acid battery that starts most car engines gets about 80 percent of its voltage from relativity, according to theoretical work using computer simulations. The relativistic effect comes from fast-moving electrons in the lead atom. The computer simulations also explain why tin-acid batteries do not work, despite apparent similarities between tin and lead. The researchers are the first to derive theoretical models of the lead-acid battery from fundamental physics principles. By switching relativistic parts of their models "on" and "off", the team found that relativity accounts for



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1.7 volts of a single cell, which means that about 10 of the 12 volts in a car battery come from relativistic effects. [[Applied Physics Letters](#)]

Image in Focus



ZnO Nanoflowers

Stem of nanoflowers made by coloring and combining different SEM images of a variety of ZnO nanostructures grown by thermal Chemical Vapor Deposition.

Credit: Abhishek Prasad, Michigan Technological University

(One of three [Science as Art competition](#) first place winners at the 2010 MRS Fall Meeting)

[We invite you to [submit your images](#) to the Editor for possible inclusion in this feature]

MEETINGS UPDATE

Meetings and Deadlines

2011 World Materials Summit – Student Congress October 8-12, 2011, Washington DC	Application deadline February 1, 2011
2011 MRS SPRING MEETING & EXHIBIT April 25-29, 2011, San Francisco, California	Registration opens mid-February
7th International Dendrimer Symposium June 26 - July 1, 2011, Gaithersburg, Maryland	Abstract Deadline - March 24, 2011 Preregistration opens mid-February
E-MRS Spring/ICAM 2011 and Bilateral Energy Conference May 9-13, 2011, Nice, France	Preregistration Deadline—March 31, 2011
International Materials Research Congress (IMRC) XX August 14-19, 2011, Cancun, Mexico	Abstract Deadline - May 1, 2011 Preregistration Deadline—July 15, 2011

JUST PUBLISHED

Journal of Materials Research

January 2011, Volume 26, Issue 2 - A selection of papers



FOCUS ISSUE: Self-Assembly and Directed Assembly of Advanced Materials

Guest Editors: Amit Goyal (Oak Ridge National Laboratory), Jay Narayan (North Carolina State University), Qinghuang Lin (IBM T.J. Watson Research Center)

An Overview of Directed Self-Assembly for Nanoelectronics Fabrication

Daniel Herr, DOI:10.1557/jmr.2010.74

Templated self-assembly of non-close-packed colloidal crystals: Toward diamond cubic and novel heterostructures

Vyom Sharma, Deying Xia, Chee C. Wong, W. Craig Carter and Yet-Ming Chiang, DOI:10.1557/jmr.2010.8

Recent developments in optofluidic-surface-enhanced Raman scattering systems: Design, assembly, and advantages

Yin Yin, Teng Qiu, Wenjun Zhang and Paul K. Chu, DOI:10.1557/jmr.2010.18

HAPPENINGS AT MRS

Of Interest to the Materials Research Community

Anne Mayes (1964-2011)



Anne Mayes, a former materials science and engineering professor at MIT, died on Tuesday, Jan. 25. She was 46. Mayes was an exceptional contributor to the Materials Research Society (MRS) in many ways including serving with distinction on the Board of Directors from 2000-2002. As chair of the Planning Committee and of the Vision 20/20 Steering Committee, she played a key part in the restructuring of MRS governance. Additionally, she was awarded an MRS Outstanding Young Investigator Award in 1998, the MRS Woody Award in 2002 in recognition of outstanding service and dedication to MRS, and she served as symposium organizer and guest editor and author

for the *MRS Bulletin*.

Advanced Materials and Devices for Electrical Energy Storage: Final Report

Making renewable energy, such as wind and solar, a more reliable, cost-effective, and widely utilized source of electricity in the United States is dependent on the development of practical electrical energy storage (EES) technologies that can be deployed at the grid scale. Renewable energy technologies pose significant challenges for integration into the electrical grid because of their intermittent nature. EES “smooths out” this variability—when the wind turbine stops turning or the solar panel has no sun to capture—by providing a means to store energy for back up power, load shifting, transmission and distribution deferral, and energy arbitrage needs. Until recently, however, stationary electrical energy storage has been relatively unexplored, with the needs and requirements for optimal performance at the grid level still largely undefined. In addition, most EES technologies currently face significant economic and technical challenges for market entrance.

A new report released by The Minerals, Metals, & Materials Society (TMS), in support of the U.S. Department of Energy's (DOE) Office of Electricity Delivery and Energy Reliability and the Advanced Research Projects Agency- Energy (ARPA-E), offers an initial assessment of material science advances and breakthroughs that could improve performance and lower costs of EES devices for the future electrical grid. The report documents the findings of a multidisciplinary workshop of materials science experts convened by TMS, in conjunction with Sandia National Laboratories and the Pacific Northwest National Laboratory, in July 2010. In addition to TMS members, the workshop drew on the knowledge and expertise from the membership of ASM International, the American Ceramic Society, the Electrochemical Society, and the Materials Research Society.

CAREER CENTRAL



Classifieds

[Partial listing](#) from the [February 2011](#) issue of the [MRS Bulletin](#)

[Carnegie Mellon University](#)

Postdoctoral Research Associate, Department of Materials Science and Engineering

[Naval Research Laboratory](#)

Scientists/Engineers, Electronics Materials Branch

[U.S. Army Research Laboratory](#)

Research Associate, Nitride Semiconductor Optoelectronics

[California Institute of Technology](#)

Associated Director / Accelerated Discovery Department Head

[City University of Hong Kong](#)

Professor/Associate Professor/Assistant Professor, Department of Physics and Materials Science

[Corning Incorporated](#)

Postdoctoral Research Associate

[Dartmouth College](#)

Tenure-Track Faculty Position, Engineering

[Honda Research Institute USA, Inc.](#)

Research Scientist, Laboratory of Material Science

[IRflex Corporation](#)

Glass Materials Scientist

[Lawrence Berkeley National Laboratory](#)

Career Research Scientist, Physical Biosciences

[Lawrence Berkeley National Laboratory](#)

Career-Track Research Scientist, Physical Biosciences

[Rutgers University](#)

Faculty Position, Department of Mechanical and Aerospace Engineering

[University of California, Davis](#)

Faculty Positions, Department of Electrical and Computer Engineering

[University of Florida](#)

Director of the Nanoscale Institute for Medical Engineering Technology

[University of Michigan-Dearborn](#)

Faculty Position, Biomaterials

[University of North Texas](#)

Faculty Position, Materials Modeling

[University of Toronto](#)

Assistant Professor in Materials Science and Engineering

[U.S. Army Research Laboratory](#)

Research Associate, Nitride Semiconductor Optoelectronics

DIVERSIONS

Did You Know?

The [MRS Bulletin](#) now has an online "[magazine view](#)" in addition to the regular web (html) and PDF options. You can "flip through" an issue online as you would a paper version.

Quiz

How many women have won the MRS Outstanding Young Investigator award?
(Answer will be published in the next Materials360®)

Answer to the Quiz in the previous Materials360®:

The 2011 *MRS Bulletin* Volume Organizers are Kyoung-Shin Choi (Purdue University), Reuben T. Collins (Colorado School of Mines), Sean Shaheen (University of Denver), and Kathryn Uhrich (Rutgers, the State University of New Jersey).

The 2012 *MRS Bulletin* Volume Organizers are Lei Jiang (Chinese Academy of Sciences), Sergei Kalinin (Oak Ridge National Laboratory), Stephanie Lacour (EPFL, Switzerland), and Steven C. Moss (The Aerospace Corporation)

Quotes of the Month

We never experiment with just one electron or atom... any more than we can raise Ichthyosauria in the zoo.

- Erwin Schrödinger

There are fashions in science as in everything else. Conduct an experiment that brings about an unusual success and before you can say, "There are a dozen imitations!" there are a dozen imitations!

- Isaac Asimov

Of course, if you can predict the consequences of your own experiments before they commence, your research is very likely to be boring.

- Solomon Snyder, American physician

For sheer intellectual drama, nothing can surpass the encounter between a great experiment and a great theory.

- Lloyd S. Swenson, Jr., in *The Ethereal Aether*

There is always more chance of hitting upon something valuable when you aren't too sure what you

want to hit upon.

- Alfred North Whitehead, English mathematician and philosopher

Miscellany

[Quandary: Scientists Prefer Reading Over Publishing 'Open Access' Papers](#)

(Science)

Scientists love open-access papers as readers, but as authors they are still skeptical, according to a new study of available journals and researchers' attitudes on the topic. Scientists love open-access papers as readers, but as authors they are still skeptical, according to a new study of available journals and researchers' attitudes on the topic. An E.U.-sponsored Study of Open Access Publishing (dubbed the SOAP project) surveyed 50,000 researchers for their opinions on open-access journals, which make all their papers freely available online and usually charge authors a fee for each published paper. The study found overwhelming support for the concept, with 89% of respondents saying that open access is beneficial to their field. But that support didn't always translate into action: Although 53% of respondents said they had published at least one open-access article, overall only about 10% of papers are published in open-access journals.

[Peer review: Trial by Twitter](#)

(Nature News)

Papers are increasingly being taken apart in blogs, on Twitter and on other social media within hours rather than years, and in public, rather than at small conferences or in private conversation. To many researchers, such rapid response is all to the good, because it weeds out sloppy work faster. For many other researchers, the pace and tone of this online review can be intimidating – and can sometimes feel like an attack. How are authors supposed to respond to critiques coming from all directions? Should they even respond at all? Or should they confine their replies to the conventional, more deliberative realm of conferences and journals? To bring some order to this chaos, it looks as though a new set of cultural norms will be needed, along with an online infrastructure to support them.

[Opinion: Of Course Scientists Can Communicate](#)

(Nature News)

There are several canards about scientists, but one is more pernicious simply because so many scientists themselves repeat it: scientists are not good communicators. Once again, the allegation is to be the subject of discussions, this time at next month's annual meeting of the American Association for the Advancement of Science in Washington DC. It can be found on *Nature's* website, heard in research councils, it is even occasionally propagated by the public-engagement community, and sometimes endorsed by journalists. In response, I can only say bosh, balderdash and Bronowski, and follow with other intemperate expletives such as Haldane, Hawking and Huxley, Eddington and E. O. Wilson, not to mention, as if in a state of terminal exasperation, Dawkins!

NEW PRODUCTS FOCUS

[New Vacuum Components and Chambers Catalog](#)



Pfeiffer Vacuum, a producer of vacuum products and services, announced the release of its Trinos Division Vacuum Components and Chambers Catalog. The 400-page, four-color, hardcover catalog covers the complete range of Trinos components, chambers and measuring instruments. This 2010/12 catalog includes: standard and custom vacuum chambers; ISO-KF, ISO-K, ISO-F, CF and COF flange components; hose and flexible connectors; glass components, valves, feedthroughs, manipulators, measuring instruments and accessories. For each product, the catalog contains photos, product drawings, technical data and part numbers. [Contact: 603-578-6500 or contact@pfeiffer-vacuum.com]

[New Piezoelectric Drop-on-Demand Printheads](#)



FUJIFILM Dimatix, Inc., a provider of inkjet printheads for industrial applications, recently launched its new Emerald series piezoelectric drop-on-demand printheads for high-performance graphics applications. Designated the Emerald QE-256/30 AAA and QE-256/80 AAA, the new 30-picoliter and 80-picoliter printhead models combine precise, high-speed multi-pulse binary jetting and versatile grayscale operation with a durable, field-proven metal nozzle plate that supports aqueous, UV-curable and solvent ink formulations. This construction was specifically chosen to accommodate broad variations in fluid jetting characteristics to facilitate development of new printer designs ideally suited to scanning architectures.

[Contact: 603-443-5300 or printinginfo@dimatix.com]

[Microcolorimetry Tool](#)



CRAIC Technologies, an innovator of UV-visible-NIR micro-analysis solutions, recently introduced the 308 PV™ microscope colorimeter. Designed to be added to an open photoport of a microscope or probe station, the 308 PV™ is a spectrophotometer that can non-destructively analyze the color of many types of microscopic samples. Featuring CRAIC Technologies new Lightblades™ spectrophotometer technology, the 308 PV™ can measure the color of microscopic sample areas by transmission and incident illumination. Applications are numerous and include quality control measurements of flat panel displays, development of lighting and more. The 308 PV™ system is a cost effective microcolorimetry tool for

any laboratory or manufacturing facility.

[Contact: 310-573-8180 or sales@microspectra.com]

[To suggest items for inclusion in Industry News and New Products Focus, please contact [Mary Kaufold](#) at 724-779-2755]

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