

March 2011  
Volume 11 • Issue 6**In this Issue!**

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On behalf of the members of the Materials Research Society, I extend heartfelt sympathy to you on the loss of so many of your countrymen and loved ones. Our thoughts and prayers are with you. And I encourage our members to continue to support you during the continuing difficulties through their personal networks or through the various relief organizations providing help to people of Japan, including:

- [AmeriCares](#)
- [International Medical Corps](#)
- [Médecins Sans Frontières/Doctors Without Borders](#)
- [Oxfam International](#)
- [Red Cross](#)
- [Salvation Army International](#)
- [Save the Children](#)
- [United Nations World Food Programme](#)

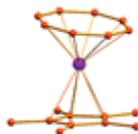
James DeYoreo  
MRS President

**NEWS FROM THE WORLD OF MATERIALS**

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**Materials in Focus**

[Organometallic single-ion magnet synthesized](#)  
(Chemical & Engineering News)



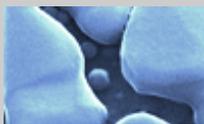
An unusually unsymmetrical organometallic complex made up of an erbium atom sandwiched between two different aromatic hydrocarbon rings exhibits unique magnetic behavior. This complex could become a prototype for further development of single-molecule magnets (SMMs). Most SMMs are based on cluster compounds with multiple metal-ion cores, but only about 10 examples of single-metal-ion SMMs are known. The erbium complex is notable for being the first example of an organometallic single-metal-ion magnet; previous versions contain oxygen- or nitrogen-based ligands. In the complex, the C8 ring is closer to the erbium atom than the C5 ring, and the rings are not perfectly parallel to each other as they are in most other sandwich compounds. The researchers find that this orientation enables erbium's electron configuration to generate magnetic properties not achieved before in

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SMMs: It has two thermal magnetic relaxation processes instead of one, and the magnetism exists at a higher temperature range. [[J. Am. Chem. Soc.](#)]

#### [Closing in on the pseudogap](#)

(Lawrence Berkeley National Laboratory)

A team of scientists has mounted a three-pronged attack on one of the most obstinate puzzles in materials science: what is the pseudogap? They used three complementary experimental approaches to investigate a single material, the high-temperature superconductor Pb-Bi2201 (lead bismuth strontium lanthanum copper-oxide). Their results are the strongest evidence yet that the pseudogap phase, an electronic state peculiar to high-temperature superconductors, is not a gradual transition to superconductivity in these materials, as many have long believed. It is in fact a distinct phase of matter. All three experiments yielded consistent results and all point to the same conclusion: there is a phase transition at the pseudogap phase boundary - the three techniques put it precisely at  $T^*$ , a temperature higher than  $T_c$ . [[Science](#)]

#### [Ultra-sensitive sensor uses new surface enhanced Raman scattering architecture](#)

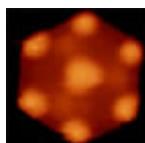
(Eurekalert/Princeton University)

An extremely sensitive sensor that opens up new ways to detect a wide range of substances has been reported. The technology is a major advance in a decades-long search to identify materials using Raman scattering. The sensor relies on a completely new architecture and fabrication technique and works by boosting faint signals generated by the scattering of laser light from a material placed on it, allowing the identification of various substances based on the color of light they reflect. The researchers developed a completely new surface enhanced Raman scattering (SERS) architecture: a chip studded with uniform rows of tiny pillars made of metals and insulators. So far, the chip is a billion times ( $10^9$ ) more sensitive than was possible without SERS boosting of Raman signals and the sensor is uniformly sensitive, making it more reliable for use in sensing devices. Such sensitivity is several orders of magnitude higher than the previously reported. [[Optics Express](#)]

#### [Nano Focus](#)

#### [Quantum dots created from buckyballs](#)

(Nanotechweb.org)



Researchers have developed the first bottom-up approach to form graphene quantum dots smaller than 10 nm in size using fullerene molecules as precursors. The dots produced are all regularly sized and have the same shape - unlike those produced using top-down techniques. The quantum dots were generated by decomposing carbon-60 molecules at high temperatures on a ruthenium metal surface. The metal

acts as a catalyst and causes the  $C_{60}$  to break down into carbon clusters. The researchers employed scanning tunnelling microscopy to observe how the carbon clusters diffused onto the metal surface and how they aggregated to form quantum dots. [[Nature Nanotechnology](#)]

#### [Self-strengthening nanocomposite created](#)

(Eurekalert/Rice University)

Researchers have created a synthetic material that gets stronger from repeated stress. The work shows the potential of stiffening polymer-based nanocomposites with carbon nanotube fillers. The trick, it appears, lies in the complex, dynamic interface between nanostructures and polymers in carefully engineered nanocomposite materials. They observed this property while testing the high-cycle fatigue properties of a composite made by infiltrating a forest of vertically aligned, multiwalled nanotubes with polydimethylsiloxane (PDMS). The team is not sure precisely why their synthetic material behaves as it does. They also found that simply compressing the material did not change its properties; only dynamic stress made it stiffer. [[ACS Nano](#)]

#### [Functionalized carbon nanotubes form efficient metal-free electrocatalysts](#)

(Eurekalert/Case Western Reserve University)

Catalysts made of carbon nanotubes dipped in a polymer solution equal the energy output and



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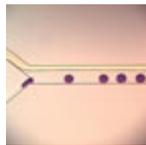
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otherwise outperform platinum catalysts in fuel cells, according to a team of researchers. They found that by simply soaking carbon nanotubes in a water solution of the polymer polydiallyldimethylammonium chloride for a couple of hours, the polymer coats the nanotube surface and pulls an electron partially from the carbon, creating a net positive charge. They placed the nanotubes on the cathode of an alkaline fuel cell. There, the charged material acts as a catalyst for the oxygen-reduction reaction that produces electricity while electrochemically combining hydrogen and oxygen. In testing, the fuel cell produced as much power as an identical cell using a platinum catalyst. But the activated nanotubes last longer and are more stable, the researchers said. Unlike platinum, the carbon-based catalyst does not lose catalytic activity and, therefore, efficiency, over time; isn't fouled by carbon monoxide poisoning; and is free from the crossover effect with methanol. [[J. Am. Chem. Soc.](#)]

### Bio Focus

#### [Making cells on a microfluidic assembly line](#)

(Technology Review)



Researchers have developed a way to create uniformly sized cell membranes, small cellular packages that can be used to study the inner workings of the cell and even create new molecules. They developed a chip-based method that creates uniformly sized vesicles in assembly-line fashion. Sized between 20 and 70 micrometers in diameter, the vesicles are large enough to be loaded with DNA and the

biochemical machinery to act as synthetic cells. In the team's microfluidic device, water droplets suspended in oil travel down one branch of a Y-shaped channel. Water flows down the other branch, creating an oil-water interface when the two liquids meet. The device then pushes the droplets through the oil-water interface, where they get coated in another layer of lipids to form the bilayer membrane. [[J. Am. Chem. Soc.](#)]

### Energy Focus

#### [MATERIALS FOR ENERGY BLOG](#)

Add your comments, or e-mail [materialsforenergy@mrs.org](mailto:materialsforenergy@mrs.org) to suggest future topics and contributors.

#### [Fukushima Nuclear Plants, Japan - Updated Information](#)

Hosted by the MIT Nuclear Science and Engineering Department

#### [Japan earthquake and Nuclear Crisis](#)

From Nature.com

#### [Battery turns entropy into electricity](#)

When fresh water rivers flow into the sea the concentration difference leads to a change in entropy. Researchers have developed a battery that generates power from this entropy difference. They were able to extract energy with 74% efficiency using manganese dioxide nanorods and silver electrodes. While entropy-based power generation has been done before but is most reliably done today by separating fresh and seawater with membranes and as ions travel through the membranes they generate currents. The new method extracts energy from the difference in concentration between two solutions by storing it chemically in batteries. The battery extracts energy through sodium and chlorine ions' movements into and out of the crystal lattice of the electrodes. The battery discharges in seawater as chlorine is taken up by the silver electrode and sodium is taken up by the manganese dioxide electrode. The ions are released when the battery charges in freshwater. Because of the higher ion concentration in seawater, the electrical energy discharged is greater than that needed for the battery to charge in freshwater. [[Nano Letters](#)]

#### [Smaller quantum dots show more efficient multiple exciton generation](#)

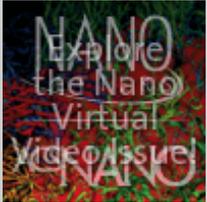
(e! Science News/NSF)

The size of light-absorbing quantum dots has been found to affect the particles' ability to transfer energy to electrons to generate electricity. This provides evidence to support multiple-exciton



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generation (MEG) which theorizes that it is possible for an electron that has absorbed light energy to transfer that energy to more than one electron, resulting in more electricity from the same amount of absorbed light. The researchers used a high performance computer cluster to quantify the relationship between the rate of MEG and quantum dot size. They found that each dot has a slice of the solar spectrum for which it is best suited to perform MEG and that smaller dots carry out MEG for their slice more efficiently than larger dots. This implies that solar cells made of quantum dots specifically tuned to the solar spectrum would be much more efficient than solar cells made of material that is not fabricated with quantum dots. [[ACS Nano](#)]

### [3D cathode nanostructure allows ultrafast battery charging/discharging](#)

(University of Illinois)

A three-dimensional nanostructure has been developed for battery cathodes that allows for dramatically faster charging and discharging without sacrificing energy storage capacity. This yields capacitor-like power with battery-like energy, according to the authors. The performance of typical lithium-ion (Li-ion) or nickel metal hydride (NiMH) rechargeable batteries degrades significantly when they are rapidly charged or discharged. Making the active material in the battery a thin film allows for very fast charging and discharging, but reduces the capacity to nearly zero because the active material lacks volume to store energy. In this work, the researchers wrapped a thin film into a three-dimensional structure, achieving both high active volume (high capacity) and large current. They were able to demonstrate battery electrodes that could charge or discharge in a few seconds, 10 to 100 times faster than equivalent bulk electrodes, yet could perform normally in existing devices. The key to the group's novel 3-D structure is self-assembly. The result is a bicontinuous electrode structure with small interconnects, so the lithium ions can move rapidly; a thin-film active material, so the diffusion kinetics are rapid; and a metal framework with good electrical conductivity. [[Nature Nanotechnology](#)]

### [Image in Focus](#)



### **Aurora Zinc Oxide**

This picture was created from the convergence of a high resolution cross-sectional (top) & a plan view (bottom) scanning electron microscope image of a zinc oxide "nanowall structure" synthesized by metal-organic chemical vapor deposition. Color was added to the original image.

*Credit: Dong Chan Kim, Sungkyunkwan University, Korea*

(One of four Science as Art competition second place winners at the 2010 MRS Fall Meeting)

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## MEETINGS UPDATE

### Meetings and Deadlines

<a href="#">2011 MRS SPRING MEETING &amp; EXHIBIT</a> April 25-29, 2011, San Francisco, California	Preregistration Deadline—5PM (EST) April 8, 2011 <a href="#">Proceedings Submission</a> Deadline—April 14
<a href="#">7th International Dendrimer Symposium</a> June 26-July 1, 2011, Gaithersburg, Maryland	Abstract Deadline Extended—April 1 Early Registration is now Open
<a href="#">E-MRS Spring/ICAM 2011 and Bilateral Energy Conference</a> May 9-13, 2011, Nice, France	Preregistration Deadline—March 31, 2011
<a href="#">Organic Microelectronics &amp; Optoelectronics Workshop VII</a> July 18-20, 2011, San Francisco, California	Early Registration is now Open
<a href="#">International Materials Research Congress XX</a> August 14-19, 2011, Cancun, Mexico	Abstract Deadline—May 1, 2011 Preregistration Deadline—July 15, 2011
<a href="#">6th International Conference of the African Materials Research Society</a> December 11-16, 2011, Victoria Falls, Zimbabwe	Abstract Deadline—June 30, 2011
<a href="#">2012 MRS FALL MEETING &amp; EXHIBIT</a> November 26-30, 2012, Boston, Massachusetts	Call for Symposium Proposals Deadline—April 18, 2011

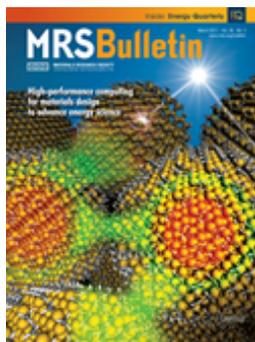
## JUST PUBLISHED

### MRS Bulletin

#### [High-Performance Computing for Materials Design to Advance Energy Science](#)

March 2011 Issue

Guest Editors: Mark T. Lusk and Ann E. Mattsson



The development of new materials typically requires an iterative sequence of synthesis and characterization, but high-performance computing (HPC) adds another dimension to the process: materials can be synthesized and/or characterized virtually as well, and it is often an overlapping quilt of data from these four aspects of design that is used to develop a new material. This is made possible, in large measure, by the algorithms and hardware collectively referred to as HPC. Prominent within this developing approach to materials design is the increasingly important role that quantum mechanical analysis techniques have come to play. These techniques are reviewed with an emphasis on their application to materials design. This issue of *MRS Bulletin* highlights specific examples of how such HPC tools are used to advance energy science research in the areas of nuclear fission, electrochemical

batteries, photovoltaic energy conversion, hydrocarbon catalysis, hydrogen storage, clathrate hydrates, and nuclear fusion.

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Energy Sector Analysis, Corinna Wu

[Variable states](#)

Interview, Guillermo Solórzano

[Brazil's energy policies: An interview with Sérgio Rezende, former S&T minister](#)

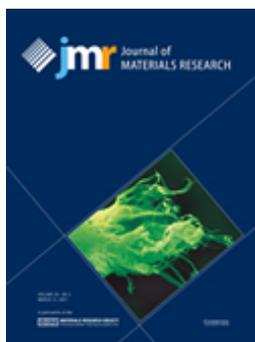
*Postterminaries*

[Theme Topics in Materials?](#)

Steven Moss

## Journal of Materials Research

### March 2011, Volume 26, Issue 5 - A selection of papers



[Continuum modeling of dislocation plasticity: Theory, numerical implementation, and validation by discrete dislocation simulations](#)

Stefan Sandfeld, Thomas Hochrainer, Michael Zaiser and Peter Gumbsch, DOI:10.1557/jmr.2010.92

[Continuous synthesis of multiwalled carbon nanotubes from xylene using the swirled floating catalyst chemical vapor deposition technique](#)

Clarence S. Yah, Sunny E. Iyuke, Geoffrey S. Simate, Emmanuel I. Unuabonah, Graham Bathgate, George Matthews and John D. Cluett, DOI:10.1557/jmr.2010.69

[Spinning yarn from long carbon nanotube arrays](#)

Chaminda Jayasinghe, Supriya Chakrabarti, Mark J. Schulz and Vesselin Shanov, DOI:10.1557/jmr.2010.91

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### March 2011, Volume 26, Issue 6 - A selection of papers



[Measuring substrate-independent modulus of thin films](#)

Jennifer Hay and Bryan Crawford, DOI:10.1557/jmr.2011.8

[Noncontact, in-line measurement of boron concentration from ultrathin boron-doped epitaxial Si1-xGex layers on Si\(100\) by multiwavelength micro-Raman spectroscopy](#)

Yu Fen Tzeng, Scott Ku, Stock Chang, Chi Ming Yang, Chyi Shieng Chern, John Lin, Noriyuki Hasuike, Hiroshi Harima, Takeshi Ueda, Toshikazu Ishigaki, Kitaek Kang and Woo Sik Yoo, DOI:10.1557/jmr.2010.62

[Growth-mode induced defects in epitaxial SrTiO3 thin films grown on single crystal LaAlO3 by a two-step PLD process](#)

Dong Su, Tomoaki Yamada, Roman Gysel, Alexander K. Tagantsev, Paul Murali, Nava Setter and Nan Jiang, DOI:10.1557/jmr.2010.82

[Structure manufacturing of proton-conducting organic-inorganic hybrid silicophosphate membranes by solventless synthesis](#)

Yomei Tokuda, Satoshi Oku, Teppei Yamada, Masahide Takahashi, Toshinobu Yoko, Hiroshi

Kitagawa and Yoshikatsu Ueda, DOI:10.1557/jmr.2010.89

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### **Upcoming JMR Focus Issues - Calls for Papers**

#### [January 2012 -- Instrumented Indentation](#)

Manuscript Submission Deadline: May 5, 2011

#### [February 2012 -- One-Dimensional Micro/Nano Materials](#)

Manuscript Submission Deadline: June 28, 2011

#### [March 2012 - Plasma and Ion-Beam Assisted Materials Processing](#)

Manuscript Submission Deadline: July 15, 2011

### **MRS Communications**

[MRS Communications](#), a new journal focused on rapid communications and high-quality, high-impact review articles across the broad materials spectrum, will be published by MRS in partnership with Cambridge University Press. MRS Communications will be a full-color, online-only publication with accepted papers appearing immediately on Cambridge Journals Online (CJO). Additional details on this new publication including a call for papers will be available at the upcoming MRS Spring Meeting in San Francisco.

## **HAPPENINGS AT MRS**

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### **Society News**

#### [TECHNOLOGY INNOVATION FORUM](#)

*Transitioning Materials for New Markets: Future Power and Energy Needs*

#### [2011 MRS Spring Meeting & Exhibit](#)

Wednesday, April 27 • 8:30 am - 12:00 pm • Moscone West

#### **Organizers:**

John Benner, National Renewable Energy Laboratory and John Busbee, Air Force Research Laboratory

8:30 am

**Yet-Ming Chiang**

Kyocera Professor, Dept. Materials Science & Engineering, MIT; Co-Founder, A123 Systems, Inc.  
*University Spin-Outs in Clean Energy: Challenges and Opportunities*

8:55 am

**Minh Le**

Chief Engineer, Solar Energy Technologies Program, U.S. Department of Engineering  
*SunShot: Leveraging Public and Private Capital to Achieve National Objectives in Solar Energy*

9:20 am

**David H. Wells**

Greentech Team, Kleiner Perkins Caufield & Byers  
*Commercializing Early Stage Research*

10:15 am

**Anand Kamannavar**

Associate Investment Manager, Applied Ventures, LLC  
*Crossing the Chasm from Lab to Fab—A Corporate Venture Perspective*

10:40 am

David J. Parrillo

Global R&D Director, The Dow Chemical Company; Solar Solutions R&D

*Corporate Venture Capital: Sustaining US Commercialization In Breakthrough Materials*

11:05 am

Brent M. Segal

Director of Research Science, Lockheed Martin Corporation

*Interesting or Innovative: Thoughts on Commercialization of Nanomaterials*

11:30 am

Panel Discussion

### [MRS Apprentice Science Reporter Program](#)

The MRS Apprentice Science Reporter Program is a joint program between the Materials Research Society (MRS) and the NSF International Center for Materials Research (ICMR) at the University of California, Santa Barbara. This program funds graduate students/post-docs in materials-related areas at US universities to accompany MRS staff to conferences outside the US and compile daily technical reports for inclusion in the MRS Meeting Scene e-newsletter. For 2011, we are looking for two graduate students or post-docs each for covering the following conferences:

- International Conference on Materials for Advanced Technologies (ICMAT) in Singapore, June 26-July 1

- XX International Materials Research Congress 2011 in Cancun, Mexico, August 14-18.

The application by e-mail should include a Resume, writing samples related to materials science/engineering, and a brief cover letter of intent sent to Dr. Gopal Rao (rao@mrs.org).

### [Of Interest to the Materials Research Community](#)

#### [NanoDays 2011: March 26-April 3](#)



NanoDays is a nationwide festival of educational programs about nanoscale science and engineering and its potential impact on the future. NanoDays events are organized by participants in the Nanoscale Informal Science Education Network (NISE Net). Hundreds of museums, science centers, and university research centers across the United States will be hosting events to help children and adults explore the tiny world of atoms, molecules, and nanoscale forces.

### [CAREER CENTRAL](#)



#### [Classifieds](#)

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

Chinese Academy of Sciences (CAS)  
Senior Positions Available, Ningbo Institute of Material Technology and Engineering (NIMTE)

Sandia National Laboratories  
Postdoctoral Positions, Thermal Property Characterization

South China Normal University  
Faculty Positions

University of Florida  
Faculty Positions, Nuclear Engineering Program

University of Florida  
Director of the Nuclear Engineering Program

University of North Texas  
Faculty Positions, Biophotonics and Nanoscale Optoelectronics

University of Texas at Dallas  
Research Scientist (or Associate)

## DIVERSIONS

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### Did You Know?

that the MRS Online Proceedings Library now features over 65,000 peer-reviewed papers presented at MRS Meetings?

### Quiz

In the MRS governance structure, there are four MRS Board committees. What are they?  
(Answer will be published in the next Materials360®)

### *Answer to the Quiz in the previous Materials360®:*

MRS is co-organizing symposia with the European-MRS as part of the [bilateral energy conference](#) that will be held along with the E-MRS Spring Meeting in Nice, France, from May 9-13, 2011. MRS is also co-organizing symposia with the *Sociedad Mexicana de Materiales* (SMM) at the [International Materials Research Congress \(IMRC\)](#) to be held in Cancun, Mexico, from August 14-18, 2011.

### Quotes of the Month

For brevity's sake, I shall use the expression "rays," and to distinguish them from others of this name, I shall call them "X-rays."  
- *Wilhelm Röntgen (1845-1923)*

One of the greatest and most surprising discoveries of our own age, that of the diffraction of X-rays by crystals (in 1912) was made by a mathematician, Max von Laue, by the sheer power of believing more concretely than anyone else in the accepted theory of crystals and X-rays.  
- *Michael Polanyi (1891-1976)*

It's a wild dance floor there at the molecular level.  
- *Roald Hoffmann, Chemist (1937- )*

Molecules – like ants, lemmings, herring, people – are happiest when surrounded by their own kind.

- Felice Frankel, Science Photographer, and George M. Whitesides, Chemist

## Miscellany

### [Sing along with the materials scientists at the Center for Defect Physics](#)

(YouTube)

Musical and graphical rendition of the scientific thrusts within the Center for Defect Physics - Energy Frontier Research Center, hosted at Oak Ridge National Laboratory. This U.S. Department of Energy funded center is composed of a total of six universities and three national laboratories focused on a fundamental understanding of the impact of defects on the properties and technological applications of materials.

## **ABOUT MATERIALS360®**

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