

April 2011  
Volume 11 • Issue 7**In this Issue!**

Materials News

Happenings at MRS

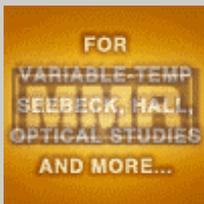
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Consumables for Electron,**IN FOCUS****2011 MRS SPRING MEETING & EXHIBIT**

April 25-29, 2011, San Francisco, California

[Registration](#)[Technical Program](#)[Itinerary Planner](#)[Proceedings Submission](#)**FROM THE EDITOR'S DESKTOP****Ten Years of Materials360<sup>®</sup> and a Change***Gopal R. Rao*

Materials360<sup>®</sup> completes 10 years of existence this year. It started as a simple text-based monthly email in 2001 as an avenue to communicate materials science and Society news and information, and has continued to grow in scope. It went semi-monthly in September 2004. In March of 2007, the name was changed from eMatters to Materials360<sup>®</sup>. It has now become the primary communications vehicle for MRS, reaching a broad readership of over 70,000+ in the materials community and beyond around the globe.

This issue also brings to an end my editorship of Materials360<sup>®</sup>. Tim Palucka recently joined MRS as Science News Editor and will take over as editor of Materials360<sup>®</sup>, bringing over 20 years of science news and feature writing experience to the position. I have transitioned to the editorship of MRS Bulletin after being MRS Web Science Editor for over a decade. Elizabeth (Betsy) Fleischer completes two decades as editor of MRS Bulletin and is now MRS Principal Development Editor. The three of us form a science team at MRS to assimilate, filter and disseminate materials science news and content.

I have enjoyed the process of first creating eMatters and then continuing to add and enhance features within Materials360<sup>®</sup>. In this process, I have heard from many of you with suggestions for content and I appreciate your feedback and the communications. It was satisfying sieving through news reports, research reports and papers to identify (in my view) important research news to include in each issue. It was even more gratifying to hear back from readers about the usefulness of the news and to receive suggestions for specific research to be considered for coverage. It is this interconnectedness, so very important in the research endeavor, that I think Materials360<sup>®</sup> brings to the community.

The process of compiling content for Materials360<sup>®</sup> cannot be accomplished in a black box. Many of my colleagues here at MRS headquarters contribute tremendously to each issue and I appreciate their efforts. I also thank the many volunteers outside HQ who have suggested ideas and who routinely help with content. Several advertisers/sponsors have supported Materials360<sup>®</sup> over the years and I thank them also.

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I look forward to Tim Palucka's new ideas and directions for Materials360®. Please keep sending your thoughts, suggestions and ideas so that Materials360® may better serve the needs of the global materials community.

## NEWS FROM THE WORLD OF MATERIALS\_

Keep up with materials research news through MRS!

[Materials News Web Page](#) | [RSS feed](#) | [Twitter feed](#)

### Materials in Focus

[First macro-scale thin-film solid-oxide fuel cell demonstrated](#)

(Harvard School of Engineering and Applied Sciences)

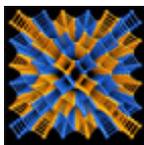


Solid oxide fuel cells (SOFCs) have taken a big step closer to practical applications as clean energy sources with the announcement by researchers at the Harvard School of Engineering and Applied Sciences (SEAS) and SiEnergy Systems LLC of a novel way of making thin-film SOFCs on a macro-scale. "Before this, we and other researchers had demonstrated thin film devices with lateral dimensions on the order of few hundred microns or less," says Shriram Ramanathan, the principal investigator and Associate Professor of Materials Science at SEAS. "Now we have

increased the active area by a factor of over 100, producing centimeter-scale membranes with power densities comparable to the previous, smaller membranes." As reported online on April 3 in *Nature Nanotechnology*, Ramanathan and his colleagues fabricated three-layer membranes approximately 100 nm thick starting with a dense electrolyte membrane of yttria stabilized zirconia (YSZ). This was followed by a lanthanum-strontium-cobalt-iron-oxide (LSCF) cathode layer—a critical step in producing large structurally robust cells—and then nanoporous Pt anode fabrication to complete the three-layer structure. When these membranes were assembled on a Si wafer to form a palm-sized macro-SOFC with integrated supports that can also serve as current collectors, the resulting fuel cell's power density was 155 milliwatts per square centimeter (at 510°C), comparable to micro-SOFCs. Depending on the total power needed for an application, these macro-SOFCs could already serve some commercial needs. "For small scale on-chip power sources such as in the case of sensors," Ramanathan says, "these could be workable already." Future steps include developing novel anode materials that can operate with a variety of hydrocarbon fuels, and the great challenge of designing fuel cells that contain no rare earth elements. [\[Nature Nanotechnology\]](#)

[New symmetry category discovered](#)

(Penn State SCIENCE)



Sixty years after the introduction of the fourth symmetry category (time reversal) to describe the structure of crystalline materials, scientists Venkatraman Gopalan and Daniel Litvin at Penn State University have recently announced the discovery of a fifth: rotation reversal. This discovery has increased the possible number of symmetry groups in crystalline materials from 1,651 to more than

17,800, which greatly increases the opportunities for finding or designing materials with unique properties to solve science and engineering challenges in many disciplines. The discovery, reported April 3 online in *Nature Materials*, came from the novel process of examining the substructures that comprise a crystal, instead of the whole crystal itself. "Usually what happens when you are looking at the symmetry of a structure, you ask what happens when everything is transformed, not when parts of them are transformed," says Litvin, a professor of physics. "We're looking at parts being transformed, and that really is unique to what we're doing." One example is paired substructures that lean alternately toward and away from each other symmetrically throughout a crystal; "tilting octahedral" units are a common example. "This new symmetry, switching the two different orientations, coupled with a translation between neighboring substructures, leaves the structure the same," Litvin explains. "That says there are certain relationships in the structure of the material, and relationships in structure relate to the properties of the material." An elusive property that rotation reversal may help to find for the first time is ferroelectric ferromagnetism. "The goal in



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developing a ferroelectric ferromagnet,” says Gopalan, a professor of materials science and engineering, “is to have a material in which the electrical dipoles and the magnetic moments coexist and are coupled in the same material—that is, a material that allows electrical control of magnetism -- which would be very useful to have in computers.” A major goal in the near future is to fully describe all of the more than 17,800 symmetry groups made possible by the combination of all six symmetry types. [[Nature Materials](#)]

#### [Researchers advance toward hybrid spintronic computer chips](#)

(Eurekalert/Ohio State University)

Researchers have created the first electronic circuit to merge traditional inorganic semiconductors with organic spintronics. Ezekiel Johnston-Halperin, assistant professor of physics, and his team combined an inorganic semiconductor with a unique plastic material that is under development in colleague Arthur J. Epstein’s lab at Ohio State University. Last year, Epstein demonstrated the first successful data storage and retrieval on a plastic spintronic device. Now these researchers have incorporated the plastic device into a traditional circuit based on gallium arsenide. In a paper published online in the journal *Physical Review Letters*, they describe how they transmitted a spin-polarized electrical current from the plastic material, through the gallium arsenide, and into a light-emitting diode (LED) as proof that the organic and inorganic parts were working together. [[Physical Review Letters](#)]

#### [Giant Proximity Effect Enhances High-Temperature Superconductivity](#)

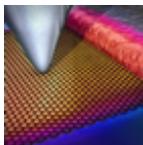
(Brookhaven National Laboratory News)

Scientists at the U.S. Department of Energy’s Brookhaven National Laboratory (BNL), collaborating with scientists from the Paul Scherrer Institute (PSI) and the University of Zürich in Switzerland, have found that sandwiching a barrier layer between two superconductors can make it superconducting at significantly higher temperatures. The results were published online in *Nature Communications* on April 12, 2011. Finding ways to raise the transition temperature further, such as by layering, could lead to the realization of such applications as low-power consumption, ultra-fast superconducting electronic devices. “For many years, we have known about a ‘Proximity Effect,’ that superconducting electron pairs from one superconducting electrode can drift and penetrate a very thin metallic layer, and then reach the other superconducting electrode without losing their coherence,” said Brookhaven physicist Ivan Bozovic, co-author of the paper. “More recently, we have observed a mysterious ‘Giant Proximity Effect’ in copper-oxide materials – cuprates – when supercurrent flows through much thicker barriers.” [[Nature Communications](#)]

#### [Nano Focus](#)

##### [Self-cooling observed in graphene electronics](#)

(University of Illinois News Bureau)



Cooling electronic devices such as computers consumes a great deal of energy, typically in the form of air or water cooling. But what if the materials used in making the electronics cooled themselves during operation? Recent findings by William King and Eric Pop of the University of Illinois, Champaign, just published in the online journal *Nature Nanotechnology*, suggest that graphene components

may be able to do just that. Using a method they developed to measure the nanoscale temperature distribution with atomic force microscopy (AFM) tips, they were able to determine the temperature distribution in a working graphene field-effect transistor (FET) with a spatial resolution of about 10 nm and a thermal resolution of about 0.25°C. They used this data to construct temperature maps of the FET. “The first thing that was remarkable to me,” King says, “was that we could actually measure the temperature of a working FET where the device layer was just 1 atom thick.” By feeding temperature data from these maps into a simulation program developed by Pop, they discovered that the temperature rise at a graphene/metal junction in the circuit differed depending on the direction of current flow through the device. In fact, they found a thermoelectric “nanoscale cooling” effect that accounted for about one-third of the temperature difference; the rest was due to resistive heating. Additional simulations that looked at possible future improvements in graphene materials and metal contacts showed further promise for self-cooling electronics. “If graphene improves in the way that everyone thinks it will, the thermoelectric effect will grow in importance,



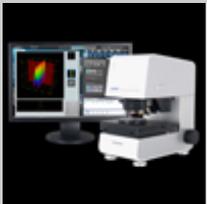
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and the resistive heating will shrink,” King says. “Projecting forward to carbon electronics of the future, the thermoelectric cooling effect will govern everything about the contacts.””<http://www.nature.com/nnano/journal/vaop/ncurrent/full/nnano.2011.39.html>”> [Nature Nanotechnology]



[MRS Sounds of Science](#)

Listen to Dr. William King discuss the implications of this research on the miniaturization of carbon-based electronics devices. (mp3, 80 sec.)

## **Bio Focus**

[Mussel adhesive inspires tough coating for living cells](#)

(ACS News Service)

Taking a cue from shellfish, scientists in Korea have developed a coating that could protect living cells during long exposures to intense heat, dryness and other hostile conditions. In the *Journal of the American Chemical Society*, Insung S. Choi and colleagues report that an organic material called polydopamine, which is a chemical analogue of mussel adhesive, protected yeast cells from cell-digesting chemicals while slowing down their rate of cell division, thereby prolonging their life cycles. The researchers liken the coating to the armor that encloses the spores of some bacterial cells, making them difficult to kill. Polydopamine could be used to encapsulate individual cells to create tiny chemical probes, single-cell chemical factories, and perhaps armor for transplanted cells used in anti-cancer therapies. [\[Journal of the American Chemical Society\]](#)

## **Energy Focus**

[MATERIALS FOR ENERGY BLOG](#)

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[Science Highlight - Mixing of Active Layer Components in Plastic Solar Cells](#)

Organic or plastic solar cells have achieved efficiencies greater than 8%, close to the estimated 10% needed to make them economically viable. To close the gap, researchers need to improve control of the nanostructure of the active layer of these organic solar cells. Recently, scientists from the University of California-Santa Barbara (UCSB) and SSRL studied a common active layer that contains a partly crystalline polymer (P3HT) and a fullerene (PCBM) to better understand the ability of the two components to mix during the manufacturing process. The researchers studied the structure and morphology of the active layer through combined depth profiling measurements at UCSB and x-ray diffraction at SSRL Beam Line 11-3. These methods allowed them to determine that PCBM is mobile in disordered regions of the P3HT polymer, and moves without disrupting the P3HT crystalline structure. This interdiffusion of PCBM in the P3HT polymer was observed at relatively low temperatures and was rapid at typical processing temperatures (e.g. 150°C). These studies suggest that in P3HT - PCBM organic solar cells there is a driving force toward a three phase mixture: pure P3HT crystallites, pure amorphous PCBM, and a mixture of disordered P3HT and PCBM. This more complete understanding of the mixing behavior of the components in blends may help make organic solar cells economically viable. This work was published in the January 1, 2011, issue of *Advanced Energy Materials*. To learn more about this research see the full scientific highlight at: <http://www-ssrl.slac.stanford.edu/science/sciencehighlights.html>

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

## **Image in Focus**

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### Grassland Sunrise

High-resolution SEM image of Germanium/Silicon core/shell heterostructure nanowires (diameter ~ 10 nm) synthesized by a two-step chemical vapor deposition method on a layered Si/SiO<sub>2</sub> substrate.  
*Credit: Yongjie Hu, Harvard University.*

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

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

## HAPPENINGS AT MRS

### MRS News

**MRS Headquarters restructures scientific team to support expanding communications portfolio**  
Building on years of solid performance and growth, the Materials Research Society is repositioning and expanding its headquarters scientific team. These changes, together with MRS's recent partnership with Cambridge University Press, support the Society's continued commitment to increasing the accessibility and growth of the current MRS suite of publications and to building a broader and more global communications portfolio.

After 20 years as Editor of the MRS Bulletin, Elizabeth (Betsy) L. Fleischer has been named Principal Development Editor. Fleischer will work closely with the Publications New Products Subcommittee and Cambridge University Press to identify and develop new publication products, develop product scope, and assist in identifying editor and editorial board candidates and authors. She will also bridge communications with other MRS committees and groups to foster activities to complement and enhance the publications portfolio.

Gopal R. Rao will assume the role of Editor of MRS Bulletin, working with the Editorial Board and Volume Organizers to continue to grow the scope and impact of the Bulletin. Rao has been Web Science Editor since joining MRS in 1997, and Editor of Materials360®, the Society's primary electronic newsletter, since creating it in 2001. He has also been Editor of the Meeting Scene electronic newsletter, reporting from MRS and other international conferences.

Tim Palucka joins MRS as Science News Editor and will work to expand the materials news portfolio

and develop synergies in the MRS publications, marketing, and social media programs. Palucka brings over 20 years of experience in science news and feature writing. He has published articles in various publications including American Heritage of Invention and Technology, Physical Review Focus, Astronomy, and Geotimes and has co-authored three history books. He has also written news and features as well as edited technical themes for MRS Bulletin and contributed to Meeting Scene.

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

This joint program between the Materials Research Society (MRS) and the NSF International Center for Materials Research (ICMR) at the University of California, Santa Barbara 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 for covering the XX International Materials Research Congress 2011 in Cancun, Mexico, from August 14-18. The candidates will need to have an interest in science writing, be able to attend talks in materials research areas outside their specific areas of expertise and be able to write up short summaries quickly. They will need to be a graduate student or post-doctoral researcher at a US-based university at the time of the conference. The application by e-mail should include a Resume, writing samples related to materials science/engineering, and a brief letter of intent sent to Dr. Gopal Rao (rao@mrs.org).

### [Of Interest to the MRS Community](#)

#### [Government Agency Invited Article](#)

*(Brought to you by the Government Agency Subcommittee of the MRS Government Affairs Committee)*

#### [The Making of Captain America's Shield](#)

Realizing a Future of “Indestructible” Materials through State-of-the-Art Synthesis and Processing Tools and Characterization Strategies

by Suveen N. Mathaudhu, Ph.D.

Program Manager responsible for Synthesis and Processing of Materials at the U.S. Army Research Office in Durham, NC.

In July 2011, Paramount Pictures will release “Captain America: The First Avenger” as a feature film. This movie is based on a Marvel Comic initially released in 1941, which tells the story of Steve Rogers, a weak man who is transformed into a super-soldier by an experimental serum injection. Captain America's purpose was originally to serve as a super-weapon for the United States against the Axis powers of World War II. Two things which have been ubiquitous to Captain America in the comics, TV shows and movies that have spun-off are his patriotic red, white and blue uniform and his “indestructible” shield [Captain America Comics, #1, Marvel Comics, 1941]. Through retroactive continuity of the comic book series, we know some details about the making of this shield. It was fabricated in part from the fictional meteorite element, “Vibranium”, which has the unique properties of being able to absorb all kinetic energy directed at it, [Captain America #303-304, Marvel Comics, 1985]. [\(more\)](#)



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## MEETINGS UPDATE

### Critical Meeting Deadlines

<a href="#">2011 MRS SPRING MEETING &amp; EXHIBIT</a> April 25-29, 2011, San Francisco, California	<a href="#">Proceedings Submission</a> Deadline—April 14
<a href="#">7th International Dendrimer Symposium</a> June 26-July 1, 2011, Gaithersburg, Maryland	Early Registration Deadline—May 2 Final Registration Deadline—June 12  No registrations will be accepted AFTER 5PM (EST), June 12, 2011, and for security reasons, no registrations will be accepted on-site.
<a href="#">E-MRS Spring/ICAM 2011 and Bilateral Energy Conference</a> May 9-13, 2011, Nice, France	Preregistration closed
<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="#">2011 MRS FALL MEETING &amp; EXHIBIT</a> November 28 - December 2, 2011, Boston, MA	Call for Papers—submission site opens May 21, 2011 Abstract Deadline—June 21, 2011

[2012 MRS FALL MEETING & EXHIBIT](#)

November 26-30, 2012, Boston, Massachusetts

Call for Symposium Proposals

Deadline—April 18, 2011

## JUST PUBLISHED

### [Journal of Materials Research](#)

[April 2011, Volume 26, Issue 7 - A selection of papers](#)



#### [Microstructural and Electrical Properties of Ce 0.9Gd 0.1O1.95 Thin Film Electrolyte in Solid Oxide Fuel Cells](#)

Sungmee Cho, Jongsik Yoon, Jung-Hyun Kim, Xinghang Zhang, Arumugam Manthiram and Haiyan Wang, DOI:10.1557/jmr.2010.72

#### [Effects of Polypyrrole on the Performance of Nickel Oxide Anode Materials for Rechargeable Lithium-Ion Batteries](#)

Nurul H. Idris, Jiazhao Wang, Shulei Chou, Chao Zhong, Md. Mokhlesur Rahman and Huakun Liu, DOI:10.1557/jmr.2011.12

#### [Mg-based bulk metallic glasses: Elastic properties and their correlations with toughness and glass transition temperature](#)

Shao-Gang Wang, Ling-Ling Shi and Jian Xu, DOI:10.1557/jmr.2011.5

### 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.

## DIVERSIONS

### Did You Know?

The Strange Matter exhibit is currently at the Museo Modelo de ciencias e industria in Toluca, Mexico. This is the first time it is being presented in Mexico.

### Quiz

When and where was the first MRS Spring Meeting held?  
(Answer will be published in the next Materials360®)

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

All members of the Board, except the President, serve on one of three committees: Planning (PlanCom), Operational Oversight (OpsCom) and External Relations (ERC), and each committee is responsible for formulating policy and strategy issues in their specific areas for full Board consideration. The chairs of these committees plus the officers comprise the Governance Committee (GovCom).

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### Automated UV-visible-NIR Spectroscopy of Microscopic Features



CRAIC Technologies, a leading innovator of UV-visible-NIR microspectroscopy solutions, introduces the automated version of its flagship product—the 20/20 Perfect Vision™ UV-visible-NIR microspectrophotometer. This system is designed to be fully programmable with touchscreen controls so that it can automatically analyze microscopic samples with UV-visible-NIR spectroscopy and microscopy. Imaging and spectroscopic analysis of samples can be done by absorbance, reflectance and fluorescence from the deep UV to far into the near infrared. Applications are numerous and include contamination analysis of hard disk components, thin film measurement of semiconductors, microcolorimetry of flat panel displays and quality control of pharmaceuticals.

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

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

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