

January 2011
Volume 11 • Issue 1**In this Issue!**

Materials News

Happenings at MRS

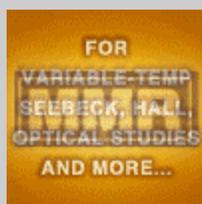
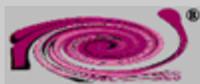
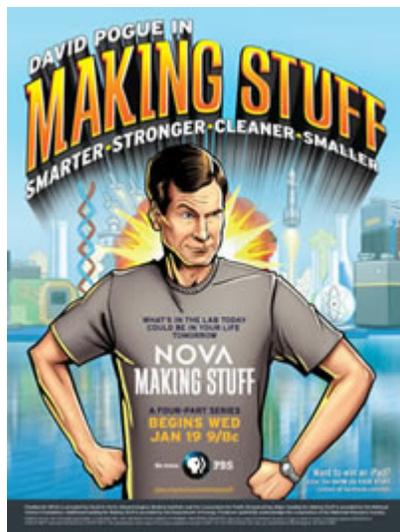
Meetings Update

Just Published

Diversions

New Product Focus

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Sponsors[MMR Technologies](#)Microcryogenic and
Thermal Stage Systems[ULVAC Technologies](#)Seebeck Measurement
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and
Consumables for Electron,
Scanning Probe and**IN FOCUS**[MAKING STUFF: Stronger, Smaller, Cleaner, Smarter](#)
Debuts January 19, 2011!

NOVA's four-hour TV series on PBS: "MAKING STUFF: Stronger, Smaller, Cleaner, Smarter," produced in cooperation with the Materials Research Society (MRS) premieres on January 19, 2011. New York Times technology reporter David Pogue takes viewers on a thrilling tour of the material world we live in. January 19, January 26, February 2, February 9 9:00 PM Eastern Time (US) (check local listings) [Visit the NOVA website](#) for more details.

"[What's This Stuff?](#)" asks David Pogue: Be the first entrant to identify 10 mystery materials from a set of clues and win a MacBook Air! The contest runs from January 12 to January 26, 2011.

"[Show Us Your Stuff](#)" contest - Upload a video, a picture or a short essay about a favorite item in your life and how you would make it stronger, smaller, smarter or cleaner! Let the world know and you could win a David "Pogue-ified" Apple iPad if you get the most votes! <http://www.facebook.com/pbs>

[MRS Communications - New Letters/Prospectives Journal Announced](#)

MRS Communications, a new journal focused on rapid communications and high-quality, high-impact review articles across the broad materials spectrum, has been announced by the Materials Research Society (MRS). The journal will be published by MRS in partnership with Cambridge University Press.

Light Microscopy



[Agilent Technologies](#)

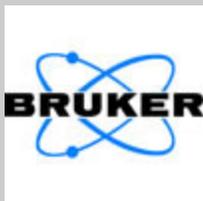
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Materials in Focus

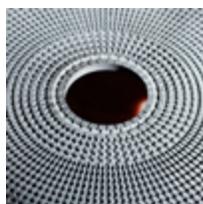
[New damage-tolerant metallic glass](#)

(Nature News)

A new glassy metal alloy has been found to be as strong and as tough as the toughest steel. Amorphous alloys are inherently brittle because they contain small defects that can clump together into bands, as the material begins to fail. These bands can rapidly turn into cracks, and the material shatters. However, generating an extremely large number of these bands could have the opposite effect, making the material tougher. Researchers have now developed a glassy alloy that can generate a large number of these bands. After a number of trials, the successful composition was a palladium alloy, with a small fraction of silver and other elements. The material demonstrates an unusual capacity for shielding an opening crack accommodated by an extensive shear-band sliding process. [[Nature Materials](#)]

[Metamaterial cloak hides underwater objects from sonar](#)

(University of Illinois)



Researchers have demonstrated an underwater acoustic metamaterial cloak, that renders underwater objects invisible to sonar and other ultrasound waves. The team designed the two-dimensional cylindrical cloak made of 16 concentric rings of acoustic circuits structured to guide sound waves. Each ring has a different index of refraction, meaning that sound waves vary their speed from the outer rings to the inner ones. The specially structured acoustic circuits bend sound waves to wrap them around the outer layers of the cloak. The cloak offers acoustic invisibility to ultrasound waves from 40 to 80 KHz, although with modification could theoretically be tuned to cover tens

of megahertz. [[Physical Review Letters](#)]

[3D magnetic domains imaged for the first time](#)

(Physics World)

While scientists have been able to study the effect of domains on magnetic properties of materials, they had not been able to make 3D images of domains deep within the bulk of a material. Instead they had to settle on destructive techniques such as imaging domains near the surface of the sample and then shaving off a thin layer and repeating the measurement. But now researchers have created the first 3D images using a new technique called Talbot-Lau neutron tomography. They did this by firing a coherent beam of low-energy neutrons at a sample of an iron-silicon alloy. A small number of the neutrons are deflected slightly when they cross a boundary between two domains. A diffraction grating with a detector behind it is scanned across the beam of deflected neutrons to determine the angle of deflection. This measurement is repeated many times as the sample is rotated through 360°. The data are then fed into a computer program developed by the team, which produces a 3D image of the domains. [[Nature Communications](#)]

Nano Focus

[Silica addition to TiO₂ nanoparticles enhances photocatalytic activity](#)

(Eurekalert/Rice University)

Adding silicone to titanium dioxide nanoparticles, a common disinfectant, dramatically increased its ability to degrade aerosol- and water-borne viruses via photocatalysis. Researchers subsequently treated a commercial form of titanium dioxide called P25 with silicon dioxide to clean-up contaminated water. Binding just the right amount of silica to P25 creates band bending, shifting the absorption of ultraviolet light (used to activate the catalyst). This creates a path for electrons freed by the UV to react with water to create hydroxyl radicals, which are responsible for contaminant degradation. [[Environmental Science and Technology](#)]

Total Quality Microscopy



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[Nanorings synthesized simply using Vernier templating](#)

(Chemical & Engineering News)

In chemistry, templates are used to arrange molecular components so they can be covalently linked into complex molecules that cannot be otherwise synthesized using classical methods. A group of researchers has now reported a circular templating approach using Vernier complexes, forming 4.7-nm-diameter macrocycles from small, easily prepared templates. Vernier complexes are precise assemblies generated by the coming together of components with different numbers of binding sites, for example, different four- and six-membered building blocks. Past experiments with Vernier systems, however, have all involved linear complexes. In this work, circular Vernier complexes were used, a circular hexapyridyl template with six binding sites. The scientists combined the template with four-membered zinc porphyrin chains, with the porphyrins linked by butadiyne groups. They were able to produce a 12-membered, -conjugated porphyrin nanoring, among the largest of similar macrocycles ever synthesized. [[Nature](#)]

[Bendy nanotubes get around](#)

(Eurekalert/Rice University)

The ability of nanotubes and other fine, filamentous particles to move through their environments is critical in various applications. Researchers have now settled a long-standing controversy in the field of polymer dynamics: They have shown that a little flexibility goes a long way for stiff filaments in a solution. Their study reveals that even a small ability to bend gives nanotubes and other tiny, stiff filaments the means to navigate through crowded environments, or even such fixed networks as cell matrices. Nanotubes served as a stand-in for any type of filament, albeit one whose stiffness can be controlled. The scientists mimicked biological networks by using varying concentrations of agarose gel, a porous material. The gel forms a matrix of controllable size through which molecules can move. The nanotubes, like all filaments, obeyed the rules of thermal-induced Brownian motion. The research established that flexibility significantly enhances the nanotubes' ability to navigate around obstacles and speeds up their exploration. [[Science](#)]



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Annual Reviews

[Bio Focus](#)

[Bacterial biofilm repels liquids, vapors](#)

(Eurekalert/Harvard University)



Researchers have discovered that *Bacillus subtilis* biofilm colonies exhibit an unmatched ability to repel a wide range of liquids—and even vapors.

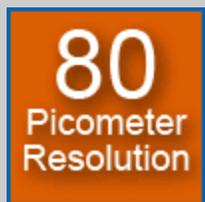
Centimeters across yet only hundreds of microns thick, such slimy bacterial coatings cling to the surfaces of everything from pipes to teeth and are notoriously resistant to antimicrobial agents. The researchers now believe they know the secret to a biofilm's resiliency. This biofilm has an unprecedented liquid-repellent surface, thereby revealing a critical clue to what may be responsible for its broad antimicrobial resistance. The study holds promise for both creating bio-inspired non-wetting materials and

developing better ways to eliminate harmful biofilms that can clog pipes, contaminate food production and water supply systems, and lead to infections. [[Proceedings of the National Academy of Sciences](#)]

[Self-sharpening mechanism of sea urchin tooth](#)

(Chemistry World)

Sea urchins use their teeth to scrape algae off rocks and carve holes for sanctuary from predators and waves. It has been known that urchin teeth remain sharp with use. Their teeth are comprised of a complex arrangement of calcite (calcium carbonate) crystals, forming plates and fibers that are cemented together by a polycrystalline matrix of nanoparticles. However, the limestone rock which they grind is also mainly composed of calcite creating a puzzle: how can the tooth be stronger than the rock? Researchers have figured out the answer by looking at the fine details of the complex tooth structure of the California purple sea urchin. The key to this design is how and where the tooth breaks. The team used high resolution imaging and found that when subjected to stress, the tooth fractures at discontinuities in the material. Around the surface of all the plates and all the fibers there is a thin organic layer about a tenth of a micron in thickness, which is the weak link. The tooth's surface breaks so as to shed a layer of material in a very specific location at the nanoscale. Since the tooth constantly grows, this wearing and shedding action continually exposes



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the stronger and fresh 'stone' part of the tooth. This self-sharpening principle could be useful for designing layered self-assembling nanomaterials in a variety of morphologies that always have a fresh surface to do a specific job. [[Advanced Functional Materials](#)]

[Silk woven into transistors](#)

(Chemistry World)

Researchers have created transistors woven from modified silk fibers. They previously showed how to make silk fibers from the silkworm *Bombyx mori* into semiconductors by dipping them in a dispersion of a conductive polymer. Now, they have demonstrated that such semiconducting silk fibers can be woven into an 'electrochemical' transistor - one that employs an ionic solution, or electrolyte, to modify conductivity, as dopants are used in conventional semiconductors. They crossed two silk fibers that had previously been dipped in PEDOT-S, and then added a drop of electrolyte at the junction. By applying a voltage across two ends of one fiber, which acted as the 'gate' electrodes, they could control the current passing along the other fiber, whose ends acted as the 'source' and 'drain' electrodes. [[Advanced Materials](#)]

[Energy Focus](#)

[MATERIALS FOR ENERGY BLOG](#)

Recent Post

[Catalytic Materials: Clean Fuels for the Future and Origins of Life](#)

Catalytic materials have played a crucial role in providing fuels, commodities, and fine chemicals for more than 100 years. The role of these materials is going to become more important than ever in the future. Catalytic materials will provide fuels for environmentally friendly transportation vehicles, as well as materials for these vehicles, well into the future. Today, more than 60% of all chemical products and 90% of all chemical processes are catalytic processes. We define catalytic materials, such as the TMS (transition metal sulfide) catalysts (described below), as solid-state materials with the recognition that many catalysts are inorganic molecules or biological molecules. A full description of catalysts and catalytic materials and the breadth of the field can be found in the Encyclopedia of Catalysis, which includes an article by the author of this report.¹ Catalytic materials are the catalysts, solids in the case of heterogeneous catalytic processes, that are optimized for activity and selectivity in catalytic processes. The process of optimizing the activity and selectivity through synthetic techniques is called structure/function optimization. This process controls the surface chemistry of the catalytic material and has been used since the dawn of catalytic processes. Today, it is called optimization of nanomaterials. [Read more...](#)

Add your comments, or e-mail materialsforenergy@mrs.org to suggest future topics and contributors.

[Image in Focus](#)



The silk collective

Silk, produced by the silkworm *Bombyx mori*, has been viewed for millennia as a prestigious and valuable material. This protein has recently found application as a high technology material in biomedical micro- and nanotechnology. This scanning electron microscopy image depicts details of a

micro-patterned silk surface, fabricated with an all-aqueous micro-molding technique. The silk structures, measuring approximately one micrometer in diameter, were fabricated at room temperature and under ambient pressure. The research was performed within Prof. Fiorenzo Omenetto's group (Ultrafast Nonlinear Optics and Biophotonics Laboratory) and is part of "the silk collective" at Tufts University.

Credit: Konstantinos Tsioris, Tufts University

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

[[Submit your images](#) to the Editor for possible inclusion in this feature]

Industry Focus

Oxford Instruments deposits first PECVD films on 450 mm wafers

In collaboration with ISMI (a global alliance of the world's major semiconductor manufacturers and a subsidiary of SEMATECH), the technology and applications teams at Oxford Instruments Plasma Technology have coated 450 mm silicon wafers with PECVD SiO₂ - a world first, according to the company. The wafers were processed using the recently launched Oxford Instruments PlasmaPro NGP®1000 PECVD system, which is capable of coating single wafer substrates up to 450mm diameter or larger batches of smaller diameter wafers. The wafers processed at Oxford Instruments will be used in ISMI's Test Wafer Generation program to enable the development of 450 mm process and metrology tools. The SiO₂ film thickness uniformity is expected to achieve ±3% based on measurements taken from batches of smaller diameter wafers. ISMI is currently building the infrastructure for the transition to 450 mm as part of its portfolio of programs dedicated to improving productivity and reducing costs in today's and tomorrow's fabs. The ISMI 450 mm Program is committed to enabling a cost-effective transition through coordination and development of infrastructure, guidance, and industry readiness.

HAPPENINGS AT MRS

MRS News

2011 World Materials Summit to host inaugural Student Congress



The 2011 World Materials Summit will host its inaugural Student Congress, a program for active graduate students and postdoctoral scholars in fields directly related to energy and environmental science, engineering and/or policy, October 8-12, 2011 in Washington, D.C. Using a competitive application process, 50 student and post-doctoral participants from around the world—the best and the brightest next-generation scientists, engineers and leaders—will be invited to join the Summit and work alongside today's energy experts. The Student Congress is a collaborative initiative of three materials research societies—the Materials Research Society (MRS), the European Materials Research Society (E-MRS) and the Chinese Materials Research Society (C-MRS). The deadline to apply is February 1, 2011.

New MRS Materials Theory Award

The Materials Theory Award recognizes exceptional advances made by materials theory to the fundamental understanding of the structure and behavior of materials. Nominations for the first award should be completed by April 1, 2011.

MRS acknowledges the generosity of Professors Toh-Ming Lu and Gwo-Ching Wang in endowing this award.

Of Interest to the MRS Community

Government Agency Invited Article

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

[Beyond Graphene - Novel Nanosheets of 2D Crystalline Materials with Revolutionary Properties](#)

Pani Varanasi, Program Manager, Materials Science Division, Army Research Office, Durham, NC
Basic research efforts in the areas of novel free-standing two dimensional (2D) crystalline structures of materials (e.g. oxides and nitrides etc.) are of great interest as they could open up unique opportunities that are not yet realized. It is evidenced by the pioneering work by Geim et al. and many other researches that graphene, a 2D nanosheet form of carbon, can exist as a stable material and exceptional properties that are not observed in 3D or 1D form of carbon are possible as a result of the electron confinement in 2 dimensions. Graphene has been shown to have many unique properties such as very high electron mobility (~200,000 cm²/Vs), very high thermal conductivity (~5.30±0.48×10³ W/mK), high strength and impermeability to gases etc., thus making it very attractive for many applications. [more....](#)

[Living in a material world](#)

(PhysicsWorld.com)

[View Video](#)

The Materials Research Society (MRS) Fall Meeting has become a reference point for the increasingly cross-disciplinary mix of scientists and engineers that make up the materials-science community. In the first of a series of video reports from the 2010 MRS Fall conference, which was held in Boston, delegates give their take from the cutting edge of materials science and technology.

[Spreading the word: why science outreach matters](#)

(PhysicsWorld.com)

[View Video](#)

Amy Moll is a scientist on a mission to inform. A professor in the department of materials science and engineering at Boise State University, Idaho, she's also chair of the Materials Research Society (MRS) public outreach committee, a role that sees her "bringing science and materials science to the general public". In a recent video report, Moll acknowledges that fear is a big issue for many scientists wary of communicating their research to a wider audience. Nevertheless, she argues that outreach is not optional, rather that scientists have a duty to spread the word about their work.

[OSTP Director Issues Memorandum on Scientific Integrity](#)

(AIP FYI)

John Holdren, Assistant to the (US) President for Science and Technology and the Director of the Office of Science and Technology Policy, has issued a "Memorandum for the Heads of Executive Departments and Agencies" on scientific integrity. Holdren's memorandum has five sections. The first is entitled "Foundations of Scientific Integrity in Government" and calls for executive departments and agencies to develop policies to "ensure a culture of scientific integrity," "strengthened the actual and perceived credibility of Government research," "facilitate the free flow of scientific and technological information, consistent with privacy and classification standards" and "establish principles for conveying scientific and technological information to the public." This section sets the tone for the rest of the memorandum and includes guidance on the selection of candidates for scientific positions, independent peer review, whistleblower protections, promoting access to scientific and technological information in online open formats, and agency communications. The remaining sections are more specific in their guidance. They are entitled "public communications," "use of Federal advisory committees," "professional development of government scientists and engineers," and "implementation."

MEETINGS UPDATE

[Critical Meeting 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

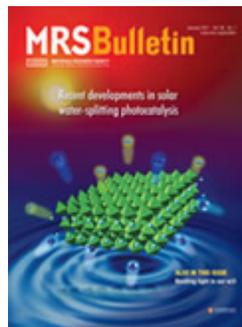
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MRS Bulletin

[Recent Developments in Solar Water-Splitting Photocatalysis](#)

January 2011 Issue

Guest Editors: Frank E. Osterloh and Bruce A. Parkinson



Although photovoltaic cells have great potential for supplying carbon-free energy, they suffer from the lack of an efficient and cost-effective energy storage process that can supply energy for transportation and nighttime use. A direct way to convert solar energy into chemical fuels would solve this problem. Of several possible schemes, the photon-driven electrolysis of water to produce hydrogen and oxygen has been studied most. Photoelectrolysis of water can be achieved with either self-supported catalysts or with photoelectrochemical cells. This issue introduces the basic principles of solar water splitting and highlight recent developments with semiconductor light absorbers and co-catalysts. The role of combinatorial approaches in identifying new metal oxide visible light-absorbing semiconductors and the potential of using nanomaterials for more efficient devices are discussed. Separate articles

in this special issue focus on recent developments in water-splitting concepts.

Also:

[Changing the way we do business](#)

Letter from the President, Jim De Yoreo

[Bending light to our will](#)

2010 Fred Kavli Distinguished Lecture in Neuroscience, Harry Atwater

[Develop and follow your own passion](#)

Beyond the lab, William D. Nix

[Coincidence or hidden connections?](#)

Postterminaries, Bob Fleischer

Journal of Materials Research

[Call for Papers - September 2011 -- Nanowires: Fundamentals and Applications](#)

Manuscript Submission Deadline is January 28, 2011

Guest Editors: Paul C. McIntyre, Stanford University, USA; Volker Schmidt, Max Planck Institute, Halle, Germany

Principal Editors: Tom Picraux, Los Alamos National Laboratory, USA; Nathaniel Quitoriano, McGill University, Canada; Heike Riel, IBM Research, Switzerland; Claes Thelander, Lund University, Sweden; Carl Thompson, Massachusetts Institute of Technology, USA

A selection of papers from the [January 2011 \(1\) issue](#)



[Phase transformation of poly \(vinylidene difluoride\) in energy harvesting](#)

Hong Liang, Rodrigo Cooper and Jason Files

DOI:10.1557/jmr.2010.81

[Catalytic graphitization of three-dimensional wood-derived porous scaffolds](#)

M.T. Johnson and K.T. Faber

DOI:10.1557/jmr.2010.88

[Thermoelectric Power Factor Enhancement of Textured Ferroelectric \$\text{Sr}_x\text{Ba}_{1-x}\text{Nb}_2\text{O}_{6-\delta}\$ Ceramics](#)

Soonil Lee, Sinan Dursun, Cihangir Duran and Clive A. Randall

DOI:10.1557/jmr.2010.78

DIVERSIONS

[Did You Know?](#)

[Childcare grants](#) are available for the upcoming 2011 MRS Spring Meeting. MRS has a limited number of childcare grants available to attendees. [Application deadline](#) is February 18, 2011.

[Quiz](#)

Who are the current Volume Organizers for the MRS Bulletin?

(Answer will be published in the next Materials360®)

Answer to the Quiz in the previous Materials360®:

There are currently 96 MRS Fellows elected in 2008, 2009 and 2010.

[Miscellany](#)

[Nano 'tea bag' purifies water](#)

Scientists have reversed the action of the humble herbal tea bag to purify water on a small scale. Instead of infusing water with flavour, a sachet sucks up toxic contamination when fitted into the neck of a water bottle. The sachets are made from the same material used to produce the *rooibos* tea bags that are popular in South Africa. But inside are ultra-thin antimicrobial nanoscale fibers, which filter out contaminants, plus active carbon granules, which kill bacteria.

NEW PRODUCTS FOCUS

[New Generation of Cell Migration Assays](#)



AMS Biotechnology (AMSBIO) has announced the launch of the first of a new generation of cell migration assays designed specifically for fully automated high throughput screening (HTS) utilizing high content screening (HCS) and high content imaging (HCI) systems. The *new Oris™ Pro 384 Cell Migration Assay* uses a non-toxic biocompatible gel (BCG) to form a centrally located and temporary cell-free zone on cell culture surfaces in a 384-well format. After cell seeding the BCG dissolves to reveal a detection zone into which the migration of cells can be observed either in real time or after further experimental processing. This breakthrough product enables

researchers to capture and quantify cell migration data while substantially improving assay efficiency and dramatically reducing assay costs.

[Contact: 44-1235-828200 or info@amsbio.com]

[Workstation for UHV Thermal Desorption Studies](#)



The new TPD Workstation from Hidden Analytical is a complete turnkey station for UHV temperature programmed desorption studies and is suited to both quality control and research applications. The system is totally UHV compatible, with a fast sample load lock and easy-glide magnetic transfer mechanism for ultimate vacuum integrity. Positive sample placement is directly onto the horizontal heater surface, aided by the three viewports and the high-intensity illuminator. A thermocouple contacts directly to the sample for positive thermal control, and internal water cooled heat-shields

inhibit degassing due to radiant heat. Applicable technologies include photovoltaics, metallurgy and semiconductor and thin-film studies.

[Contact: 44-1925-445225 or info@hidden.co.uk]

[New Catalog of Research Chemicals, Metals and Materials](#)



Alfa Aesar, A Johnson Matthey Company, announces the publication of the 2011-13 Catalog of Research Chemicals, Metals & Materials. The new catalog features over 4,000 new products, many of which are novel fine organics, including over 800 new boronic acids and esters. Other products include aryl homopiperazines, zeolites, fluoroaromatic compounds, silica gels and more. Many of the new products are unique and exclusive to Alfa Aesar. In addition to chemical compounds, the catalog includes special sections listing pure elements, alloys, analytical products, and precious metal compounds and catalysts.

[Contact: 978-521-6300 or info@alfa.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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