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Science and art intersect in the Hot Glass Shop, where students have been exercising their creativity since the facility opened on the Missouri S&T campus in 2007. Only 16 students are accepted into the course each semester since the small workspace restricts the number of participants able to work safely in the shop with its one crucible and one reheat furnace. Once they learn the basics of working in the shop, students are turned loose to express themselves by making a variety of objects for practical application or aesthetic appeal. The shop contains a freestanding crucible filled with more than 100 pounds of clear glass at 1,135 degrees Celsius. Photo By Sam O’Keefe/Missouri S&T
DEAR ALUMNI, COLLEAGUES AND FRIENDS

On behalf of the students, staff and faculty of the Department of Materials Science and Engineering, welcome to the 2016 edition of our annual newsletter.

This past year was a busy one both on campus and within the department. First, I’d like to thank ceramic engineering professor Wayne Huebner for his dedicated and productive service to the department as chair for the past nine years. Wayne’s leadership and enthusiasm has resulted in significant growth in student enrollment, endowments and faculty size during his tenure. Fortunately, his return to full-time teaching and research activities will enable Wayne to make significant contributions to the primary mission of our university: educating students.

Thanks as well to Curators’ Distinguished Professor Dick Brow for serving as interim chair. The department is very supportive of and grateful for Dick’s willingness to also serve as the interim vice provost and dean of our College of Engineering and Computing, a position he assumed in July.

My appointment as MSE chair began in March. After 17 years as a metallurgical engineering faculty member and as a MetE’85 graduate and Rolla native, I look forward to working with all our stakeholders to make a great department even better. As the country’s only materials science and engineering department offering ABET-accredited undergraduate degrees in both disciplines, there is a strong heritage here to build on and carry forward in the field of engineering.

These days, the excitement of a new school year is pulsating through the department, Missouri S&T and all of Rolla. Enrollment approaching 9,000 undergraduate, graduate and online students produces an environment that fosters creative discovery and innovation in teaching, research and service.

Turn inside for some examples of the activities and accomplishments of our students, staff and faculty. And please let us know when you’re in town to visit campus, or contact the department for ideas on how to stay engaged, learn more or begin your own S&T journey.

Warm Regards,

Matt O’Keefe, Ph.D.
MetE’85
Professor and Chair, Materials Science and Engineering

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A high-strength steel being developed at Missouri S&T could help auto manufacturers in their quest to meet future fuel efficiency requirements.

The development of this new steel, known as a “third-generation advanced high-strength steel,” is under way at Missouri S&T’s Kent D. Peaslee Steel Manufacturing Research Center. “We are currently refining the steel design to achieve ‘Gen 3’ mechanical property goals while also maintaining manufacturability,” says center director Dr. Ronald J. O’Malley, the F. Kenneth Iverson Endowed Chair of Steelmaking Technologies at Missouri S&T. “This is one of the most promising generation-three steels I’ve seen.”

Under the U.S. Department of Transportation’s Corporate Average Fuel Economy (CAFE) regulations, auto manufacturers must improve the fuel efficiency of their vehicles year-by-year through 2020. Regulators have set a tentative goal of increasing fuel efficiency to 54.5 miles per gallon for cars and light trucks by the 2025 model year. Improvements in exhaust treatment systems, transmission efficiency and aerodynamics all contribute to better fuel efficiency. But reducing vehicle weight is also important in achieving the CAFE goals, O’Malley says.

“Automakers must make lightweight vehicles without sacrificing safety,” he says. What is called first-generation steel is most commonly used in today’s cars and trucks. A second-generation product has been developed, and it is stronger and more lightweight than the first-generation material, but O’Malley says it is too costly to produce and more difficult to manufacture. The third-generation steel being developed by Missouri S&T metallurgical engineers should be lighter, easier to make and strong enough to address automakers’ safety concerns, he says.

TAKING A TRIP
The S&T researchers are employing a method known as TRIP — or transformation-induced plasticity — to obtain the performance required to meet both safety and CAFE goals. It involves the transformation of an unstable crystal structure known as austenite, which normally exists at high temperatures, into martensite, a harder substance that develops as the steel deforms. “The S&T alloy design employs a two-stage or ‘dual TRIP’ mechanism that leads to extreme work hardening and energy absorption, so it’s very good for automotive crash-worthiness,” says O’Malley.

Under the direction of Dr. David C. Van Aken, Curators’ Distinguished Teaching Professor of materials science and engineering, the Missouri S&T team has used an atomic modeling method known as density functional theory to identify alloying elements to create the dual TRIP character of these new steels.

The real challenge, however, lies with the large-scale production of these new steels. With the help of industrial partners, the researchers in Missouri S&T’s Peaslee Steel Manufacturing Research Center are examining all aspects of the steel manufacturing — “from melt practice to final formability by the automotive producer,” O’Malley says. A committee of representatives from four steel manufacturers — Nucor, U.S. Steel, AK Steel and ArcelorMittal — oversees the project.

One benefit of conducting the research at Missouri S&T is the ability of researchers to create and test small batches of steel. In S&T’s labs, researchers can create 200 pounds of steel at a time, whereas large steel manufacturers like Nucor, where O’Malley was chief metallurgist before joining S&T, would have to make 170 tons of steel for testing, O’Malley says.
The center’s mission is to develop skilled engineers and scientists who are trained in the technology of steel manufacturing and to provide scientific and technical support to the industry.

PSMRC ENTERS FOURTH YEAR

The Kent D. Peaslee Steel Manufacturing Research Center, which was officially launched in October 2012, has now begun its fourth year of operation. The center currently has 12 industrial members: ArcelorMittal, AK Steel, Gerdau, Imerys, MetalTek, Morco, North American Stainless, Nucor Steel, SSAB, US Steel, Vesuvius and our most recent new member: Magnesita. The membership is a mix of producers and raw material and refractory suppliers that collectively support research projects in steel manufacturing at Missouri S&T.

The center has provided research funding for nine projects to date: Grain refinement during solidification of austenitic steels; hot working modeling and simulation of rounds, beams and slabs; non-metallic inclusion engineering in pipeline and foundry steels; third-generation advanced high-strength steel development; mold flux crystallite morphology and stability in continuous casting; effect of microstructural features on steel machinability; next-generation slag-line refractories; reducing nozzle clogging in continuous casting; and ladle/refractory interactions in ULC steel manufacture.

RESEARCH ON NEW ADVANCED HIGH STRENGTH STEEL YIELDS AWARDS

Research funded by the Kent D. Peaslee Steel Manufacturing Research Center was recognized in 2015 with the Gilbert R. Speich Award and in 2016 with the Hunt-Kelly Outstanding Paper Award. The paper “Developing a Third Generation Advanced High Strength Steel with Two-Stage TRIP Behavior” was authored by Scott T. Pisarik (left), MetE’12, MS MetE’14, Dr. David C. Van Aken, Curators’ Distinguished Teaching Professor of materials science and engineering, Dr. Krista R. Limmer, PhD MatE’14, and Dr. Julia E. Medvedeva, associate professor of physics. Team Pisarik came in second place in the Hunt-Kelly competition and our good friends at NUCOR — led by Zane T. Voss, MetE’07 — came in first for the paper titled “Electric Arc Furnace Process Improvements and the Law of Unintended Consequences.”
Ceramic engineers help make everything from the casserole dish in the cupboard to artificial joints for hip replacement to coatings that protect jet engine blades — but there aren’t enough ceramic engineers to meet industry needs, says a Missouri S&T professor. The university is working to change that. Missouri S&T is one of five colleges to take part in the Ceramic and Glass Industry Foundation’s University-Industry Network. The CGIF is an outgrowth of the American Ceramic Society. Dr. Richard Brow, Curators’ Distinguished Professor of ceramic engineering at Missouri S&T, served as ACS’s president in 2012-13.

The CGIF, Brow says, “is a recognition that ceramic engineering as a stand-alone educational discipline has shrunk over the last 30 years to where there’s very few in the country.” Missouri S&T graduates 25 to 30 ceramic engineers each year, Brow says — about half of what the entire country produces. That’s where the University-Industry Network comes in, to encourage materials science and engineering programs around the country to teach key concepts in ceramics and glass science and steer students toward careers in ceramic materials.

The UIN is exactly what it sounds like: a partnership between universities and industries that use ceramic materials. Those industries also include automakers, who need ceramics for catalytic converters; phone companies, who use glass and ceramic components to generate and transmit information; steelmakers, who produce metals in refractory-lined furnaces; and electronics manufacturers, who use multilayer ceramic capacitors — more than 1 trillion a year — in televisions, home appliances, cell phones and basically anything that has a circuit.

Companies such as Rolla-based Mo-Sci Corp. need ceramic engineers for specialty glass products for energy, healthcare, automotive and military applications, Brow says.

“Industry needs are not being met,” he says. “There are not enough ceramic engineers left to fill the pipeline, so this partnership is an attempt to attract additional students to the profession and help it grow.”

Students interested in careers involving ceramic materials can come from many other disciplines, such as chemical engineering, materials science and engineering, and chemistry. To connect those students with industry partners, the first five universities participating in the project each name a key professor. Dr. Jeffrey Smith, associate professor of ceramic engineering, is Missouri S&T’s key professor.

The partnership, Brow says, works to keep S&T’s connections to industry strong and grow the field as a whole. Other universities involved in the project are Alfred University, Pennsylvania State University, Clemson University and Colorado School of Mines.
FACULTY ACCOMPLISHMENTS

Our faculty are recognized experts, published authors, accomplished researchers and more. Here are just a few of their recent accomplishments.

**RICHARDS NAMED BARLOW AWARD WINNER**

Dr. Von Richards, professor emeritus and former Robert V. Wolf Professor of Metallurgical Engineering, has been awarded the Thomas E. Barlow Award of Honor from the Steel Founders’ Society of America.

Richards’ research involves casting steel in a variety of ways to make products for industry that need little machining of the finished item, saving time and expense.

**TRIO WINS BEST PAPER AWARD**

At the 2015 AFS Metal Casting Conference, Dr. Jingjing Qing, assistant research professor, Dr. Dave Van Aken, Curators’ Distinguished Teaching Professor, and Dr. Von Richards, former Robert V. Wolf Professor of Metallurgical Engineering, were recipients of the best paper in the cast iron division for their paper “Examination of Nodular Graphite Formation and Austenite Solidification in Ductile Iron.”

**BROW EARNED N.F. MOTT AWARD**

Dr. Richard Brow, Curators’ Distinguished Professor of ceramic engineering, earned the N.F. Mott Award from the Glass and Optical Materials Division of the American Ceramics Society (ACS). The award is presented every two years by the “Journal of Non-Crystalline Solids” to a senior scientist for outstanding contributions to the science of non-crystalline solids. Brow received the award at the ACS annual meeting.

**MATERIALS SCIENCE AND ENGINEERING RECOGNIZED BY AFS**

The materials science and engineering department won the Group Service Award from the Cast Iron Division of the American Foundry Society. The award, which recognizes Missouri S&T for its years of dedication and service, was presented in April at the 120th Metalcasting Congress in Minneapolis.

**2016 AIME MATHEWSON AWARD**

Dr. Laura Bartlett (left), Robert V. Wolf Associate Professor in Metallurgical Engineering, and Dr. Dave Van Aken (right), Curators’ Distinguished Teaching Professor of materials science and engineering, and co-authors were the recipients of the TMS 2016 Champion H. Mathewson Award for their paper “An Atom Probe Study of Kappa Carbide Precipitation and the Effect of Silicon Addition,” published in Metallurgical and Materials Transactions A, Vol. 45, May 2014.

**O’MALLEY NAMED OFFICER AT LARGE OF AIST**

Dr. Ronald J. O’Malley, F. Kenneth Iverson Endowed Chair of Steelmaking Technologies and director of the Kent D. Peaslee Steel Manufacturing Research Center, was named Officer at Large of the Association for Iron and Steel Technology (AIST).
Being the best can be as much a curse as a blessing. Dr. Laura Bartlett, associate professor of materials science and engineering at Missouri S&T, is living proof.

Long before the “Dr.” was added to her name, she was Laura Bartlett, high school valedictorian; Laura Bartlett, Missouri S&T student; Laura Bartlett, waitress. Bartlett came to S&T in the fall of 1993 as a mechanical engineering student. But Bartlett “was more interested in the social aspects than the courses,” she says, and after three years and change she left Rolla without a degree. For a person who was smart enough to make her own fireworks (charring the driveway in the process) and breezed through high school, it was a sobering experience. She couldn’t see it then, not through the disappointment and the regret, that leaving S&T was just the beginning of her journey, not the end. She couldn’t see that she would be back at S&T, earning bachelor’s and doctoral degrees in metallurgical engineering, the latter as part of the federal Graduate Assistance in Areas of National Need (GAANN) program. She couldn’t see the resolve that led her to where she is today.

MANUAL LABOR
After leaving school, Bartlett worked for years in jobs that had nothing to do with mechanical engineering.

There was the job on a print production line, 12-hours shifts of lifting and loading 20-pound bales of papers. She went home after work, bone tired.

There was the job at a dog food factory. The smell of dog food permeated her clothes, her hair, her home.

There was the job at a dog food factory. The smell of dog food permeated her clothes, her hair, her home.

There was the job cleaning motel rooms. “I did a lot of very, very hard jobs,” Bartlett says.

And there was a job as a waitress in Ravenden Springs, Arkansas, population 137, her husband, Chris’ hometown.

Waiting tables one day in 2005, she overheard a diner mention something about the university in Rolla, Missouri. She struck up a conversation with the man, Tom Baird, a computer science professor at Missouri S&T, and in the course of that talk, she mentioned that she wanted to get back to Rolla. Baird encouraged her to contact Jerry Bayless, associate professor of civil, architectural and environmental engineering at S&T.

“That night, I couldn’t sleep,” Bartlett says. “I was very apprehensive about making the call because frankly I didn’t know if I could still do well after being out of school for so long.”

By that time, it wasn’t just her and Chris she had to think about. Son Christopher, now a 13-year-old middle school student, was in the picture. “I wanted something more for him,” Bartlett says.

She made the call.

And when her family’s tax return came in, she said, “Let’s go.”

CHANGING DIRECTION
Bartlett returned in 2005 as a mechanical engineering student, but one day she went to Missouri S&T’s foundry to watch molten iron being poured.

“That hooked me,” she says. “I said, ‘I’ve got to do that.’”
With a bachelor’s degree in hand in 2008, she had an offer to work in a steel mill, but she was worried that she would be out of a job if the economy got worse. Looking around for something more stable, she was encouraged to apply for a GAANN fellowship that focuses on training the next generation of researchers and professors. “It turned out to be the best thing,” Bartlett says. “I never would have thought 15 years ago that I would fall into this line, to be a professor and a teacher.”

As a GAANN student, she had to pass another test, to teach one course by herself, start to finish. It was a course taught by her dissertation advisor, Dr. David C. Van Aken, Curators’ Distinguished Teaching Professor of materials science and engineering. Determined not to let Van Aken and herself down, she found her footing teaching Mechanical Testing of Materials and passed that test, too.

And then she did what the GAANN program prepared her to do by accepting a job as an assistant professor at Texas State University.

SCHOOL DAYS

At Texas State, Bartlett was involved in the Foundry Educational Foundation, which is a consortium of about 20 universities with a metals casting program. Bartlett helped lead open foundry days where middle school and high school students would tour the school and the foundry. They put the students in three groups, and watching the kids light up, their wonder and imaginations ignited by the glow of red-hot molten steel. (She hopes to set up a similar program at Missouri S&T.)

When the offer came in to be Missouri S&T’s Robert V. Wolf Professor in Metallurgical Engineering, it didn’t take Bartlett long to decide that Rolla was where she wanted to be. Now she gets a chance to help students at her alma mater, whether it’s professionally or through life lessons she learned the hard way. Bartlett looks back and on all the tough jobs she had, and she says they taught her things she uses now, like how to identify with all different kinds of people. And she believes that experience makes her more in touch with her students. “If I see a student is struggling and going down the wrong path, I can tell them my story, that they can turn their fortunes around,” she says. “I think that’s a very powerful message.”

CURATORS’ DISTINGUISHED PROFESSOR TAKES OVER MATERIALS RESEARCH CENTER

Dr. William Fahrenholtz, Curators’ Distinguished Professor of ceramic engineering at Missouri S&T, has been named the director of the Materials Research Center at Missouri S&T. His appointment took effect in March. Fahrenholtz succeeded Dr. Matt O’Keefe, who became chair of materials science and engineering at Missouri S&T.

“Dr. Fahrenholtz’s work as a professor of ceramic engineering has been exemplary, and he is one of the leading researchers in his field, making him an excellent choice to lead the MRC,” says Dr. Mariessa Crow, vice provost for research and engineering at Missouri S&T. “His move from senior investigator to director will ensure that the MRC remains on the cutting edge, helping prepare our students to tackle the challenges of today — and beyond.”

Fahrenholtz’s recent research focuses on ultra-high temperature ceramics, rare-earth coatings for corrosion protection and low-temperature glass joining. His research expertise is processing and characterization of ceramics, which, he says, “is the common theme among those seemingly disparate areas.”

Besides leading the center’s research efforts and mentoring junior faculty, Fahrenholtz will continue working on his recent research and teaching one class per semester.

“Another goal is to raise the visibility of materials research on campus and nationally, which can range from marketing the accomplishments of the center to leading major research initiatives such as large, multidisciplinary research proposals,” Fahrenholtz says.

Fahrenholtz has been on the Missouri S&T faculty since 1999. He was named a full professor in 2008 and that year began serving as senior investigator in the Graduate Center for Materials Research.

He has been the lead author or co-author on more than 95 manuscripts published in peer-reviewed journals and has been the presenter or co-author on more than 200 presentations at international technical conferences.

MSE RECEIVES GAANN FUNDING

MSE has been awarded a Graduate Assistance in Areas of National Need Program (GAANN) grant by the U.S. Department of Education. This award funds five GAANN Fellows to pursue doctorate degrees in materials science and engineering, with the primary objective being to enhance the number of U.S. citizens who will pursue teaching and research careers in MSE.

This is the fifth GAANN program awarded to our department, with nearly continuous funding since 1992. Over 20 MSE students have received their Ph.D.’s through GAANN. Our new Wolf Professor, Dr. Laura Bartlett, is a former GAANN Fellow; she will be advising one of our new students as well. This program not only pays for graduate student stipends, but also provides over $15,000 annually to pay for tuition and fees as well as items such as books, supplies, computers, travel, membership in professional societies and research expenses.

The GAANN program is the premier DOE fellowship program, and is highly competitive both in terms of being awarded a grant as well as becoming a fellow. Successful candidates must be U.S. citizens or have permanent resident status, and have an undergraduate GPA of 3.5 or higher, a GRE score in the 90th percentile, and a desire to pursue a teaching and/or research career. During the course of their studies fellows will teach two undergraduate courses by themselves, supervise an undergraduate research assistant and participate in K-12 outreach activities. We are happy four GAANN Fellows have already started.
The materials science and engineering department has a long history in bioglass and bioceramics research, development and innovation. Radioactive glass microspheres (Theraspheres™) developed in the early 1980s by Dr. Delbert E. Day, Curators’ Distinguished Professor Emeritus, are used clinically in over 100 institutions worldwide to treat inoperable liver cancer.

More recent research by Day, Dr. Mohamed Rahaman, professor, and Dr. Dick Brow, Curators’ Distinguished Professor of ceramic engineering, has targeted the development of bioactive glasses and bioceramics to repair bone, heal soft tissue wounds and eradicate infection. Bioactive glasses degrade in vivo and convert to hydroxyapatite, releasing inorganic ions that can assist the body to heal itself. A bioactive borate glass developed in the MSE department has been used successfully in a clinical trial to heal chronic soft tissue wounds in humans.

Bioactive glass particles and weak porous scaffolds are used to heal small contained bone defects in humans. A challenge has been to develop bioactive glass scaffolds with the requisite mechanical reliability and microstructure to heal large defects in structural bone. Research in the MSE department has shown, for the first time, the ability to create such bioactive glass scaffolds. The approach uses a combination of finite element modeling and additive manufacturing (robocasting) to design and create strong porous bioactive glass scaffolds. Then an adherent biodegradable polymer layer is bonded to the external surface of the scaffold to further improve its mechanical response. The scaffolds have all the desirable characteristics for repairing structural bone: bioactivity, high compressive and flexural strength, a well-controlled porous microstructure conducive to bone infiltration and, most notably, a non-brittle mechanical response with a dramatic improvement in the work of fracture when compared to the bioactive glass scaffold alone. These scaffolds could provide optimal implants for healing structural bone defects.
ASM/S&T MATERIALS CAMP

For the 16th consecutive year, the materials science and engineering department hosted the ASM/Missouri S&T Materials Camp this summer on July 24-29.

Camp co-directors Dr. Scott Miller and Dr. Mary Reidmeyer welcomed 46 high school juniors and seniors from 23 states. The students heard presentations from MSE faculty about current research topics and engaged in a wide range of design projects, including aluminum lost-foam casting, strengthening and coloring of glass, copper electroplating and creating castable refractory ceramic or anti-corrosive metal coatings. They visited the Hot Glass Shop, the foundry, the high temperature and mechanical testing labs, the biomaterials manufacturing lab, and the electron microscopy suite. They also visited the Missouri S&T Student Design and Experiential Learning Center and the MO-SCI Corp., a specialty glass research and manufacturing facility founded by Dr. Delbert Day, Curators’ Distinguished Professor Emeritus of the MSE department.

Campers attend each summer free of charge (other than transportation to/from Rolla), thanks to the sponsorship of the ASM Materials Education Foundation, the Daniel C. Jackling Fund at Missouri S&T and generous donations from Nucor-Yamato, Nucor-Decatur and ArcelorMittal. Over 50 faculty, staff and student volunteers assist in the many activities of the camp throughout the week. The Rolla ASM Materials Camp is one of only three week-long residential camps held each summer, and the only one provided free of charge.

STUDENT TEAM WINS ASM DESIGN COMPETITION

A group of Missouri S&T undergraduates has won third place in the ASM Materials Education Foundation’s 2016 Undergraduate Design Competition for their project, “Reduction of the Adhesion of Fayalite Bearing Scale (Silicon Streak Scale) in CSP Steel Mill Production.” The goal of the project was to alter the conditions in the tunnel furnace to help decrease the amount of scale that causes surface defects.

Team members included Adam Schmitz, Mark Emmendorfer, Charles Campbell and Cameron Rudolph. The project, sponsored by Nucor Steel – Indiana, was completed under the guidance of Dr. Mark Schlesinger, professor of materials science and engineering, and John Lowry.

7 RECEIVE AWARDS

The materials science and engineering department is pleased to announce the 2015-16 awards presented at the annual spring banquet sponsored by the Keramos and Materials Advantage student groups.

• Outstanding Undergraduate Ceramic Student Award: Elizabeth Robinson
• Outstanding Undergraduate Metallurgy Student Award: Margaret Scott
• Outstanding Graduating Ceramic Undergraduate Student: Michael Walden
• Outstanding Graduating Metallurgy Undergraduate Student Award: Anna Bretzke
• Outstanding Ceramic Graduate Student Award: Ryan Grohsneyer
• Outstanding Metallurgy Graduate Student Award: Dan Field
• Outstanding Materials Science Graduate Student Award: Jingjing Qing
WITH YOUR SUPPORT, THERE’S NO LIMIT TO WHAT WE CAN ACHIEVE.

Thank you to everyone who made contributions to last year’s Phonathon. Beginning Oct. 9, a student representative will call you to swap stories about your Rolla experiences, share information about the university and talk with you about making a gift to S&T.

Help keep S&T’s future bright. Answer the call.