

MSE

Materials Science and Engineering | Missouri S&T | Fall 2018

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PEASLEE STEEL MANUFACTURING RESEARCH CENTER UPDATE

The PSMRC, directed by **Ron O'Malley**, is now starting its sixth year of operation at Missouri S&T.

Our steel center has grown to include 18 industrial members: 12 steel mill and foundry producers and six refractory, equipment, and consumables suppliers. The newest members are Timken, which joined the consortium in January, and American Pipe, Spraying Systems and Steel Dynamics, which came aboard in July. This growth increases the center's annual budget to just over \$960,000 to support steel-related research at S&T.

We're also growing our faculty ranks, with **Caizhi Zhou** and **Haiming Wen** from materials science and engineering and **Jie Huang** from electrical engineering joining PSMRC as new principal investigators.

Several students who worked with the research center have also finished their degree programs. **Xin Wang** received his Ph.D. in mechanical engineering for his work on hot working modeling and simulation, while **Daniel Field** received his Ph.D. in metallurgical engineering for his work on third-generation, advanced high-strength dual-trip steels. Wang

has accepted a job offer from Caterpillar and Field has joined Argonne Research Laboratory as a postdoctoral fellow.

Dustin Arvola and **Mark Emmendorfer** also recently completed their master's degree programs through Peaslee-supported projects and joined Steel Dynamics and MetalTek, respectively. In addition, O'Malley won an AIST best paper award for "Inclusion Evolution and Removal in Ladle Refining" at AISTech2018 in Philadelphia and was also awarded the Kent D. Peaslee and Richard J. Fruehan award by AIST this year.

The center's active research projects include non-metallic inclusion engineering in steels; effect of microstructural features on steel machinability; next-generation ladle slag line refractory development; peritectic behavior measurement and prediction in highly alloyed steels; centerline segregation and ductility; interactions with steel and refractory glazes and tundish lining refractories; scale formation and removal in reheating and hot rolling; hot working process optimization; and Ti-Nb-V micro-alloy hot ductility and microstructure.



DEAR ALUMNI, COLLEAGUES AND FRIENDS

On behalf of the students, staff and faculty of materials science and engineering, welcome to the 2018 edition of our annual newsletter.

It's hard to believe that I just completed my first year as interim chair. Frankly, it was the busiest year of my life, but when you are working with the best, time just flies. As promised, we kept our focus on MSE students as our top priority and had a very successful year.

This semester, we have roughly 220 undergraduates and 63 graduate students in the department. That makes us No. 8 nationwide for undergraduate enrollment. And those students are getting jobs.

Research and development productivity also remains on an upward trend, with significant growth in both metallurgical and ceramic engineering. The department had more than \$4.3 million in 2017 research expenditures, and with our growth in faculty I see this trajectory continuing.



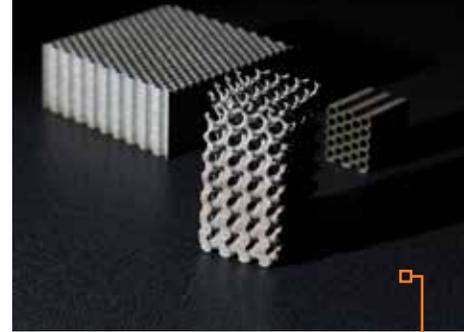
On the faculty side, we bid **Mary Reidmeyer** a fond farewell in December after nearly 20 years of dedicated service. But she didn't stay retired for long, though, as we hired her back part-time to run the hot glass shop. We are in the process of creating an office for her in Fulton Hall so she can be even closer to the action. That said, replacing Mary in the ceramic engineering labs will be a tall order.

We've also hired two new professors, including an alumna. You can read more about **Kelley Wilkerson** and **Anthony Convertine** in the pages to follow.

Of course, we would not be where we are today without you, our alumni, colleagues and friends of MSE. Please stop by next time you're in Rolla so that we can thank you in person.

Warm Regards,

Greg Hilmas
Curators' Distinguished Professor
of ceramic engineering, chair of
materials science and engineering



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Megan Kelso is researching ways to help the pharmaceutical industry identify and separate chiral compounds.

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Danny Drury is adept at throwing Frisbees and flying discs, but thanks to Material Advantage, he makes them too — only these are ceramic.

9 MSE innovation fuels growth in S&T patent royalties

Fiscal year 2017 was a record year for technology transfer at Missouri S&T — and materials science and engineering led the charge.

Professor Joseph Newkirk and Myranda Spratt, a Ph.D. student in materials science and engineering, examine samples of stainless steel alloy that have been designed to be lighter than conventional alloys. The new material is an “open-architecture” design that could be used to make lightweight yet strong materials, according to Newkirk.

NEWKIRK TRAVELS GLOBE AS ALPHA SIGMA MU PRESIDENT TO PROMOTE

“MATERIALS OF TOMORROW”

As a boy, Joseph Newkirk was fascinated by artwork that depicted a sleek, space-age future of flying cars and robotic servants — the stuff of TV shows like “The Jetsons.”

Today, the professor of metallurgical engineering is still fascinated by a space-age future. But Newkirk isn’t dreaming about speedy spacecraft. Instead, he’s thinking about what future materials will be needed to transport people to Mars or make robots stronger.

As current president of Alpha Sigma Mu, the professional honor society for the materials science and engineering profession, Newkirk has been on the road delivering a series of talks in hopes of spurring colleagues to imagine new classes of metals, ceramics and other materials that will help create that not-so-far-fetched future.

In February, Newkirk delivered a talk titled “Creating the Materials of Tomorrow” at the 15th annual Congress

on Materials Research and Technology in Paris. He spoke on a similar topic in Pittsburgh in October 2017 and will do so in November in Rio de Janeiro, Brazil.

In each of these talks, a recurring theme emerges. Historically, the discovery of new materials spurred technological development. These days, however, the opposite is true.

“Technology is advancing much faster than materials are advancing,” says Newkirk. “And what the materials community needs is a clear vision of what we need to turn the latest technological ideas into reality.”

In the past, the development of new materials led to massive technological and societal change that we now take for granted. The development of large-scale steel production in the 1800s led to the construction of bridges, railroad tracks and bolts, nails and screws that led to widespread improvements in infrastructure, industry and trade.

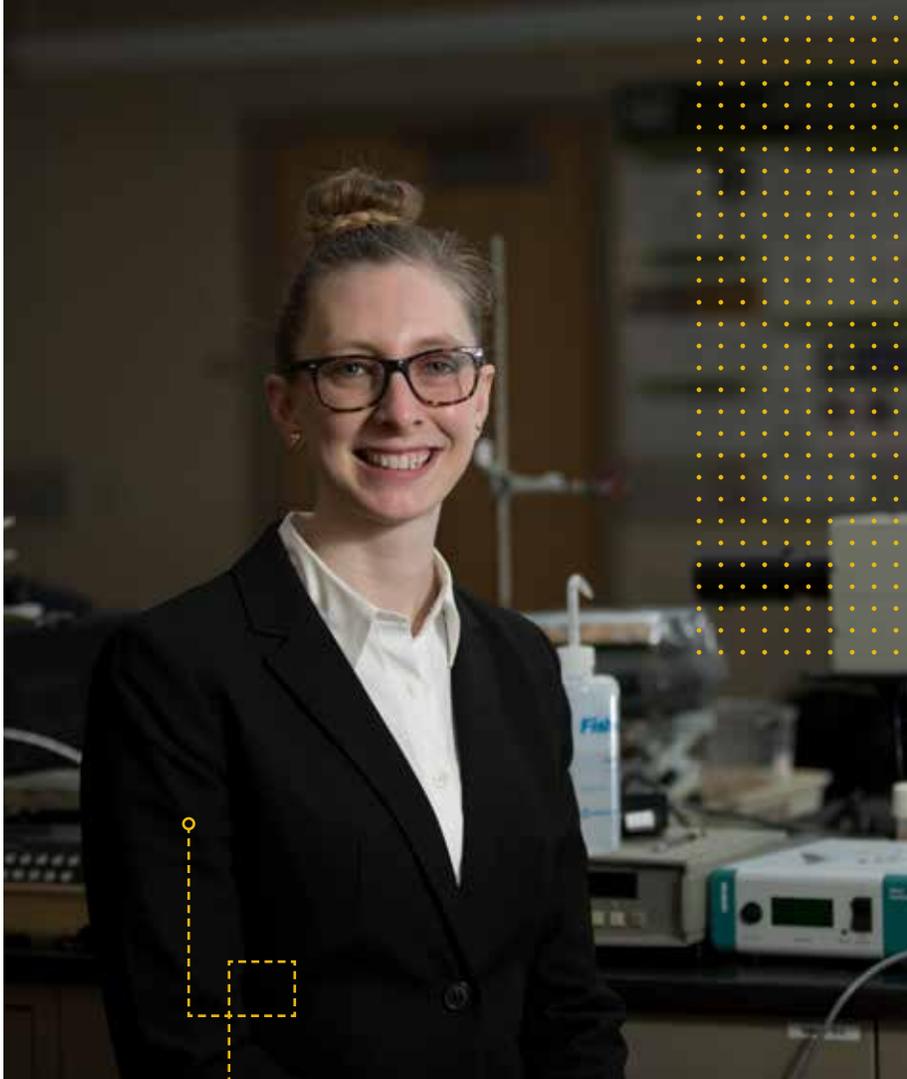
To propel future advances, the materials community needs to develop materials that are lightweight yet strong enough to withstand ultra-high temperatures when re-entering Earth’s atmosphere from a trip to Mars, for instance.

Several efforts by the U.S. government may help spur further development of new materials.

Newkirk points to the federal government’s Materials Genome Initiative, launched in 2011 to accelerate the development and deployment of advanced materials.

Over its first five years, the MGI provided \$500 million in federal support toward developing new materials as well as computational and experimental tools and a digital database to help spur research and development.

Another initiative is NASA’s Advanced Materials and Processing Branch, which supports research to develop advanced materials to support future missions.



DOCTORAL STUDENT WORKS TO IMPROVE DRUG SAFETY, EFFICACY

In the early 1960s, the Thalidomide drug scare caused thousands of worldwide infant deaths and birth defects from a morning sickness medicine for expectant mothers. The disaster transformed drug regulation systems, and changed the pharmaceutical industry's understanding of chiral properties: the notion that molecules with otherwise identical properties are in fact mirror images, like your right and left hands.

Doctoral student **Meagan Kelso** wasn't close to being born when the chiral consequences of Thalidomide first became apparent. But the drug industry's continued efforts to fine-tune how it first identifies and then separates chiral compounds is driving the native Texan's Ph.D. research.

"Chirality is just like your right and left hand," explains Kelso, whose ability to concisely describe her work led to a victory in S&T's Three Minute Thesis competition for graduate students. "Two molecules that have exactly the same chemical compositions — like you have the same five fingers on each hand — but they're arranged differently.

"The molecules, like your hands, are mirror images of each other, and they're not superimposable. So if you put one on top of the other, no matter how much you rotate them, they'll never line up.

"Just like a key, one hand of a molecule is arranged just right to resolve your headache, while the other may do nothing, or cause harmful side effects."

Chiral chromatography is now used to separate the mirror-image molecules known as enantiomers. But that process is pretty costly and time-consuming, Kelso explains.

Kelso's research relies instead on the simpler and less costly process of adsorption — the adhesion of a substance, in an extremely thin layer, to a solid surface — using the combination of thin layers of gold, silver and other materials electrodeposited atop silicon. Silicon(643) is a variation of the common semiconductor that has a two-dimensional chiral surface capable of sensing 3-D chiral molecules.



MSE WELCOMES NEW FACULTY

A pair of new faculty members have joined our department this fall.

→ **Anthony Convertine** is the new Roberta and G. Robert Couch Assistant Professor of Materials Science and Engineering. He comes to Rolla from the University of Washington, where he was a research associate professor of bioengineering on a campus he called home since 2006.

His research interests include polymer synthesis and characterization, targeted drug delivery and cancer therapy. Convertine earned his Ph.D. in polymer science and engineering from the University of Southern Mississippi. He joins **Caizhi Zhou**, who remains a Couch Assistant Professor, and replaces **Mohsen Asle Zaeem**, who has joined the Colorado School of Mines.

Kelley Wilkerson, CerE'07, PhD CerE'12, ← returns to Rolla as an assistant teaching professor after several years at Allied Mineral Products in Columbus, Ohio, first as a senior research and development engineer and, since April 2017, manager of light metals research.



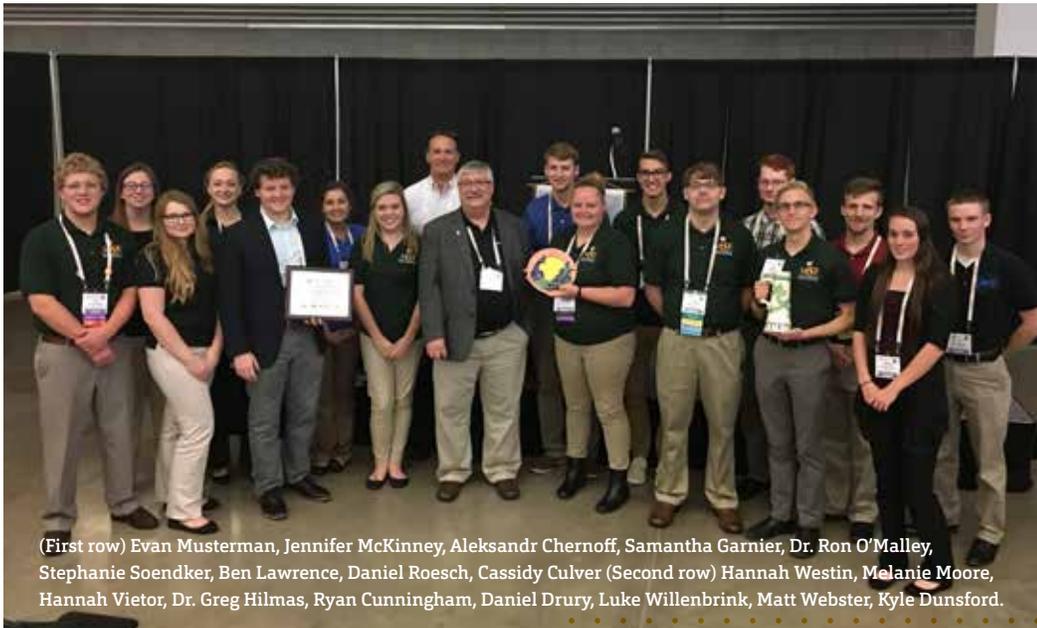
ANTHONY CONVERTINE

Roberta and G. Robert Couch Assistant Professor of Materials Science and Engineering



KELLEY WILKERSON

Assistant teaching professor



(First row) Evan Musterman, Jennifer McKinney, Aleksandr Chernoff, Samantha Garnier, Dr. Ron O'Malley, Stephanie Soendker, Ben Lawrence, Daniel Roesch, Cassidy Culver (Second row) Hannah Westin, Melanie Moore, Hannah Vietor, Dr. Greg Hilmas, Ryan Cunningham, Daniel Drury, Luke Willenbrink, Matt Webster, Kyle Dunsford.



FRISBEE FLINGER TOPS MATERIAL ADVANTAGE DISC GOLF TOSS

As a four-year member of the university's nationally competitive club Ultimate team, senior **Danny Drury** has become pretty adept at throwing Frisbees and other flying discs.

Combine that with his ceramic engineering skills, and you have the recipe for a first-place finish in the Material Advantage national disc golf contest. He was joined at the podium by **Stephanie Soendker**, CerE'17, capping an eight-award performance by MSE students at the Materials Science & Technology 2017 annual conference in Pittsburgh, Pa.

Also earning first-place awards were the S&T chapter of Material Advantage, cited as a Chapter of Excellence; and the S&T affiliate of Keramos, the ceramic engineering professional fraternity, which was named Most Outstanding Chapter.

Drury, who spent the summer as an intern at Sandia National Laboratories, tied for first with a student from Virginia Tech. Both advanced through by successfully

tossing their ceramic discs into a stationary golf basket from increasing distances, topping off at six meters.

At least what was left of the disc.

In Drury's case, his throwing tool cracked in half on his second throw, an occupational hazard of an event that measures the disc's strength and mechanical reliability. The entries must be made entirely from ceramic or glass materials — no metal, plastic or paint, and no commercial-made parts such as rods or pre-woven fiber mats.

The disc made by Drury and senior classmate **Drew Jacobs** was a "zirconia-toughened" alumina composition, Drury says.

"We chose this combination because it is well known to possess high strength and

fracture toughness, which are important for mitigating crack formation and propagation."

He cast the disc using the official team disc of Miner Threat, a 175-gram piece of plastic the club rode to an appearance at USA Ultimate's national championships for small programs. As for the other top finisher?

"It looked like the other winner used a cement-based disc, which survived multiple missed throws from seven meters. One of the times the disc landed in the basket but it bounced out. However, the disc was very bulky which made it difficult to accurately throw."

Here's a look at the other winners from the conference, which 27 undergraduates attended.

- 
 Senior **Henry Dul**, Steel Internship Scholar
- 
 **Ben Lawrence**, third place, student speaking contest
- 
 **Sean Duran**, **Sierra Rasmussen**, **Dan Field** and **Ransom Stamps**; third place, ASM Domesday competition
- 
 Keramos Diamond Award for Exemplary Performance



Photo by George Bridges

LEAVING A LEGACY IN METALLURGICAL ENGINEERING

The steel industry career **Lindell R. "Bob" Hurst** expected when he majored in metallurgical engineering never materialized.

But things have a way of working out, and that's the wisdom Hurst offers to students today.

"You may think you're preparing for a certain profession, but opportunities change that," he says. "You need to be ready to adapt."

Hurst, MetE'74, MS MetE'77, MS EMgt'84, MS EMch'87, grew up in the St. Louis area and applied to two universities: Missouri S&T and Purdue. He says deciding which to attend was easy: "Rolla was just a much better value."

In choosing a major, Hurst went with a smaller program.

"I was a good chemistry student in high school but I didn't want to major in chemical engineering because it was one of the larger departments," he says. "I liked being part of a smaller department because of how well I got to know my classmates."

A summa cum laude graduate, Hurst attributes his GPA to a disciplined disposition.

"I studied from 6 to 10 p.m. every night with only an occasional trip to the vending machine."

He finished his bachelor's degree and earned the first of three master's degrees before joining Monsanto, where he spent 17 years in corrosion and materials engineering, working as a troubleshooter in chemical plants. During this time, Hurst earned two additional S&T master's degrees.

When Monsanto spun off its chemical division as an independent company, Hurst went to work for the spinoff, Solutia. He joined Shell Oil Co. in 2006.

Hurst retired from Shell in 2016 as senior corrosion and materials engineer. He and his wife, **Kathleen**, a University of Missouri journalism graduate, live in the Houston area.

Longtime supporters of the Miner Alumni Association and the metallurgical engineering department, they recently established the Lindell and Kathleen Hurst Endowment, a planned gift that will support a faculty chair and lab fund in metallurgical engineering.

"I was well-prepared for the industry because of my excellent engineering education," says Hurst. "We want our gift to give others that advantage."

HILMAS NAMED DEPARTMENT CHAIR

► **Greg Hilmas**, Curators' Distinguished Professor of ceramic engineering and interim chair of materials science and engineering since July 2017, is our new department chair.

He succeeds **Matt O'Keefe**, MetE'85, who is now executive director of the Haley Barbour Center for Manufacturing Excellence at the University of Mississippi.

"I'm thrilled at the opportunity to continue leading the department I've called home the past 20 years," Hilmas says. "We have a great team of students, faculty and staff here, and are poised to continue to help S&T pave the way toward further innovation and discovery in our disciplines."

Hilmas is known for his work in the field of ultra-high temperature ceramics — those that can withstand temperatures up to 3,000 degrees Celsius. The ceramics, similar in concept to the leading and trailing edges of hypersonic vehicles, such as the space shuttle, could be employed to keep modern hypersonic vehicles (which travel at speeds greater than Mach 5) from burning up as they cruise at extremely high altitudes over longer periods of time than shuttles or Apollo-style capsules.

Hilmas holds a bachelor's degree in materials science and engineering from the University of Minnesota, a master's degree in ceramic engineering from The Ohio State University and a Ph.D. in materials science and engineering from the University of Michigan. He worked in the private sector for several years before joining Missouri S&T in 1998.



GREG HILMAS

Curators' Distinguished Professor of ceramic engineering, chair of materials science and engineering



LARGEST GRADUATING CLASS IN HISTORY

During spring commencement in May, the materials science and engineering department saw the largest class in the department's history. During the ceremony, 34 ceramic engineering students and 13 metallurgical engineering students earned bachelor of science degrees. We also awarded two Ph.D.s and one master of science degree.



ATKINS COMMISSIONS INTO AIR FORCE SPACE UNIT

After completing Total Force Officer Training, **Maggie Atkins**, MetE'14, will assume her rank as second lieutenant in the Air Force Reserves as part of the 19th Space Operations Squadron (SOPS), part of the 310th Space Wing — the only Reserve Space Wing in the Air Force.

"I am very excited to join 19 SOPS," Atkins said in an interview with the 310th Space Wing public affairs office. "It is literally a dream come true to have been accepted into this unit."

Photo by Staff Sgt. Laura Turner

FACULTY HONORS

Our faculty continue to receive both internal and external recognition for their teaching, research and service. Here's a look at some recent honors:



Mohsen Asle Zaeem, Roberta and G. Robert Couch Assistant Professor of materials science and engineering, was named a Young Leader

International Scholar by The Minerals, Metals & Materials Society (TMS) and the Federation of European Materials Society (FEMS). Zaeem recently left S&T for a position at the Colorado School of Mines.



Laura Bartlett, MetE'08, PhD MetE'13, associate professor of materials science and engineering, received an inaugural AIST Foundation Steel

Professor award from the Association for Iron & Steel Technology.



William Fahrenholtz, Curators' Distinguished Professor of materials science and engineering, received the ACerS Global Ambassador

Award for volunteer service and leadership. Fahrenholtz was also inducted into the World Academy of Ceramics and named editor-in-chief of the ACerS Journal.



Greg Hilmas, Curators' Distinguished Professor of materials science and engineering and department chair, and **Jeff Smith** (at

left), professor of materials science and engineering, received Outstanding Teaching Awards from S&T for 2016–17.



Wayne Huebner, CerE'82, PhD CerE'87, professor of materials science and engineering, received the Outstanding Educator Award from the American Ceramics Society (ACerS).



Joseph Newkirk, professor of metallurgical engineering, received a 2017 Missouri S&T Faculty Research Award. Newkirk, the current president of

Alpha Sigma Mu (see p. 2), also delivered the organization's lecture at the Materials Science & Technology (MS&T) 2017 annual meeting.



Ron O'Malley, the F. Kenneth Iverson Endowed Chair of Steelmaking Technologies and director of the Kent D. Peaslee Steel Manufacturing

Research Center, accepted the nomination to become AIST president in 2019–20. O'Malley is currently second vice president of the organization's board of directors.



F. Scott Miller, PhD MetE'99, teaching professor of metallurgical engineering, received a 2017 Missouri S&T Faculty Achievement Award.



David Van Aken, Curators' Distinguished Teaching Professor of metallurgical engineering, was named an ASM International Fellow at MS&T 2017. The

award cited his "distinguished contributions" as an educator and his work developing new manganese steels for lightweight military armor and automotive steel.

DAY, SCOTT RECEIVE S&T AWARDS OF PROFESSIONAL DISTINCTION

A prominent local business owner and a distinguished alumnus — both with strong ties to our department — received the university's Award of Professional Distinction during spring commencement ceremonies in May.

Ted Day of Rolla is CEO and owner of Mo-Sci Corp., the company founded by his father, **Delbert E. Day**, CerE'58 and Curators' Distinguished Professor emeritus of ceramic engineering. He joined Mo-Sci in 1998 as executive vice president before becoming sole owner in 2007. The company manufactures high-tech glass products for the health care, automotive and aerospace industries and has been internationally recognized for innovative product development.

Day holds six U.S. patents and has authored several technical publications and presentations. He is a member of the American Ceramic Society and Sigma Xi Research Society, chairman of the Ceramic and Glass Industry Foundation and past chairman of Phelps County Regional Medical Center. He holds a bachelor of science degree in pharmacy from the University of Missouri-Kansas City.

Danny Eugene Scott, MetE'70, of Montgomery, Texas, retired from Baker Hughes after a nearly 50-year career at the company and one of its forerunners, Hughes Tool Co.

Scott served in a variety of engineering and management roles,

primarily involved in developing innovative solutions for drilling oil and gas wells. He produced over 150 U.S. patents and authored 65 publications, as well as textbook chapters. He is an ASM International Fellow and a distinguished member of the Society of Petroleum Engineers.

At S&T, he served on the Metallurgical Engineering Advisory Board and is currently on the Industrial Advisory Board for petroleum engineering and geology and geophysics. He was inducted into the Academy of Mines and Metallurgy in 2013 and has been a frequent speaker on campus, including at the S&T Energy Symposium.





THE INNOVATOR'S TOOLBOX

As a Ph.D. student at S&T, **Martin Perez** dove deep into studying the effects of molten metal corrosion and the use of alloy powders in alkaline batteries.

He's since spent more than a decade working in corporate research and development, collaborating on defense industry contracts involving solid-oxide fuel cell plates, refractory metals and repair technologies for nickel-based, high-performance alloys.

But when Perez, an R&D engineer for the industrial technology company Kennametal Inc., returned to campus in October 2017 to deliver the ninth annual Dr. Thomas J. O'Keefe Lecture, there was little to no discussion about powder metallurgy. Instead, the guest lecturer focused on what he calls the "secret to innovation: applied imagination."

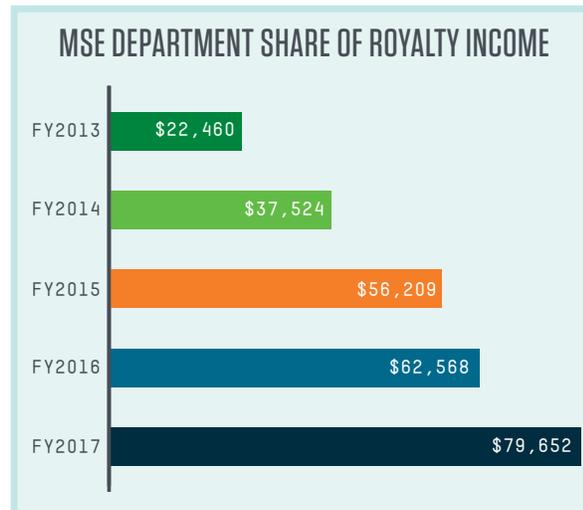
"You need a creative toolbox," says Perez, MS MetE'00, PhD MetE'05. "Creativity can exist without innovation. But innovation cannot exist without creativity."

The lecture series was created in memory of **O'Keefe**, MS MetE'58, PhD MetE'65, a Curators' Distinguished Professor emeritus of metallurgical engineering, spending a total of 55 years on campus. The lecture series is funded by **Joe**, MetE'72, and **Sally Rupp**. Joe was a student of O'Keefe's.

MSE INNOVATION FUELS GROWTH IN S&T PATENT ROYALTIES

Fiscal Year 2017 was a record year for technology transfer at Missouri S&T — and MSE led the charge.

In fact, MSE has been leading this charge for many years as the university has made a push to patent and license technology. Departmental patent royalties have grown annually the past four years, increasing from \$22,460 in FY2013 to nearly \$80,000 in FY2017.



A large share of this income is due to the efforts of **Delbert Day**, Curators' Distinguished Professor emeritus, and his research and development of irradiated glass beads for the treatment of liver cancer known commercially as TheraSphere.

Day's work led to additional bioactive glass patents held by him, **Roger Brown**, professor emeritus of biological sciences, and **Steve Jung**, CerE'05, MS CerE'07, PhD MSE'10, whose Mirragen wound care product grew out of his graduate research and subsequent work at Mo-Sci

Corp., the spinoff company Day helped start and now run by his son, Ted.

Another group of patents that have generated significant income are based on the non-chromate coatings research and development of **Tom O'Keefe**, MetE'58, PhD MetE'65, **Matt O'Keefe**, MetE'85, and **Jim Stoffer**, emeritus professor of chemistry. Finally, research by ceramic engineering professor **Fatih Dogan** on supercapacitors has been generating income for four years now.

The future continues to be bright, with 14 additional patents issued for Missouri S&T in FY2017 — eight of which have at least one MSE faculty member as an inventor.

VAN AKEN, REIDMEYER RETIRE



After 25 years in the department, **David Van Aken** is bidding us farewell. So has **Mary Reidmeyer** — but she's not going very far.

Before leaving in September, Van Aken compiled a slew of honors at S&T, most recently being named an ASM International fellow in 2017. He received 14 campus awards for teaching excellence, 11 departmental faculty excellence awards and four S&T faculty excellence awards, and served as associate dean for research and graduate studies in the former School of Materials, Energy and Earth Resources. He was named a Curators' Distinguished Teaching Professor in 2008.

Reidmeyer, CerE'78, MS CerE'84, PhD CerE'89, was named the inaugural recipient of the Dr. Elizabeth Cummins Women's Advocate Award in April 2017, eight months before her retirement after two decades here. You can still find her running the Hot Glass Shop, though, working part-time in Fulton Hall.

The teaching professor of ceramic engineering and outreach coordinator was pivotal in helping to double undergraduate enrollment in ceramics, with women accounting for 50 percent of the growth. She co-directed the S&T Materials Camp, coordinated our department's Jackling Introduction to Engineering curriculum, and mentored generations of future female scientists and engineers.





RENAISSANCE MAN

A recent ceramic engineering graduate who also studied art and worked on campus theatrical productions received the 2018 Missouri S&T Renaissance Student Award.

Daniel Roesch, CerE'18, graduated in May with minors in chemistry and studio art. He also found time to explore glass blowing, sculpture, calligraphy, Chinese art history, copper forming and work as a Leach Theatre technician.

The award from S&T's College of Arts, Sciences, and Business and the arts, languages and philosophy department included a \$1,000 prize. Its name stems from the term "Renaissance person," originally coined to describe the great philosophers of the Renaissance and Enlightenment eras, including Leonardo da Vinci, who were experts in numerous fields.

S&T faculty say Roesch exemplifies the characteristics of a Renaissance student through his engagement in a breadth of subjects.

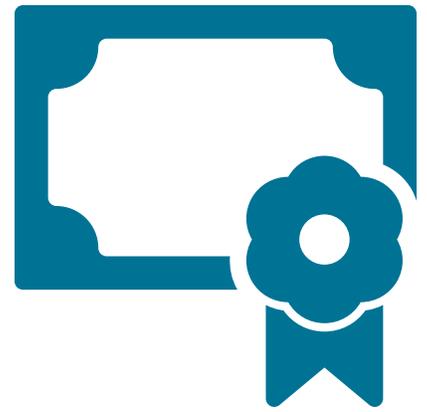
"Of all the students I have interacted with in the last 10 years, Daniel stands out as a student with much greater curiosity and breadth of interests than others," says **Mary Reidmeyer**, a recently retired teaching professor of ceramic engineering.

Roesch was an honor roll student every semester during his time at S&T, a member of Keramos, the ceramic engineering professional society, and Gaffer's Guild, a student-run glassblowing organization.

WITH YOUR SUPPORT,
THERE'S NO LIMIT TO WHAT WE CAN ACHIEVE

Thank you to all of our alumni and friends who contributed to last year's Phonathon. This fall, 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 MSE's future bright. Answer the call.



FREUDENBERGER EARNS CEC HONORS

A materials science and engineering doctoral student was honored by the university's College of Engineering and Computing (CEC) for her teaching excellence.

Parker Freudenberger was among 18 graduate students to earn CEC recognition for their classroom prowess or scholarly productivity. She's a Graduate Assistance in Areas of National Need (GAANN) fellow whose research involves the development of phosphate and borophosphate glasses for optical and biomedical applications.

Freudenberger took on significant teaching responsibilities in the 2016-17 academic year when her advisor, **Richard Brow**, Curators' Distinguished Professor of ceramic engineering, served as interim CEC dean.

"Parker taught my fourth-semester lab course, and she covered many of the lectures in my Introduction to Glass course, in a way, quite frankly, that made the students forget that I was involved," Brow says. "She is a conscientious, creative and patient teacher, one who has a reputation among our undergrads as someone who can answer any question about glass science or technology."

Freudenberger was one of 10 doctoral students designated as inaugural Dean's Graduate Educators. Each student was recognized and honored at an end-of-semester campus reception in May. The award winners were nominated by professors in their home departments, then selected by a department committee or department chair for college consideration.



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