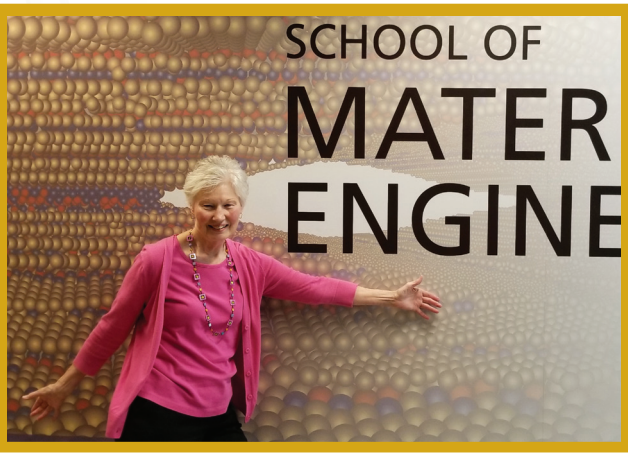
Materials Matter @Purdue

2018 Annual Newsletter



Donna Bystrom Retires

AFTER 4 DECADES OF LOVING SERVICE TO MSE

PURDUE UNIVERSITY

Materials Engineering

A Message from the Head

inside

MSE Alumni, Students, and Friends:

As I type this letter, summer seems to be flying by on campus. We are getting labs ready for the 2018-19 school year, setting up new facilities for research, teaching more summer students than ever before (including our first online, off campus undergraduate course as a pilot), and in general wondering where the summer went. We have had a busy couple of years onboarding new faculty, and we have a few more searches underway. But being busy is a good problem to have. And we have another significant change that will have happened by the time you read this; after 48 years of service to Purdue, and 40 to MSE, Donna Bystrom will have retired. She is irreplaceable, but we will have a new person in place soon to try to keep us on track.

On the student experience side of things, we're fully into our plan for teaching many of our core undergraduate courses twice a year. This ensures the classroom will still have that personal feeling our faculty and students expect (and our alumni remember) and still allow us to be on track to graduate over 70 students per year (we crossed 200 enrolled sophomores, juniors, and seniors last year). Our graduate students continue to be one of the strongest assets to the school; with over 150 PhD students, we have one of the highest PhD student/faculty ratio in the College. Last year we spent over $16M in external grants to support our students and research activities, coming from grants from the federal government (≈$11M), industry partners (≈$3M) and the State of Indiana (≈$2M).

You might be wondering where all of this takes place; MSE now has a presence in 10 different buildings on and off campus. As this goes to print, the MSE faculty focused on thin films research are setting up in the new Flex Lab Facility (FLEX) (where some of the old married student housing buildings were located). They are moving equipment from the Neil Armstrong Hall of Engineering (ARMS) into FLEX, making room for expanding our teaching labs (we want to keep our undergrad courses in ARMS). And we're about to undertake almost $2M in improvements in the off-campus building on Kepner Drive (near the Caterpillar plant), which is home to many of our faculty working in the Laboratory for Advanced Materials Processing. We aim to be the School where industry partners in the state, region, and world can come to develop new materials at scale, and in all the categories of materials we embrace, from high temperature metals and ceramics to polymers and composites and down to new semiconductor nanomaterials. These facilities don't just benefit our graduate students, over 50% of our undergraduates are working on research projects with faculty on campus.

And one last thing I want to mention: We have about 12 months to go in the Ever True campaign (Purdue's 150th anniversary and the 50th anniversary of the moon landing). We will be having quite a few events during this upcoming year, so keep your eyes out for emails, Facebook, and LinkedIn postings of events. I hope to see you in person.

Hail Purdue,

Dr. David F. Bahr
Professor and Head
of Materials Engineering

PURDUE UNIVERSITY | Materials Engineering
COLLEGE OF ENGINEERING

SCHOOL OF MATERIALS ENGINEERING

The John A. Edwardson Dean of the College of Engineering and the Roscoe H. George Professor of Electrical and Computer Engineering • **Dr. Mung Chiang**

Head • **Dr. David F. Bahr**

Director of Development • **Robyn Jakes**

www.engineering.purdue.edu/MSE

Materials Matter@Purdue is published by the School of Materials Engineering at Purdue University for alumni, faculty, students, corporate partners, and friends.

We welcome your comments, opinions, and questions. Please send them to the following address:

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701 West Stadium Avenue
West Lafayette, IN 47907-2045

To make a gift to the School of Materials Engineering, please contact:

Robyn Jakes
Director of Development
765-494-4094
rnjakes@prf.org
Or click the "Giving" link on our homepage.

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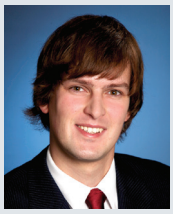
Visiting Assistant Professor



Dr. Wolfgang Rheinheimer joined the School of Materials Engineering as a visiting assistant professor in January 2018. Dr. Rheinheimer received his Diplom in Industrial Engineering and his Doctorate (PhD) in Mechanical Engineering from Karlsruhe Institute of Technology (KIT) in 2009 and 2013, respectively. Following his PhD, from 2013-2015, Dr. Rheinheimer worked as a postdoctoral researcher at the Institute of Applied Materials at KIT in cooperation with Robert Bosch GmbH. In 2016, he was appointed as Group Leader in the Institute of Applied Materials at KIT where he supervised research in the field of sintering and grain growth in perovskite ceramics. His research interests at Purdue will center around the fundamentals of microstructural evolution of functional ceramics, specifically, impact of electric fields, impact of defect chemistry and atomic grain boundary structure. In addition he will also study synthesis, sintering and electrical properties of functional ceramics.

Faculty Promotions

Professor Lia Stanciu promoted to Associate Head

Professor John Howarter promoted from Assistant Professor to Associate Professor

Professor Kendra Erk promoted from Assistant Professor to Associate Professor

The inaugural Richard E. Grace Best Faculty Research Grant was presented to **Professor Haiyan Wang**. This award recognizes a faculty member annually, whose research program and professional development show the greatest innovation, scholarship and professional recognition.

Professor Wang is the Basil S. Turner Professor of Engineering with joint appointments in Materials Engineering and Electrical and Computer Engineering. Dr. Wang conducts research in electronic materials, nanocomposite design; functional oxides and nitrides for multiferronics, ferromagnetic, plasmonic and photonics, batteries, fuel cells, and high temperature superconductors, and radiation tolerant materials. She has over 400 journal publications, 230 conference presentations and 50 invited talks. In the past two years, she has published or has had accepted 33 publications. At present, she has two NSF grants, three Naval Research grants, and one grant from the Department of Defense (DOD). Professor Wang is an American Physical Society (APS) Fellow, an American Association for the Advancement of Science (AAAS) Fellow and an American Ceramics Society (ACerS) Fellow.

Recent Faculty Awards

Mysore Dayananda
Distinguished Teaching Award – ASM International

Albert Nelson Marquis Lifetime Achievement Award – Who's Who

Anter El-Azab
Professional Development Committee – The Minerals, Metals & Materials Society (TMS)

Michael Titus
Early Career Faculty Fellow - The Minerals, Metals, & Materials Society (TMS)

Xinghang Zhang
Brimacombe Medalist – The Minerals, Metals & Materials Society (TMS)

Alejandro Strachan
Reinhardt Schuhmann Jr. Best Undergraduate Teacher Award

Professor Carol Handwerker was named a Fellow of the Minerals, Metals, & Materials

Society (TMS) for her national leadership across the field of electronic materials packaging, from structure evolution in ceramics to Pb-free solder replacements. Learn more: ***bit.ly/HandwerkerTMSFellow***

Welcome New Faculty Member

Dr. Rahim Rahimi will be joining the MSE faculty as an Assistant Professor in January 2019. He earned his BS (2009) and MS (2012) degrees in Electrical Engineering from the Iran University of Science and Technology, and his PhD (2017) degree and post-doctoral (2018) in Electrical and Computer Engineering from the Purdue University, USA. His research has explored development of innovative, scalable, multifunctional,

microsystem platforms for medical applications, with emphasis on smart wearable and autonomous devices for wound monitoring and therapy. His research on smart dressing for burn victims and stretchable embroidered electronics has been featured in various news media, including Science Nation, Science360, The Computer World, and Science X. During his graduate and post-graduate career, he has co-authored over 50 publications in world renowned journals and international conferences as well as book chapter and patents. Dr. Rahimi has also has led research teams on multi-institutional research endeavors focused on developing scalable manufacturing processes of flexible electronic devices that can empower technologies for health-care and precision agriculture.

Smooth Landing:
New Material Melts Snow from Airport Runways


Martinez


Youngblood

Carlos Martinez and Jeff Youngblood are no strangers to airplane travel. The Purdue Materials Engineering professors fly to conferences and research meetings. Soon, they could be taking off and landing on runways made safer by a novel material they have developed to melt snow on runways.

Tiny capsules inserted in airport runway asphalt to melt snow could save airport authorities millions of dollars in plowing and de-icing costs. The research conducted by Martinez and Youngblood is focused on microencapsulated phase change materials with poly(urea–urethane) (PU) shells containing cellulose nanocrystals. When cooled, the stored thermal energy in the capsules can be released because of the phase-changing materials' high heat of fusion. This heat can delay or prevent ice formation on the surfaces of buildings, pavement, and runways.

The longer newly fallen snow sits on a surface and undergoes temperature change the more likely it is to transform to ice and form a tight bond with the pavement. This bond makes it more difficult to remove, so quick action on the part of snow removal teams is necessary. FAA regulations prohibit most aircraft from operating on runways covered by untreated ice or by more than ½-inch of snow or slush.

Snow removal at airports is not as simple as home or city street removal. Runways require special polyurethane plows that won't leave potholes in the runways, brushes, chemicals that won't corrode aircraft metals, and much more that is detailed in a long FAA document. It is little wonder the agency is interested in economical and efficient ways to remove newly fallen snow and extend the life of asphalt runways.

Phase-changing materials have been in existence for several decades and are used in thermal protection, energy storage systems, and as electronic active and passive cooling systems in concrete structures. They produce a significant amount of thermal energy (latent heat or heat of fusion) through their phase transformation from liquid to solid. The challenges are that they generally suffer from supercooling, low heat conductivity, large volume changes, and decomposition upon melting. The material also must last for about 10,000 thermal cycles, or about 20 years of operational service. The runway research is funded by the Federal Aviation Administration (FAA).

Martinez and Youngblood are focused on poly(urea–urethane) as a superior material for encapsulation technologies. It offers low toxicity, high elongation, high tensile/tear strength, wear resistance, flexibility, and high toughness, with low stiffness. The addition of nanoparticles into PU resins is a well-known approach to overcoming this deficiency, but the resins are often brittle.

The researchers found that by incorporating cellulose nanocrystals (CNCs) in the microcapsule shell, they were able to overcome this weakness and create strong and flexible shells and increase thermal conductivity. The CNC material is sustainable, can be used as an asphalt additive to regulate temperature, and can be manufactured in an easily scalable process. And it may be the key to ice-free, plow-less runways.

Asphalt + PCM Microcapsules

"In general, PCMs can help with cracking and pothole formation due to freeze-thaw cycles. However, they have been stymied by a variety of factors," Youngblood says. "In this case, encapsulation helps with keeping the PCM from bleeding away, but usually capsules are too weak and break during mixing/processing. Our CNC-based encapsulation can strengthen the capsule walls to prevent breakage."

The asphalt-additive snow-melting material developed by Martinez and Youngblood would be appropriate for regional airports in a region ranging from Indiana to Oklahoma where temperatures do not get much colder than 37F. This could include airports in Indianapolis and Louisville. Larger airports have runways made of concrete, which is more durable and can take repeated hits from aircraft landings.

Martinez, whose doctoral work at the University of Illinois focused on ceramic films, has long been interested in research with an impact on daily life. As a post-doctoral fellow at Harvard, he became fascinated with research that examined emulsion and the behavior of droplets within other droplets. This was a precursor to his current expertise in encapsulation. Youngblood's research interests are in polymers, surface science, advanced processing of materials, and sustainable materials. He had previously developed a technique to modify CNCs when he began collaborating with Martinez and applied the technique to encapsulating phase-changing material.

The team's runway material research is now ready for trial, which requires manufacture of enough .10 mm capsules to test in a 4-meter x 4-meter x 5-inch patch of asphalt. Martinez estimates this will require about 200 liters of material, which is significantly more than the 15-gram quantities produced in the lab. He and his team are making a vessel large enough to create the required test lot. Once the material has been produced, they will hand it over to Professor John Haddock in Civil Engineering, who will mix it with an asphalt binder and aggregate, and lay it. The process could be easily scaled up for commercial use.

Martinez says the researchers hope the material will reduce costs associated with snow removal in states that do not have significant snow precipitation, will extend the life of runways, and enhance sustainability. "As CNC is derived from biomass, by its very nature it is sustainable," Youngblood adds. "If we can get phase-changing materials into wider use, then roads (and runways) may last longer, which would be an added sustainability metric."

Turning Rocks into Copper:
Extractive Metallurgy and Exergy

I am a second year Ph.D. candidate in the School of Materials Engineering. As an undergraduate, I attended the University of Arizona in my hometown of Tucson and majored in Mining Engineering with an emphasis on extractive metallurgy and mineral processing; I also minored in Chemical Engineering.

My choice of Purdue for graduate studies was a slow process that went smoothly thanks to the help of many people, especially my parents, and it really stretches all the way back to my freshman year. My freshman year in mining I was not certain what specific direction to take my studies. I was interested in extractive metallurgy, rock mechanics, mine-construction, and so on. Mining really has a lot of different facets! Thanks to the mentorship of Professors Moe Momayez and J. Brent Hiskey, who both granted me the favor of doing research as an undergraduate in their labs, I discerned extractive metallurgy was the area I was most interested in. This interest was allowed to bear fruit especially thanks to Mr. Tom Bolles and Dr. Jodi Robertson, my supervisors and mentors at Freeport-McMoRan Inc's Tucson Technology Center, and Professor Mary Poulton, who put me in contact with them. For three summers, I had the opportunity of researching (and sometimes solving) real extractive metallurgy challenges as part of the Technology Center team. These experiences both confirmed my desire to go to graduate school and helped me get a better idea of what I wanted to research. In the spring of 2016, at the recommendation of Dr. Hiskey, I applied to and visited three graduate materials engineering schools, and needless to say, picked the best one.

My graduate research is with Professor Matthew Krane on modeling irreversibilities in the copper pyrometallurgy process and associated processes, such sulfuric acid manufacture and air distillation. These processes consume large amounts of useful energy, useful meaning can be used to do work. No process destroys energy, however, the vast majority destroy part of its usefulness by converting the useful fraction of the energy to unrecoverable heat. By modeling processes, we can get an estimation of where and how much usefulness is being destroyed. We can also find "losses" of this usefulness, that is, outflows of energy that can still do work, but are not recovered. Once these destructions and losses have been identified, work can begin on reducing or eliminating them, potentially leading to large energy savings and corresponding reductions in environmental impact and cost.

The research already conducted by our group shows that changes to the copper smelting process, for example, increasing the oxygen enrichment in the blow air, can save megawatts of power. The models also show what cost this irreversibility savings has, e.g., increasing the oxygen grade in the smelter could lead to increased copper losses to smelting slag, or unacceptably low throughputs needed to keep the temperature manageable. Findings like these give an estimation for the effects of process changes that allow real operations a better idea of what process parameters to change to try to improve their process than cruder calculations or unadorned intuition. Our findings are directly applicable to copper smelting sites but can also serve as a basis to model other industrial processes, like steel or titanium making.

When I am not in class, studying, or enraptured in trying to make a model work, I enjoy going to the gym, dancing tango, and reading mystery books or books on art or history (or both). If I have an especially free weekend, I might spend it hiking or heading up to Chicago. To use one of my parents' favorite expressions, "Never a dull moment;" well, usually.

Recent Staff Awards

Stacey Coar with Dr. Mung Chiang, John A. Edwardson Dean of the College of Engineering, Roscoe H. George Professor of Electrical and Computer Engineering

For her steadfast commitment, natural leadership and her people-first outlook in the School of Materials Engineering that ensures a pleasant and open culture for faculty, staff, students and visitors, while engaging alumni through coordinated communication channels, **Stacey Coar** received the College of Engineering Customer Service Excellence award. This award is bestowed upon a staff member who exhibits a consistent pattern of congenial behavior to all contacts, leads by example, exhibits a positive attitude, and develops a creative or innovative method for providing or improving customer service.

Shannon Heidrich with Dr. Mung Chiang, John A. Edwardson Dean of the College of Engineering, Roscoe H. George Professor of Electrical and Computer Engineering

For her enthusiastic advocacy for expanding safety training procedures to establish prudent practices in a laboratory environment within the School of Materials Engineering and introducing new tactics for researchers to seek technical advice to broaden their skillsets, **Shannon Heidrich** was recognized by the College of Engineering as a finalist for the New Employee Excellence Award. This award honors a staff member who has been employed by the College for less than two years and who demonstrates uncommon initiative on the job.

Timothy VanMeter has been promoted from Lab Technician to Lab Coordinator. In his new position, he will support instructional and research laboratories, maintain associated equipment including ordering supplies, supervise other technical staff, and provide recommendations for laboratory improvements.

Donna Bystrom Retires
after 4 decades of loving service to MSE

Donna started her long service to the School of Materials Engineering in 1978 when she started as "Secretary to the Head," with Jerry Liedl at the helm. She then served as administrative assistant for subsequent heads, Alex King, Keith Bowman, Elliott Slamovich (Interim) and Dave Bahr. She is the longest serving administrative assistant in the College of Engineering, with 40 continuous years of keeping the School of Materials Engineering and hundreds of our students on track.

Donna has performed her varied responsibilities and duties to the MSE faculty, students, and alumni of the School wearing many hats including those of office manager, record keeper and archivist, and coordinators for hiring, alumni relations, development, hospitality, and corporate relations. She supervised the physical moves and relocations of the School of Materials Engineering twice: first from CMET to MSEE building in 1988 and second from MSEE to ARMS building in 2007.

Making a personal connection with every student who enrolled in MSE, Donna knew their names, prepared their class photos, and helped them with their every need outside of the classroom. In short, Donna dedicated herself to serve all enrolled MSE undergraduate and graduate students. She played an equally vital role in faculty and staff development. Donna shepherded the MSE faculty promotion and tenure cases for decades assisting the faculty in the preparation of their documents to ensure clarity and correctness. She has been exceptional in her interactions with clerical staff including their training, scheduling, and staffing times. Her volunteerism to help with events like senior banquets, and graduation night receptions are also quite well known.

Donna has been the glue to link all the alumni, who love to be in touch with her informally through phone calls, letters and emails. She has tracked their careers and prepared nominations for various alumni awards, such as OMSE and DEA. She has been the chief organizer of faculty receptions on campus and at professional society meetings.

Donna's door was always open to all sharing their achievements and heartbreaks. She has a passion for listening and guiding those who need help—with a sick child, work issue, divorce, or a death in the family. Her heart and mind guide her love for the students, faculty and staff—they are her MSE family!

Donna's outstanding capacity for empathetic human interactions with students, staff, faculty, alumni, and visitors was recognized by the College of Engineering through the Staff Leadership Award of Excellence in 2005 and her long, dedicated service to Purdue, by the Provost at a recognition luncheon in 2006. She was also honored with the 2016 Eudoxia Girard Martin Memorial Staff Recognition Award for her unique "qualities of heart, mind and spirit that evince a love for and helpfulness to students, faculty and staff."

Donna has been an exceptionally dedicated member of the School of Materials Engineering and truly an outstanding representative of Purdue to all who came into contact with the School. She helped watch over and care for over 1100 MSE students (now alumni), most of whom she can still call out by name. More than half of all the MSE graduates of all time (around 1900 living alumni) remember Donna as the first one that greeted them as they joined the school, and the last one that bid farewell upon graduation.

As Donna embarks on her retirement in August 2018, all of us, her entire MSE family - past and present students, alumni, faculty and staff - express our grateful thanks for her four decades of loving service to MSE and wish her a golden period of relaxation and exploration ahead.

2016 Eudoxia Girard Martin Memorial Staff Recognition Award

Early 1980's

2007

Donna Bystrom with MSE alumus, Mike McCulley

Donna enjoys a ride on the Boilermaker Special

"When I go to see Donna, she always says to me: Welcome home. We are so glad to see you again."

WILLIAM SHROPSHIRE, JR.,
President, American Chemet Corporation
(DEA 2000)

The Donna L. Bystrom Undergraduate Service Award

The MSE staff depends very heavily on our students as we continue to increase the visibility of Materials Engineering. The Donna L. Bystrom Undergraduate Service award will be given annually to a student or students who exemplify servant leadership by actively volunteering within the School. Preference will be given to a senior who demonstrates a consistently positive attitude, willingly represents MSE at various events, mentors other students to become involved and has a genuine desire to uphold the reputation of the School. The recipient of this award will be selected by a committee comprised of the MSE staff in consultation with the MSE Department Head.

MAKE YOUR GIFT ONLINE TODAY!

giving.purdue.edu/DonnaBystrom

GIFTS CAN ALSO BE MAILED TO: The Dauch Alumni Center,
403 West Wood Street, West Lafayette, IN 47907-2007.
Please make checks payable to: ***Purdue Foundation***.
Please include code **15529** on the memo line of your check.

Questions? Contact Robyn Jakes at 765-494-4094 or rnjakes@prf.org.

Your contribution will be commingled with the funds of other donors in support of an endowment for the benefit of The Donna L. Bystrom Undergraduate Service Award. Funds contributed for this purpose will be used to create an endowment, which requires a minimum of $25,000.00 within five years. Once the minimum is reached, the revenue will be used to support the above mentioned endowment. If this minimum is not reached within five years, then the amount in the fund will be used for non-recurring expenses. However, if less than $10,000 is received within two years of its establishment, all funds and future funds will be distributed as non-recurring funds to support the purpose described above.

"In all my experience with Purdue staff, no one showed more compassion and spirit then Donna Bystrom. She bleeds black and gold from the bottom of her heart and instills that passion and motivation in the students."

DUSTIN RUH
Commercial Director, Arconic
(OMSE 2017)

Gary Kleinedler:
A ticket to the world of possibility

As a high school student in the Chicago suburbs, Gary Kleinedler (BS Metallurgical Engineering '59) was fascinated with science and how things worked. His chemistry teacher encouraged him to try chemical engineering, and he chose to do so at Purdue. The year was 1955. It was the beginning of what he likens to an adventure that became "one of the best experiences of my life."

That fall, Kleinedler moved into Purdue's Cary Quad, where he would live all four years as an undergraduate. He began the freshman engineering courses that gave an overview of all disciplines, and was intrigued by the course on metallurgy, and its introduction to welding, heat-treating, and casting. The discipline appealed to him more than chemical engineering and its required organic chemistry.

Life in the dorms was a mix of studies and fun. There, Kleinedler gave and received academic help, benefitting from older roommates who knew advanced calculus, while working with new engineering students on entry-level classes. He recalls lively—sometimes-crazy—times with fellow members of the Metallurgical Engineering Class of 1959, one of whom was Sam Hruska (1936-2006), whom he describes as an inveterate jokester and shenanigan-leader who later joined Purdue's Materials Engineering faculty. Kleinedler has continued to exercise his adventuresome spirit well into life as a commercial hot air balloon pilot, participating in festivals including the world-famous International Balloon Fiesta in Albuquerque, New Mexico.

Though graduating seniors sponsored an annual faculty roast, where Kleinedler says, "we chafed our professors mercilessly in a final conclusion to our experiences at the school," they had great respect for the faculty. Kleinedler studied under Reinhardt Schuhmann Jr. (1914-96), who had arrived from MIT in 1954 and would in 1959 become founding head of Purdue's School of Metallurgical Engineering, and Richard E. Grace, a professor only a few years older than the students. "They were outstanding educators (who were) easy to talk to, helpful, and a pleasure to be with both inside and outside the classroom. Both men offered their advice, coupled often with a challenge to do better, to think in broader terms, be aware of new ideas, and think outside normal boundaries," Kleinedler says.

The Metallurgical Engineering Class of 1959 was the largest up to that time, with some 32 students. Kleinedler points out that Purdue's 2018 Materials Engineering school now has about that many people on its teaching staff, a testament he says to how the discipline has expanded in 59 years.

Between his junior and senior years at Purdue, Kleinedler participated in a six-week program in the physical chemistry of metals and modern metal physics at Rensselaer Polytechnic Institute that was sponsored by General Electric's Schenectady Research Labs. GE later offered him a graduate scholarship to the University of Michigan. Following the first year of studies there, he spent the summer as a metallurgist at Teletype Corporation in Skokie, Illinois, exploring the development of post-weld tempering of high carbon steel. He received a Master of Science degree in Engineering (Metallurgical Engineering) from Michigan in 1961, and hired on as an engineer at Bell System's Western Electric Engineering Research Center (ERC) in Princeton, New Jersey, which had been established only three years prior.

Kleinedler's first ERC project involved "dirty" metallurgy: reclaiming Bell System scrap insulated wire and cable by adapting a new process of furnace refining and continuously casting and drawing copper wire (Properzi Process). Over the next 22 years at ERC, some of his other projects included ultrasonic and micro bonding to thin films, non-destructive testing using liquid crystals, weld repairing undersea Trans-Atlantic telephone cable, in-situ repair of central office telephone relays, and heat-staking of plastic connectors on circuit boards. With others in his group, he holds three patents in the bonding and connector fields.

When the Bell System was split under the Consent Decree in 1983, Kleinedler left Western Electric for AT&T Network Systems. His group was responsible for funding Forward-Looking work in Bell Laboratories, which required detailed knowledge of the Lab's research work and how to best allocate resources and develop technology to transfer basic research into manufacturing processes for new products.

On the side, he focused on a lifelong fascination with electric rail transportation, visiting most American cities that have or had trolleys, as well as Toronto, Canada; the Isle of Man; Hungary; Switzerland; and Austria. Along the way, he accumulated some 15,000 slides and digital images. Combining his railroading hobby with a sideline interest in cartography, Kleinedler also started a computer-assisted map business and has drawn several-hundred railroad/trolley maps for railroad magazines and books. And he is co-author of a recent book tracing the long-abandoned Morris Canal in New Jersey. He and longtime-partner Orysia Kaufman live in Allentown, New Jersey.

The son of parents who did not have an opportunity for college during the Depression, Kleinedler is grateful for his Purdue education and the life it offered. He has supported two endowments—one each in honor of Professors Schuhmann and Grace—for student scholarships, as well as travel and research opportunities. By giving to Purdue Materials Engineering, he hopes to offer aspiring engineering students a ticket to the world of possibility that he discovered.

"Engineering is akin to driving without a map or GPS on an unknown highway with a goal to arrive at some (sometimes unseen) distant place. It's a road with no signs, no speed limit, and is usually unpaved with deep ruts. You'll face sharp turns, detours, dead ends, and may be forced to retrace your path. But the rewards and satisfactions can be great at the end," Kleinedler says.

2018 Outstanding Materials Engineer Award Recipients

Jessica Van Dalen
Partner
Faegre Baker Daniels

Jessica Van Dalen is a partner in the Intellectual Property group of Faegre Baker Daniels LLP. As a registered patent attorney, Jessica works with clients to prepare and prosecute patent applications. Jessica practices before the U.S. Patent and Trademark Office as well as government entities in Japan, Europe, Canada, Mexico, China, and Australia. She collaborates with clients on licensing agreements, portfolio analysis, opinion work related to infringement and patent invalidity and post-grant proceedings.

Jessica joined Faegre Baker Daniels in 2010 as an associate and spent about a year before that as a summer associate and law clerk in the firm's Indianapolis office. Her work tends to focus on automotive technology, including all components and systems for recreational and off-road vehicles; engine components, fuel systems, and turbochargers for heavy-duty engines; and truck and trailer bodies for cargo vehicles. She also handles materials science matters related to various technologies, for example coatings for fuel injectors, materials for various automotive components, composite materials for cargo vehicles, shape-memory materials for medical applications, thermally-reactive materials for medical devices, and various coatings for optical fiber technologies.

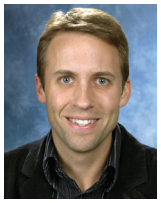
Jessica also manages and actively works on various intellectual property matters for pro bono clients. In particular, she is an adjunct faculty member for the Intellectual Property Clinic at the Indiana University Maurer School of Law in Bloomington, where she works with students to both help pro bono clients with various patent matters and provides guidance and real-world experience to the students. Through this work, Jessica has been able to help several start-up companies and individual inventors pursue patent protection that they otherwise would not be able to afford. For this work, Jessica has been recognized on the pro bono honor roll at Faegre Baker Daniels since 2014 and received the Pro Bono Publico award from the Indiana Bar Foundation in 2017.

Jessica is an alum of the School of Materials Engineering, graduating in 2007, and was a participant in the Co-Op program, working on material formulations for heavy-duty friction materials at Raybestos in Crawfordsville, IN, during her time at Purdue. She also worked with Professor Youngblood on an undergraduate research project involving acrylic adhesives during her senior year at Purdue. Following Purdue, Jessica attended law school at the Indiana University Maurer School of Law in Bloomington and graduated in 2010. Jessica lives in a historic home, built in 1901, in Indianapolis with her husband, Phil, their son, two cats and dog. In her free time, Jessica enjoys running, hiking, traveling, reading, and all things Purdue!

William John Jarosinski
Associate Director, Materials
Praxair Surface Technologies, Inc.

Bill was a 5 session Co-op with Union Carbide Coating Service while he attended Purdue and obtained his BS in Metallurgical Engineering. He graduated in 1990 and continued his employment with Union Carbide (which became Praxair in 1992) and completed his MS in Materials Engineering in 1995 (working with Professors Bowman, Trumble, Dayananda). Additionally, he completed a MBA in Finance from Butler University.

Bill has over 30 years of experience in advanced material manufacturing, for thermal spray powders and coatings. His powder responsibilities have included Development Engineer, Product Manager, Quality Manager and Engineering Manager. In 2003, his role expanded to include corporate development activities working as Customer Engineering Manager and Senior Project Manager. He is currently Associate Director, Materials - leading efforts in development of coatings to reduce wear, corrosion and oxidation for critical components operating in severe environments. R&D programs under his supervision include New Material Development, Additive Manufacturing Lab, Metallographic Lab and Detonation Gun Coating Development. This work has led to seven U.S. Patents (with foreign equivalents) related to materials and coatings for improved quality and extended product life.



Kevin Lohner
Manager
Propulsion Engineering Space Exploration Technologies (SpaceX)

Kevin Lohner has over twenty years of experience in design, development, and test of propulsion components and systems. He joined Space Exploration Technologies (SpaceX) as a Senior Propulsion Development Engineer in 2011 and is now the Propulsion Engineering Manager for Advanced Manufacturing, responsible for developing additive manufacturing technologies as well as thrust chambers and nozzles for the Merlin and Raptor liquid rocket engines. His other areas of expertise include refractory alloys, ceramic matrix composites (CMC), monopropellant catalytic gas generators, hybrid rocket propulsion, and micro-electro-mechanical systems (MEMS).

Prior to joining SpaceX, Kevin worked as a Senior Engineer at Northrop Grumman Aerospace Systems for 3 years, where he was the Propulsion Lead for the Altair Lunar Lander. He also worked for 5 years in the Advanced Propulsion Development group at Rocketdyne Propulsion & Power as a Combustion Devices Development Engineer.

Kevin received his Bachelor of Science degree in Materials Science Engineering from Purdue University in 1997, his Masters of Science degree in Aeronautics & Astronautics from Massachusetts Institute of Technology in 1999, and his Ph.D. in Mechanical Engineering from Stanford University in 2012. Dr. Lohner received the Engineering Student of the Year Award from Boeing & Flight International in 2007. He holds five U.S. patents and is an author of many conference papers on liquid propulsion technologies.

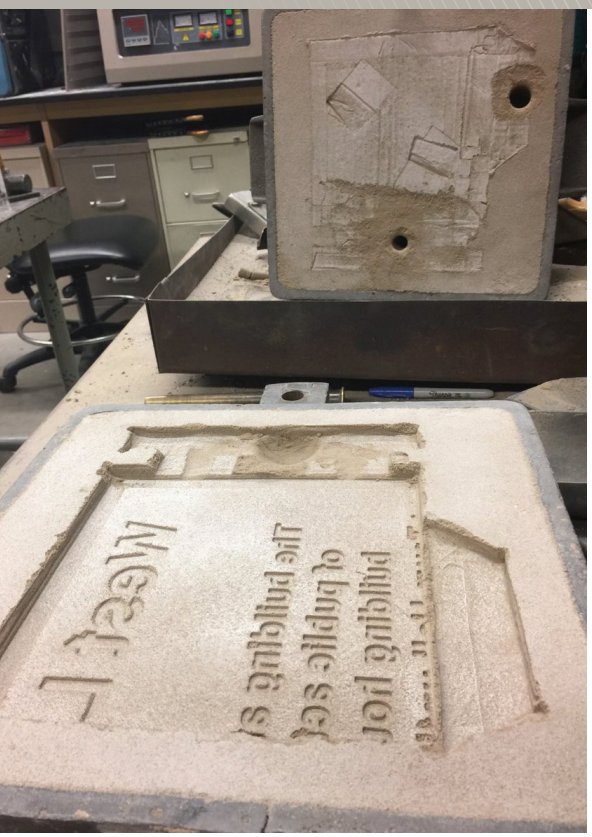
Outside of work, Kevin is an ironman triathlete and an avid marathon runner, having competed in over 60 marathons including the past 21 consecutive Boston Marathons.

John Storm, President and CEO of Contour Hardening Inc. (CHI), passed away on May 13, 2018, at the age of 63. John studied Metallurgical Engineering at Purdue University and graduated in 1977 with a BSMetE degree. After a co-op with US Steel in Gary, Indiana, John started his career at the Detroit Diesel Allison (DDA) Division of General Motors.

While at DDA, John helped pioneer work with dual frequency induction hardening to strengthen gears and shafts by creating a uniform hardened case pattern. In 1986, John's entrepreneurial spirit was sparked as he ventured out to co-found CHI with the goal of supplying the industry with innovative induction hardening systems. Under John's guidance, CHI has grown to be a leader in the field of induction hardening and has facilities in Indianapolis, Indiana, and Silao, Mexico, and has supplied equipment and heat treat services all over the world. John holds over 200 US and International patents on a variety of processes and applications. In 2003, John formed Real Power Division of CHI which manufactures chassis-integrated electric generator systems for trucks. In 1998, John combined his love for Indy Car racing with the development of ultra-lightweight transmission gears heat-treated using CHI's Micropulse® technology. The CHI gearbox contributed to Arie Luyendyk's 1997 Indy 500 win, and Scott Goodyear's second place finish in that same race.

John received many awards and accolades in his life, but none he cherished more than the "Distinguished Engineering Alumni" award bestowed on him in 2004 from the Purdue University Materials Engineering department. John is survived by his wife, Mary Ann (Gibbs) Storm, daughter Emily Ann (Storm) Smith (Donald L.A. Smith), daughter Allison Ann Storm, and grandson Charles Storm Smith.

OUTREACH



Molding for the first official plaque.

Making an *IMPRINT:*

MSE-led EPICS project provides plaques to local non-profits

Due to demand from the MSE students to play a more active role in the EPICS program, the EPICS MSE Bronze Project Team was established in August 2017 as unique route to increase the involvement and impact of the School of Materials Engineering in service learning projects that cater to the communities surrounding Purdue University. The overarching goal of the EPICS MSE Bronze Project Team has been to provide historic markers for noteworthy locations in the communities of Lafayette and West Lafayette. This project provides undergraduate students, from both materials engineering and other academic backgrounds, an opportunity to explore innovative and cost-effective ways to produce aesthetically pleasing historic plaques. The project partners for this project are the Greenbush Cemetery of the City of Lafayette and the West Lafayette's Historical Preservation Team. The standing need presented by the team's project partners was to create plaques highlighting the compelling stories of historic buildings and gravesites of important historic individuals. These plaques give insight into what these buildings mean to the history of Lafayette and West Lafayette, as well as the significant people buried in this area. The deliverables of this project will allow visitors of these sites a way to learn more about the rich history of the Greater Lafayette area and how it came to be what it is today. Students participating in this project utilize many fundamental materials science and engineering concepts to refine the production of the historic plaques via sand casting (using material donated by Logan Aluminum), from metal alloy selection to casting design to protective surface finishing. This project is ongoing, with the first plaque set to be delivered to the City of West Lafayette in Fall 2018.

100 lbs of aluminum donated by Logan Aluminum, Russellville, KY.

OUTREACH

MSE students represented the Material Advantage Student Program in Washington D.C. as part of Congressional Visits Day. The Purdue team, accompanied by MSE head, David Bahr, included residents of Indiana, Virginia, Ohio, and New Mexico, and met with staff and members of the House of Representatives and Senators to share their stories of how basic materials research impacts their careers.

A group of MSE undergrads spent their afternoon in the classroom of MSE alumna and McCutcheon High School (Lafayette, Indiana) science teacher, Ms. Cheryl Meyer. The students had the chance to share information about Purdue, share their passion for MSE and demonstrate why materials engineering is so cool!

MSE Professor Matthew Krane recently returned to his high school alma mater, Webb School of Knoxville to share his passion for Materials Engineering with high school students. Thanks to Professor Krane for helping us recruit the next wave of Materials Engineers!

Undergraduate Student Profile

Hugo Arribas • Morgan Hill, California

What attracted you to Purdue University and specifically, Materials Engineering?
The moment I visited Purdue University it felt more like home then any place I had lived before. I already knew I was going to get a great education at Purdue so that really solidified my choice. Choosing Materials Engineering wasn't something I had as clear. My father is a geologist, which gave me exposure to the world of material science, and with talking to some professors in many departments I found that Materials Engineering was going to offer me something I wanted to pursue. I was also heavily drawn to Materials Engineering because of the bonds I saw formed in across the whole major. I wanted to be part of the Materials family.

What has been your greatest achievement during your time in the School of Materials Engineering?
My greatest achievement in Materials Engineering has been the connections I have made with class mates, faculty, graduate student, professionals, and administration. Getting to know the people who make everything in Purdue and MSE run smoothly on a day to day basis has granted me the opportunities to be where I am today.

What has been your favorite MSE course; why? I do have to also mention all the lab classes that give me the opportunity to work with samples to get a better grasp of what we are learning and its applications.

One of my favorite MSE course has been Transport Phenomena. It was a class I struggled with greatly throughout the semester to keep up with the material being taught. I greatly appreciated the teaching style of the class, and towards the end of the semester I had a moment of clarity where all the concepts made sense. Since that time it has easily become one of my favorite classes.

Please briefly discuss any participation in study abroad and how the experience was beneficial.
I have not had any study abroad experiences while at Purdue, but I have had the incredible opportunities to travel around the world during break. This opportunity let me see unique scenarios where unique material interactions are showcased and common place (Maglevs are my favorite). Seeing all the different solutions to common problems tackled by different countries, like preventing pedestrians from falling on train tracks, opened my mind to the great deal of thought that can be put into everything to help in discrete ways.

Please discuss any participation in co-op or internship programs and how the experience was beneficial.
I have the great fortune that I have been interning at the local Caterpillar Inc. manufacturing plant full time over the summer and part time over the academic year ever since the summer after my freshman year. It has given me the opportunity to get contextualize the theoretical problems we may cover in class with industry needs. Getting the opportunity twice a week to leave the class room and get the opportunity to see what my life after graduation might look like gives me a nice mental break of the monotony of class.

Have you been involved in any student organizations while at Purdue? If so, which ones?
I am involved with the Minority Engineering Program at Purdue as an ambassador during the school year encouraging children of all backgrounds to think about engineering as a future. During the summer I am a camp counselor for their summer engineering programs getting students ready for Purdue engineering. I am also involved with Purdue University Material Advantage where I will be the Ambassador chair for the upcoming academic year. These opportunities help get me in touch with incoming students and direct them to the major best fit for them, and hopefully we find that its Materials Engineering.

Why would you recommend this department to others who are still deciding on an area of study?
I would recommend this department based on the faculty and the amazing plan of study that covers a wide variety of topics. The faculty deserve the praise for making the tough subjects much more understandable and easier to learn. If that isn't convincing enough I would talk about the strong community, we have within our major where we are willing to ask each other for help and receive it when we encounter issues understanding concepts.

How do you plan to use your knowledge and experience gained at Purdue University in the future?
I plan on working in industry for a couple years and then I would ideally return to graduate school to get a PhD and hopefully become a professor to teach the next generation of engineers.

Undergraduate Research

FIONA O'DOWD

My first research experience and exposure to a real organic chemistry lab occurred when I attended the Pennsylvania Governor's School for the Sciences, a group of five-week summer programs for gifted high school students, at Carnegie Mellon University. My research dealt with computational physics, which was not something I desired to pursue, but the environment sparked my initial interest in research and chemistry.

My love of chemistry and interest in sustainable materials drew me towards materials engineering initially. I had the opportunity to deviate from the regular First-Year Engineering plan of study to take the introductory MSE course early, which solidified my choice to pursue materials engineering.

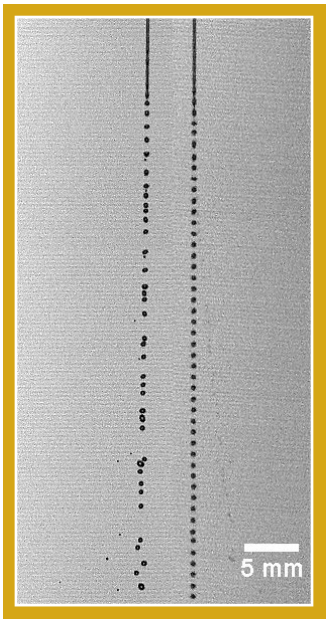
The summer between my freshman and sophomore years, I worked in the analytical lab for plastic films in a division of Berry Global. There, I found I was most interested in the early stages of product development work and proof-of-concept testing. After this experience, I knew I was interested in pursuing undergraduate research going forward, but I was not sure how to get involved.

Luckily, Professor Martinez reached out to all undergraduates at the start of my sophomore year looking for students to join his group. One of his projects interested me, and it was an easy and convenient way for me to start my undergraduate research career.

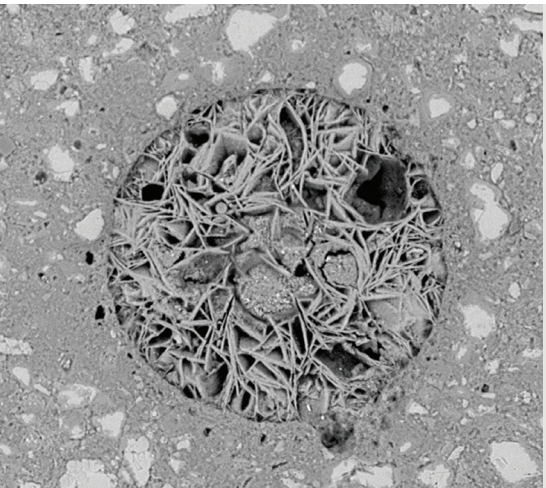
My work with Professor Martinez is on phase-change materials (PCMs) for use in asphalt formulations to minimize snow and ice accumulation. The objective of this project is to synthesize and characterize strong microcapsules composed of cellulose nanocrystals (CNCs)-reinforced poly(urea-urethane)-shells with methyl laurate (PCM) cores and their incorporation in asphalt formulations. Currently, the CNCs are embedded in poly(urea-urethane) (PU) microcapsules via in-situ emulsion interfacial polymerization.

My efforts on this project have been focused on developing fabrication methods for the capsules alongside PhD candidate Daniela Betancourt Jimenez. Most recently, I have been focused on the use of vibration-assisted drop formation and electrospraying to form monodisperse drops which do not coalesce, with the objective of using this method for interfacial polymerization. I use high-speed imaging techniques to collect information on drop generation rates and their size distribution. Additionally, I use FTIR and DSC to characterize the drop composition and confirm the presence of the CNCs. This work will result in improved capsule strength and reduced synthesis costs.

With the encouragement of Professor Martinez, I applied to and participated in a National Science Foundation Research Experience for Undergraduates (REU) program at the University of Southern Mississippi studying nanoscale polymer vesicle fabrication for biomedical applications. This experience solidified my decision to pursue my PhD in MSE following my graduation in May 2019. This summer I will be working with the Boeing Company studying thermoplastic composites before completing my senior year, hoping to expand the breadth of my MSE background.



Optical image showing the generation of drops from static (left) and vibrating (right) nozzles. At the optimal frequency drops of equal diameter form near the nozzle tip at flow rates up to 0.5L/hour.



YOU CAN'T MAKE IT WITHOUT
MATERIALS

Graduate Student Profile

Nelyan López Pérez • Vega Baja, Puerto Rico

How did you first hear about Purdue University?
My sister is a Purdue alumna and I had the chance to visit Purdue since I was in high school.

What attracted you to Purdue University's graduate programs?
My undergraduate major is in Physics and I wanted to pursue a career that involved Physics in everyday applications. Materials Engineering seemed as the perfect fit. One of my Summer internships as an undergrad was in the School of Materials Engineering here at Purdue. I learned about polymers, an area that was not researched in my university at the time. During that Summer I learned more about the MSE program, and I had the chance to see the interaction between the students and professors. They really invest of their time to make students interested in materials and research.

What has been most rewarding about your time in Materials Engineering?
How much I have learned in the past three years and being able to share my experiences with students that want to study science, engineering or want to pursue graduate studies in these fields. Most of all, seeing undergraduate students that I taught get involve in research is really rewarding.

What is your area of research?
My research area is in polymers, specifically fibers used for bulletproof applications. I study the effect of degradation over time and how it affects the mechanical and structural properties. The main goals is to use a non-destructive characterization technique called positron annihilation lifetime spectroscopy (PALS) to detect early stages of degradation and predict the lifetime of soft body armors based in those results.

Have you been involved in any student organizations or community activities while at Purdue? If so, which ones?
I have worked with the Materials Engineering Graduate Student Association (MSEGSA) as a board member. The purpose of this organization is to create events to enrich the experience of MSE graduate students at Purdue in areas ranging from professional development to social gatherings. I have also participated in the diversity program from the College of Engineering, where I have had the opportunity to meet with other minority students and attend conferences to recruit students for the College of Engineering.

Why would you recommend this department to others who are still deciding on an area of study?
One of the reasons I would recommend Purdue MSE is how broad and diverse it is. It is diverse in research areas and in people. It is amazing to work alongside talented people from around the world. Also, in my experience, professors are helpful and want you to succeed in your career. Moreover, I've had the opportunity to travel to several conferences as a recruiter for the College of Engineering and people's reaction to our presence confirms the reputation of Purdue as one of the top engineering universities in the nation.

How do you plan to use your knowledge and experience gained at Purdue University in the future?
I am still debating on what to do after grad school, but I would love to work on science policy. Scientist and engineers like us all around the world are making groundbreaking innovations from which humanity can take advantage and build a better future. That is why I believe it is important that our knowledge and innovations should not just stay in the lab. Using our knowledge to pass policy over issues of public concern like climate change, medicine, and which materials to use for bulletproof vests is very important. I believe that we currently lack people with knowledge in STEM in positions of power making decisions based on opinions and not scientific evidence. So, I would like to offer my input in these important issues to implement logical policies that benefit everyone.

Why did you choose grad school as opposed to going straight into the workforce?
I wanted to know more about polymers. After two summer internships working with polymers I realized that I wanted to continue knowing more about these materials. So, I can say I chose grad school out of curiosity. Also, I think that in the end a PhD might offer me better work opportunities than going straight into the workforce after finishing my bachelor's degree.

If you could give one piece of advice to undergraduates considering graduate school, what would it be?
Graduate school is tough, but very rewarding. You will learn a lot about science and engineering, and as cliché as it, sounds, you will learn a lot about yourself and your abilities. Be open to take risks and see failure as an opportunity not an omen. Because, yes, you will fail and your research might be on hold for a while, but you will learn the skills to solve and overcome those problems and keep going. Sometimes we learn more through failure.

2017-2018
Student Award Recipients

INTERNAL STUDENT AWARDS:

Samuel Reeve
MSE Outstanding Graduating Graduate Student

Kristen Adair
MSE Outstanding Graduating Senior - Service and Leadership

Nicholas Macke
Eric Rohrbach
John Keil
John L. Bray Memorial Award

Saaketh Desai
Jerome Nash
Estus H. and Vashti L. Magoon Graduate Teaching Award

Thomas Reeve
College of Engineering Outstanding Graduate Student Researcher

Matthew Korey
College of Engineering Outstanding Graduate Student Service Award

Cole Davis
Outstanding Graduating Undergraduate Research Award

EXTERNAL STUDENT AWARDS:

Sarah Boes
inducted into Phi Beta Kappa and Mu Sigma Rho

Allison Chau
1st place, oral presentation, Purdue Undergraduate Research Conference

Cole Davis
Charles C. Chappelle Fellowship

Kayli DeCocker
Office of Undergraduate Research (OUR) Scholarship

Naomi Deneke
George Washington Carver Fellowship

Aline Elquist
Ross Fellowship

Cuncai Fan
Bilsland Dissertation Fellowship

Alejandro Figueroa
Office of Undergraduate Research (OUR) Scholarship, NRC Fellowship

John Keil
inducted into Phi Beta Kappa and Mu Sigma Rho

Matthew Korey
NSF Graduate Research Fellowship

Christina Landon
First place in the PepsiCo Student Engineering Challenge

Nelyan Lopez Perez
NSF Graduate Research Fellowship

Jerome Nash
Bilsland Dissertation Fellowship

Fiona O'Dowd
Office of Undergraduate Research (OUR) Scholarship

Robynn-Lynne Paldi
Purdue Doctoral Fellowship

Anthony E Pupillo
American Society for Iron & Steel Foundation (AIST) Steel Intern Scholarship

Jorge Ramirez
Idaho National Lab, GEM PhD Engineering Fellowship

Carlos Serratos
Andrew's Fellowship

Alex Strayer
Roll-Royce Fellowship

Erich Weaver
Ross Fellowship

Matthew Welch
First place in the PepsiCo Student Engineering Challenge

MaterialsMatter @Purdue

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West Lafayette, IN 47907-2045

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EVENTS *Mark Your Calendar!*

MSE Current Student and Alumni Mixer

Wednesday, September 12
5:30 pm - 7 pm

Mackey Arena, Spurgeon Club

Cost: Free

MSE Alumni Reception at MS&T Conference

Monday, October 15
6:30 pm - 8 pm

Callahans
520 Park Street
Columbus, OH 43215

Cost: Free

For additional information about these events or to rsvp, please contact Stacey Coar at 765-494-4100 or at scoar@purdue.edu.