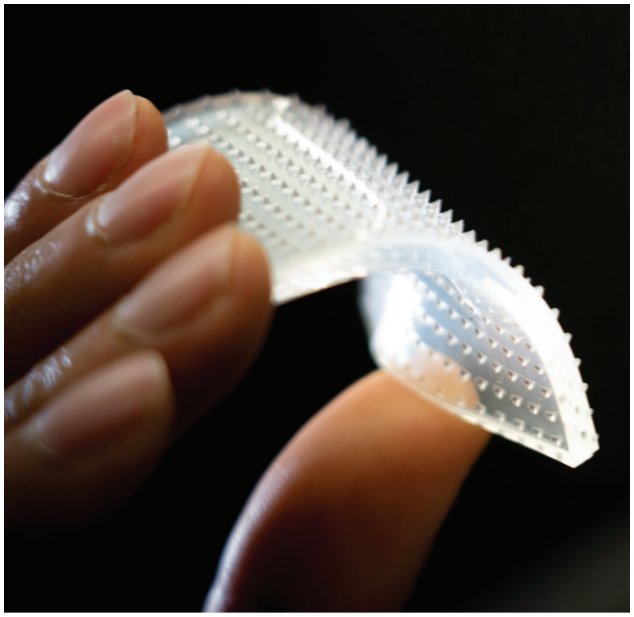
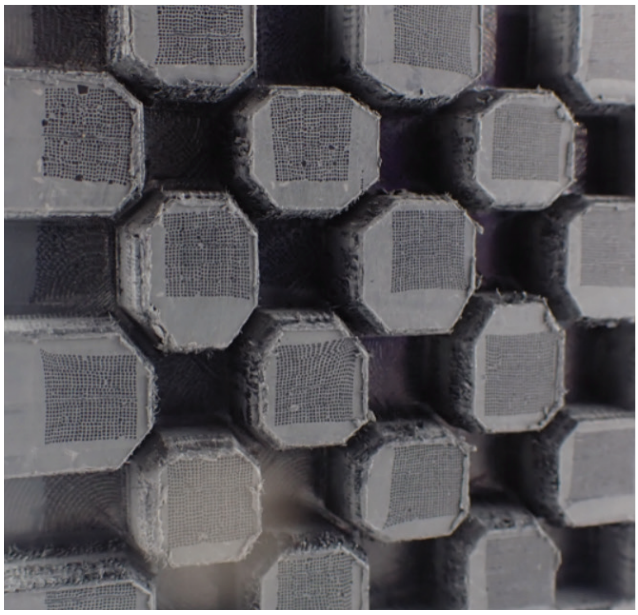
MATERIALS MATTER @Purdue

2022 Annual Newsletter

Student highlights | Cutting-edge, faculty-led research | School updates





PURDUE UNIVERSITY | School of Materials Engineering

A MESSAGE FROM THE HEAD

MSE Friends and Family,

I still tip my hat to Dr. Alex King, Head of Purdue MSE from 1999-2007 for coming up with "You can't make it without materials"— the best quick way to capture Purdue MSE on a bumper sticker. We make stuff that the world needs, and we help our students "make it" in their careers. I also want to add a new, not as catchy phrase (I don't see us actually making a window decal with this one): "There's no normal MSE." Over the 2021-22 school year, we graduated over 80 BS, 9 MS, and 36 PhD students. Another record class - that's getting to be normal. But what stands out after dozens and dozens of exit interviews this year is that our students are unique. There are majors that have typical career paths, where big groups of students go to one or two particular industries. We don't do that; we have almost as many paths as we do students.

"Where does the normal BS MSE end up?" is a question we get from incoming first year students all the time. This past year our BS graduates went to automotive, aero and space, defense, large-scale manufacturing, small start-ups, polymer formulators and polymer processors, semiconductors and graduate school. And this is reflected in why they chose MSE at Purdue. We used to hear "I like hands on;" "I like the small classes." I still get those answers, but the most common reason a student selects MSE now is "I like that my options are open." Our grad students are just as wide-ranging on their career paths. This year they are going to other universities, to big chip fabs, small battery start-ups, national labs, and specialty metals companies just to name a few.

We want to reflect this breadth when we provide professional development opportunities for our students. We're continuing to bring in-person and online presenters to seminar programs to let graduate and undergraduate students know about career options; last year we had speakers ranging from patent law to metals processing, from small business consultants to some of the largest consumer electronics and medical device companies in the world. We still need your assistance in helping students see themselves in our alumni (be it a large seminar, or a small online or in-person coffee break), and ensuring MSE is an inclusive and welcoming place for all our students.

Last year I noted providing financial support to students was crucial, and that's even more important this year. We've added several undergraduate scholarships (which is great) but taking care of our graduate students and providing both stipend support AND professional development opportunities for travel are crucial this year. Costs have gone up for everyone, and we're trying to provide extra help to the students who are the engine that drives our research enterprise. To do so, we need your help. If you would like to make a gift to MSE for the support of graduate students or any other initiative, please reach out to Robyn Jakes at rnjakes@purdueforlife.org.

As I wrap up my 10th year as Head I'd like to thank the faculty, students, and Dean and Purdue President-elect, Dr. Mung Chiang for the honor of continuing to serve the School. I will be taking a short sabbatical for the spring 2023 semester while the administration of the School will be in the very capable hands of Prof. Nik Chawla as acting Head until I'm back in summer '23. I hope you enjoy the highlights in this year's newsletter, that you'll follow the school's LinkedIn updates, and that you'll help spread the message that a degree in MSE opens an infinite number of doors. The career path of every Purdue Materials student, faculty and alum is unique.

Hail Purdue,

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

inside

PURDUE UNIVERSITY

School of Materials Engineering

SCHOOL OF MATERIALS ENGINEERING

Interim Dean of the College of Engineering and the Don and Carol Scifres Distinguished Professor of Electrical and Computer Engineering ▪ **Dr. Mark Lundstrom**

Head ▪ **Dr. David F. Bahr**

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

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Senior Director of Development
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Or click the "Giving" link on our homepage.

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Follow the Purdue Materials Engineering on Facebook: Purdue School of Materials Engineering

Watch Purdue Materials Engineering on YouTube: bit.ly/PurdueMSE_YouTube

New Professor of Practice

In October 2022, MSE will welcome **Dr. David Gildemeister** (Dave) as a Professor of Practice. In this role, Dr. Gildemeister will use his more than 30-year career with Arconic (formerly Alcoa) to bring more industry-relevant content to several MSE courses, including senior design. In addition, Dr. Gildemeister will help ensure that the School continues to provide students with hands-on, real-world experiences that enable them hit the ground running when they enter the workforce.

During his time with Arconic, Dr. Gildemeister served at seven different aluminum manufacturing and research locations. He began his career with Alcoa as a metallurgist, and moved into several other positions including Senior Technical Leader, Ingot Plant Manager, Quality Manager, and he ended his distinguished career as a Casting Technical Specialist earlier this year. Dr. Gildemeister's experience encompasses casting and solidification, rolling, and extrusion, and we are excited for the extensive knowledge and practical experience that he will bring to MSE.

Dr. Gildemeister received his BS in Metallurgical Engineering from South Dakota School of Mines and Technology (1993), his MS in Materials Science and Engineering from University of Florida (2010) and his PhD in Materials Science and Engineering from Carnegie Mellon University (2016), and he holds several patents and trade secret awards from Arconic in the area of aluminum ingot casting. Dr. Gildemeister's professional interests lie in the physics of manufacturing; he is a registered professional Engineer (PE) in Metallurgical Engineering, and he has been an active member of TMS for 30 years.

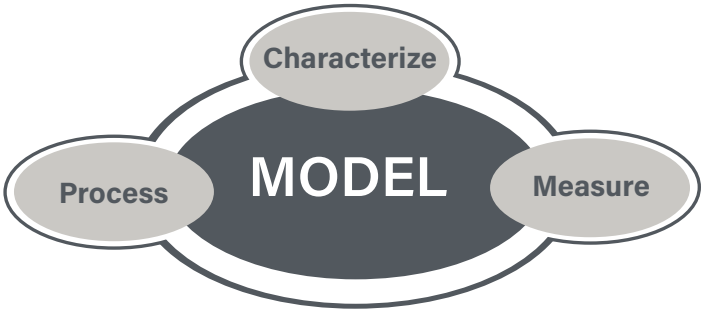
In addition to professional interests, Dave enjoys all sorts of outdoors pursuits, winemaking, beer brewing, and spending time with his wife and two grown children.

New Center offers Heat Treating Solutions.

Purdue MSE has recently started the Purdue Heat Treating Consortium (PHTC). PHTC's focus will be to conduct graduate level, industrially-oriented heat treating projects. MSE feels that PHTC offers another way for our corporate partners to engage the school and other companies interested in heat treating research with industry-relevant content.

PHTC

Purdue Heat Treating Consortium



PHTC ATTRIBUTES

Industry-Focused Heat Treating Research

- Member-driven, pre-competitive projects
- Company specific proprietary projects
- Graduate and undergraduate projects

Renowned Faculty Expertise

- Extensive project history
- Sustainability and environmental focus
- Ferrous and non-ferrous backgrounds

MEMBER BENEFITS

Interactive Project Experience

- Semi-annual meetings and presentations
- Project voting and scoping
- Member/faculty/student networking

Customized Participation and Access

- Multiple project and lab discounts
- Flexible engagement options
- Three year membership commitment

https://engineering.purdue.edu/MSE/PHTC

Mark Gruninger: mgruninger@purdue.edu
Robyn Jakes: rnjakes@purdueforlife.org
Mike Titus: titus9@purdue.edu

FACULTY AWARDS & RECOGNITION

John Howarter

College of Engineering, Outstanding Faculty Mentor (Environmental and Ecological Engineering)

bit.ly/Zhang-Howarter-Outstanding-Mentor

Chelsea Davis

Reinhardt Schuhmann, Jr. Best Undergraduate Teacher Award

2021 Adhesion Society Early Career Scientist Award

bit.ly/Davis-Adhesion-Society

Michael J. Manfra, (MSE by courtesy)

Purdue College of Engineering - 2021 Arden L. Bement Jr. Award

bit.ly/Manfra-Bement-Award

Xinghang Zhang

Richard E. Grace Best Faculty Research Grant

College of Engineering, Outstanding Faculty Mentor (Materials Engineering)

bit.ly/Zhang-Howarter-Outstanding-Mentor

R. Edwin Garcia

Named one of the most prolific researchers in the realm of invention disclosures by Purdue Research Foundation

bit.ly/Frontiers-of-Engineering-2022

Elliott Slamovich

Dean A.A. Potter Undergraduate Teaching Award

https://bit.ly/Slamovich-Potter-Award

Nikhilesh Chawla

Distinguished Lecturer, Sigma Xi, The Scientific Research Honor Society, as a distinguished lecturer for 2022-23.

bit.ly/Chawla-Distinguished-Lecturer

Rahim Rahimi

Named one of the most prolific researchers in the realm of invention disclosures by Purdue Research Foundation

Grainger Foundation Frontiers of Engineering 2022 Symposium of the National Academy of Engineering

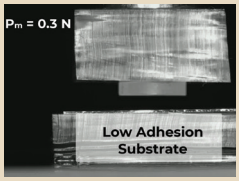
bit.ly/Frontiers-of-Engineering-2022

Maria Okuniewski

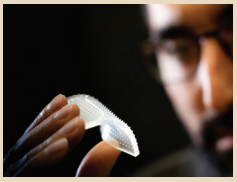
Leadership Team, Materials in Nuclear Energy Systems (MiNES)

bit.ly/Wharry-Okuniewski-JOM

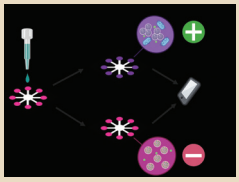
Faculty Research Highlights



Chelsea Davis: Pressure Tunable Adhesives
Recent graduate, Dr. Naomi Deneke, in the Davis Research Group developed a reversible adhesive that can be tuned in adhesive strength by adjusting the pressure of application. This scalable surface is achieved through self-assembly of a dewetting thermoplastic film on an elastomeric foundation. Her invention can be used for "pick-and-place" manufacturing processes in the semiconductor industry. https://rsc.li/3zT8zoL

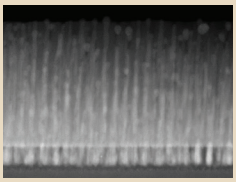


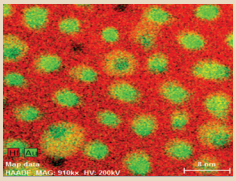
Rahim Rahimi: MSE assistant professor, Rahim Rahimi, has developed a flexible polymer composite microneedle that will provide more effective topical delivery of antibiotics to an infected wound. This research was published in ACS Applied Bio materials, and a video about the invention is available on the MSE YouTube channel. bit.ly/Rahimi-Microneedles



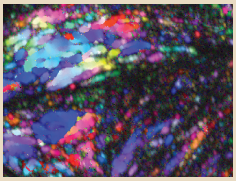
Lia Stanciu: In response to the high number of foodborne illnesses and infectious diseases worldwide, the Stanciu Research group has developed and fabricated low-cost paper-based devices that can detect the presence of more than one type of pathogen in food products with one single rapid test. bit.ly/Stanciu-aptasensor-devices

Jeffrey Youngblood: A team of Prof. Jeffrey Youngblood, Purdue Civil Engineers Profs Jan Olek and Pablo Zavattieri and Gabriel Falzone of RCAM Technologies, working with graduate students Fabian Rodriguez, Christian Lopez and Yu Wang have been researching application of 3D printing of concrete anchors for offshore wind power. The concept, if successful, could dramatically lower the cost due to reduced labor, formwork and shipping (it will be done port-side). They have recently shown that printing parameters could have a large effect on salt corrosion, but that proper tuning can alleviate this issue. bit.ly/Youngblood-3D-printed-concrete-anchors

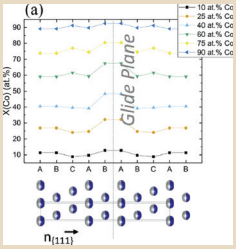




Haiyan Wang: Professor Haiyan Wang and her PhD student, Yizhi Zhang, have created a self-assembled HfO2-Au hybrid metamaterials using a pulsed laser deposition technique. The crystallinity and optical properties are highly improved by adding a suitable buffer layer between the film and substrate. Such ordered and ultra-thin Au pillars (~3 nm in diameter) embedded into the dielectric oxide matrix. The overall hybrid film exhibits unique surface plasmon resonance properties and hyperbolic optical response (i.e., highly anisotropic optical dielectric properties). This new hybrid plasmonic metamaterial could find unique applications in future integrated optical and electronic switching device designs. https://rsc.li/3QVhifo



Janelle Wharry: PhD student Haozheng (Joseph) Qu in Prof. Janelle Wharry's research group has worked with a multi-institutional team to show that cold spray coatings can dramatically improve the chloride-induced stress corrosion cracking (CISCC) resistance of stainless steel welds. This finding offers promise for applying cold spray to extend the safety, integrity, and lifetime of nuclear waste storage canisters. bit.ly/Wharry-cold-spray-coatings

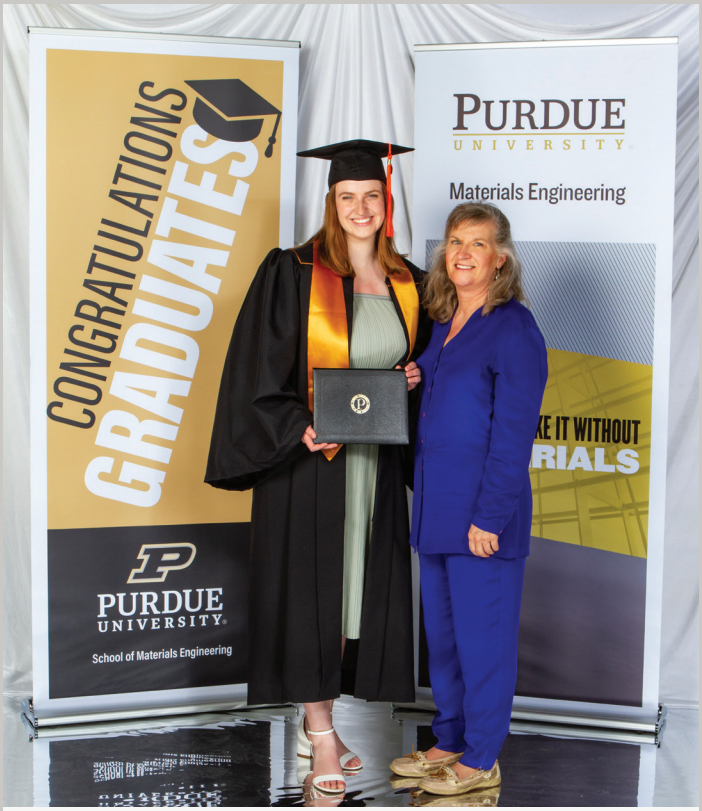


Electronic structure calculations of atoms reveals nanometer-scale segregation
Prof. Titus' and recent MSE PhD graduate Dr. Dongsheng Wen used atomistic calculations to understand material compositions at nanoscale defects in structural alloys used in aircraft engines. These calculations show that in metals containing mixtures of cobalt and nickel, cobalt will preferentially segregate to nanoscale defects known as stacking faults that are about 1nm in thickness (about one ten-thousandth of the thickness of a human hair). These results can be used to make stronger materials used in aircraft engines. bit.ly/Titus-atomistic-calculations

ARE THERE MATERIALS IN YOUR

Family Tree?

The school of Materials Engineering has always been known as a tight-knit family, but sometimes, we have actual family members who graduate from MSE! This is the case with Kathy Kansky Giannini (BS MetE '82; MS MetE '83) and her daughter Kimberly Giannini (BS MSE '22). As they graduated 40 years apart, some things have changed, while others have remained the same!



Kimberly Giannini, Materials and Processes Engineer at Sierra Space and Kathy Kansky Giannini retired Quality Manager from an ArcelorMittal legacy company at the Spring 2022 MSE Graduation reception.

How did you choose Purdue University, and more specifically, what drew you to Materials Engineering?

Kathy: In high school in the late 1970s – the pre-internet days – exploring careers was primarily through magazines and newspaper articles. My mom found an magazine article called "Top Ten Careers for Women 1977". As I recall, the first three suggestions were all finance and banking. I already had taken accounting and found it dry and boring. Engineering was 4th, with a minimal explanation of what it was. My mom's summary was "it's science and math, and you can make a lot of money." Science was my passion, and so I started an exploration of what engineering was. I'd never heard of it.

I took an Engineering Aptitude Test offered at Purdue Calumet Campus, and scored very high. It suggested Industrial Engineering as #1, but I decided it wasn't enough science. Materials was #2. Then I signed up for a week-long Purdue engineering camp for girls in West Lafayette, I think sponsored by SWE, in summer 1977. It was my first time away from home and I lived with a roommate in Harrison Hall. The experience cemented my choice.

My parents were both elementary teachers – Dad was an IU grad and mom was Ball State. I had no sentimental attachment to the idea of Purdue – it was the only state university with a well-recognized engineering program. SOLD. I applied no where else.

I did apply and receive a four year renewable metallurgical engineering scholarship from Inland Steel with an internship every summer where I could live at home. Everything fell into place.

Kimberly: Most of my family went to Purdue – I'm actually a fourth-generation alumnus on my dad's side – so Purdue's been a part of my life for as long as I can remember through sports games on the TV at home, visits to campus to tailgate, and countless stories. I did the STEP program at Purdue before my senior year of high school, and that week on campus cemented that I wanted to be a Purdue engineer. Materials engineering had been on my radar longer than most people because of my mom, of course. I remember hearing a lot of steel lingo at the dinner table growing up and learning what it meant (sort of!) through context clues and her very simplified explanations. I wasn't sold on it for me until I was on a materials science event in high school Science Olympiad – that's when I really fell in love with the discipline's wide range of applications and unique part of science that we didn't really learn in your classic biology, chemistry, or physics classes.

What was your favorite class, and what was the hardest class?

Kathy: I loved Mechanical Metallurgy and Physical Metallurgy, and the labs. I spent most of my career in these areas.

Professor Robert Spitzer's Metallurgical Thermodynamics class during senior year is still a mystery to me. I just chose a career path to stay FAR AWAY from thermodynamics.

Kimberly: My favorite class was anything and everything that got me into the lab. I love getting to see the concepts we learn about on paper in action and taking a sample through all its data collection and then evaluation. Transport Phenomena was the most difficult for me because the concepts didn't come naturally at all, so I had to spend a lot of time with the material to have any understanding of it.

What student club or extracurricular activities were you a part of during your time on campus?

Kathy: I stayed all four years in Shreve Hall. I participated in dorm student government, serving as Shreve's president my senior year. I also was on the staff of WRFL, the Shreve radio station. And I was an editor of PEM – the *Purdue Engineering Magazine*.

Kimberly: I was the most involved in the University Choir in Purdue Musical Organizations – I was a section leader for two years and then the student manager my senior year. In addition, I was an Outreach Team member for the Women in Engineering Program for four years, working specifically with the educational after-school programs. I also had some involvement in Purdue University Materials Advantage (PUMA) and the Purdue Period Project.

Describe an interaction with a faculty member that helped to shape your career.

Kathy: Dr. Mysore Dayananda was an amazing professor! My group did our senior project with him and his work on zero flux plains, and I chose to stay with him to get my master's degree. I was so excited to see him again at the graduation reception in May.

Dr. Dayananda was a stickler for technical writing, and painstakingly made us revise our reports until they were perfect. To this day I cannot put a dangling participle even in an email! He was patient, excellent on conveying content, and inspired my love of product rather than process.

Kimberly: Professor Youngblood was my faculty adviser, and even though our conversations were limited to our scheduling meetings each semester, he was helpful in quelling some of my fears about the state of the aero industry in a post-COVID world. I would have been a lot more hesitant about pursuing it at the current moment if not for him sharing his perspective with me.

What was it like working with other students in your class?

Kathy: MSE graduated less than 30 each year back in the early 80s. We all knew each other, and only one section of each class was offered each year. Interestingly, nearly a third were women when females were only 10% of Purdue engineering overall.

With small classes we weren't very competitive with each other. The atmosphere was very collaborative. Several of us over a couple of graduating classes ended up working together at Inland Steel.

Kimberly: I wish I got to experience more of it! With COVID taking up the majority of my years in MSE, I didn't get to interact with my classmates as much as I'd like, but I can't imagine I would have gotten through my toughest classes without study groups, peer editing each other's lab reports, or just popping in an empty classroom after lectures to go over lesson topics and example problems. They're a brilliant, hardworking, and inspiring group of people.

What was your experience finding your first job?

Kathy: Despite graduating into a recession, there were many jobs. I had already had seven job offers senior year when I decided to stay for graduate school. I was exploring my options during my master's program but got the perfect offer from Inland Steel, where I had done four internships. I ended up working my entire career there.

Kimberly: I actually got my job as a Materials & Processes Engineer at Sierra Space because of a recruiting email sent by Rosemary Son to MSE students. It was for internships, but I went to their website to look at full-time opportunities, and here we are!

For Kathy: What is something that Kim told you about MSE that really surprised you?

I was quite surprised how large that MSE had grown. And while not surprising, I was intrigued on how much more was offered within MSE now. There are so many more types of materials and composites and techniques developed over the last forty years. Polymers were pretty much owned by chemical engineering "back then." And the entire concept of 3D printing still seems science fiction to me!

And an addendum: I'm proud to have started a Purdue engineering dynasty in my family. My only brother became EE86, his son ECE17, his daughter ME21, my daughter Kim is MSE22, and my black sheep son chose engineering technology in the Polytech – Robotics & Mechantronics Engineering Technology 24 :) And that's the entire family!

For Kimberly: What is something that Kathy told you about MSE that really surprised you?

I always knew that my mom was specifically a metallurgical engineer, but I didn't realize that was because Purdue MSE was an almost entirely metals program when she was a student until we were talking about my plan of study one day. I hadn't considered how recently ceramics and polymers became more present in our curriculum.

Outstanding Materials Engineer Awardees

Dr. Kayla Calvert earned her BS (2004), MS (2006), and PhD (2010) degrees from Purdue University in Materials Engineering. She is currently the Global Director of Metallurgical Engineering at Titanium Metals Corporation (TIMET) based out of the Henderson Technical Laboratory in Nevada and has been with TIMET since 2013. In her current role, she oversees technical collaborations with aerospace customers worldwide and serves as an industrial advisor on PhD and consortium research projects. Kayla is the lead for an industry wide team within the Metals Affordability Initiative supported by the Air Force Research Lab that is aimed at correlating ultrasonic signal with microtextured regions (MTRs) in titanium. She and her team develop new titanium alloys as well as advanced characterization methods for aerospace, defense, and industrial markets. Prior to joining TIMET, she was at Abbott Vascular working on development of a new alloy for coronary stents and was awarded a patent for the new alloy.

She received an EAPSI Fellowship during her PhD to study at University of New South Wales located in Sydney, Australia. While there, one of Kayla's favorite Purdue athletic memories is when she and her husband rode on the team bus back to Sydney after cheering on the men's basketball team in an exhibition game. After graduating with her PhD, she received a DAAD scholarship for a short-term postdoc assignment in Heilbad Heiligenstadt, Germany. As a postdoctoral researcher at University of California San Francisco, Kayla was managing a biomechanics laboratory to assist surgeons with research studies at the Orthopedic Trauma Institute. She has published over a dozen articles and presented at numerous technical conferences.

During her time at Purdue, in addition to serving as a TA, Kayla also spent time tutoring athletes, and working summer camps for Women in Engineering that were aimed at introducing engineering to girls in middle school. Kayla was the chapter president of Purdue honor societies Tau Beta Pi and Alpha Sigma Mu as well as a member of Phi Kappa Phi. In addition, she was a student liaison for Purdue with the ASM Indianapolis Chapter. After graduation, she continued her professional service and is currently the TMS Titanium Committee Secretary. She is also a member ASM International. Boiler Up!

Dr. Jon Hilden is a Director of Engineering in the Small Molecule Design and Development (SMDD) group at Eli Lilly and Company, Indianapolis, IN, where he helps bring new medicines to patients by engaging on late-stage tablet commercialization activities. Dr. Hilden received a bachelor's degree in Materials Engineering from San Jose State University, San Jose, CA 1996 before attending the Purdue School of Materials Engineering where completed both his Masters (1998) and PhD (2001) degrees. He followed with 1 year of post-doctoral work split between the MSE and the Industrial and Physical Pharmacy departments at Purdue.

Through Dr. Hilden's career, he has been fortunate to help bring life-saving cancer medications, Covid-19 and immunology treatments, diabetes medicines, and others to patients around the world. He began his career at Bristol Myers Squibb, New Brunswick, NJ, in the materials characterization lab assisting with phase equilibrium analyses and crystal form identification of active pharmaceutical ingredients. He also developed particle size and NIR-based PAT methods for potency determination of drug products. Upon joining Eli Lilly and Company in 2007, he installed a new lab capable of delivering a ~10x reduction in the scale/cost of early-phase formulation development. The reduction was achieved by focusing workflows on the characterization of intensive materials properties and through advanced data strategies combined with judicious use of mathematical scale-up models. The workflow has been implemented on all new solid drug products since the lab's creation. Dr. Hilden has also been active in data engineering and data science activities. He developed the CRAVE computer system and database, passively capturing all aspects of formulation development experiments directly from electronic lab notebooks and linking them with corresponding analytical and materials characterization results in a structured relational database. The system provides efficiency gains by streamlining data analyses and the creation of development reports. The system provides statistical datasets to machine learning algorithms to produce new scientific insights and inform business decisions. The CRAVE system has been implemented across over 500 users and contains fully structured data over 4,000 batch records. Jon has also contributed 35 research articles and book chapters to the scientific community.

Dr. Hilden is actively engaged in various external organizations such as IQ and the ETC and regularly talks at pharmaceutically related conferences. In his free time, he enjoys playing guitar and singing for the SMDD band, sailing, competing in triathlons, including completion of the Louisville Ironman in 2014, and raising 3 wonderful children.

For more than 25 years, **Dr. Jason Jenny** has been a key player in the LED arena, and his work has literally changed the light around us.

In his role as Operations Manager, Global Operations for Wolfspeed, a leading company making wide bandgap semiconductors, Dr. Jenny currently oversees annual capital expenditures of over $500M, and selects key technologies to invest in equipment and manufacturing capabilities for Silicon Carbide. Prior to his work in capital management, he has led manufacturing organizations both in the United States and in China, deploying silicon carbide wafer and LED component manufacturing. He was a leader on several million dollars in Department of Defense (DoD) contracts for developing SiC for semiconductors, demonstrating 2 inch, 3 inch, and 100 mm diameter single crystal growth of SiC for lighting and high power electronics. He was also responsible for developing the business product line for clear gemstone simulants (moissanite), as well as the R&D for silicon carbide for semiconductor applications, having established SiC fabrication and growth facilities in the U.S. and abroad. In addition to his work at Wolfspeed, he has been lecturing in the MBA@UNC program for the University of North Carolina as an adjunct professor in operations for the past 8 years.

Dr. Jenny holds 18 U.S. patents, and has published 33 papers and refereed conference proceedings, having been cited over 1,000 times in the literature.

Glenn Teuber received his BS in Materials Engineers in 2002 and an MBA in 2008 from Isenberg School of Management. Currently he serves as the Chief Operating Officer of Google Fi, a wireless mobile virtual network operator product. In this role he is responsible for day to day operations of the business, product policy, business planning, strategic growth efforts including mergers & acquisitions, and driving cross product collaboration with other businesses within the Google ecosystem. He joined the Google Fi product prior to its public release, and is one of a few members of the team that has been guiding the product from launch to its current position within the competitive cellular market. Early in his tenure on the product he established the Strategy & Operations job function and all core operating structures before being elevated to the COO role.

Prior to his experience on Google Fi he held a wide variety of positions in program management and finance in his 11+ year career at Google. In these prior roles he led global teams tasked with selling Google hardware on its e-commerce site and financial operations allowing Google to conduct business in over 100 countries. During Google's ownership of Motorola Mobility, he was Head of Global Procurement Operations for the business unit, where he executed a global reorganization to increase efficiency and drove the divestiture process for the cable box and modem business lines. Before Google, he worked as a consultant supporting retailers and held several engineering positions at IBM Microelectronics.

As a leader at Google he also supports global hiring in the product operations job function where he reviews all roles for appropriate job structure and career progression, all candidates' hiring packets for skills and culture fit, and diversity, equity and inclusion in the hiring process. He is also the executive sponsor for the product operations MBA Internship program where he ensures the success of the interns' summer experience and conversion to full-time hires.

Outside of work, he serves as the audit chair of a non-profit aimed at helping young professionals enter the working world and navigate a growing career.

2022 AWARDEES OMSE

Co-op Hall of Fame

Congratulations to MSE alumnae, Dianna Clute and Jessica Van Dalen, J.D. who were part of the 2021 class inducted into Purdue's Professional Practice Hall of Fame. The Hall of Fame was created in 2010 to recognize individuals who have had a significant influence on Purdue's Professional Practice Programs, as well as alumni of our programs that have demonstrated unparalleled excellence in their field and serve as shining ambassadors of the opportunities that experiential education grants.

Ms. Clute received her Bachelor's degree in Materials Engineering from Purdue in 2005. While attending Purdue, she completed a 5-session co-op with Raybestos Products Company. She currently serves as an Engineering Manager for Core Components Design in the Large Power Systems Division at Caterpillar, Inc. In her role, she leads a team of engineers with product ownership responsibility for the core components used across the full LPSD product offering portfolio. She positions her team as the go-to product experts leveraged by internal partners and external customers.

Dianna delivers top results in a global organization, and seeks opportunities to engage in outreach with Purdue, the Society of Women Engineers (SWE), and STEM education whenever possible. She strongly attributes her collaboration and leadership skills to her early experiences during the Purdue co-op program, and her solid foundation established as a Purdue MSE student.

A few highlights of her time as a co-op student include creating and optimizing a three-step process to replace a standard seven-step production of a carbon yarn composite material, and developing and implementing a procedure to analyze the surface energy of friction materials using a Drop Shape Analysis instrument (DSA). By the end of her co-op, Dianna was also recruiting and interviewing new co-op employees and aiding in the training of those individuals. In addition to her co-op experience, she also participated in the Summer Undergraduate Research Fellowship (SURF) program, served as the Secretary of the Society of Materials Engineering, served as the Membership Committee Head for the Purdue Society of Professional Engineers and was a member of the Alpha Sigma Mu Materials Honors Fraternity.

Ms. Clute has served on the Purdue MSE Advisory Committee since 2015, and is a 2018 graduate of Leadership Lafayette, a yearlong community leadership program in Lafayette, Indiana. In 2014, she received the Manufacturing Institute "Women in Manufacturing STEP Award which recognizes the achievements of women in manufacturing, quality and engineering roles.

Ms. Van Dalen received her Bachelor's degree in Materials Engineering from Purdue in 2007. Following graduation from Purdue, she went on to receive her Juris Doctor from the Indiana University Maurer School of Law in 2010. While attending Purdue, she completed a co-op with Raybestos Products Company in Crawfordsville, IN.

During her co-op, she gained experience with heavy-duty friction materials used primarily for automotive and agricultural vehicle applications. From 2006-2007, Jessica served as a research assistant in engineering at Purdue, where she focused on formulations and testing of adhesives used for joining metallic substrates.

Currently, Ms. Van Dalen is a Partner in the Faegre Drinker Biddle & Reath law firm in Indianapolis, where she works in the firm's intellectual property group. She works with clients to prepare and prosecute patent applications before the U.S. Patent and Trademark Office as well as government entities in Japan, Europe, Canada, China, Australia and other countries. In addition to this work, Ms. Van Dalen also has experience in licensing agreements, portfolio analysis, opinion work related to infringement and patent invalidity and post-grant proceedings. She works primarily in the mechanical arts but focused her engineering curriculum on polymer science and molecular-level interactions between materials. Secondarily, she works in the materials and chemical arts in a variety of technology areas.

Ms. Van Dalen has served as an adjunct faculty member at Indiana University Maurer School of Law Intellectual Property Clinic and, was named a Rising Star by Indiana Super Lawyers in 2019. She was the recipient of the 2017 Pro Bono Publico Award from the Indiana Bar Association and also named an Outstanding Materials Engineer by the Purdue School of Materials Engineering in 2018. She was named to the Faegre Baker and Daniels Pro Bono Honor roll from 2014-2016 and served as the Women's Law Caucus President at the Indiana University School of Law. In addition to these activities, she has served on the Advisory Board for the Indiana University Maurer School of Law Intellectual Property Clinic and has been a board member for both the Old Northside Association and the Old Northside Foundation as well as serving on the Steering Committee for the YMCA of Greater Indianapolis.

UNDERGRADUATE STUDENT PROFILE

Tristan Wiley · Indianapolis, IN

What attracted you to Purdue University and specifically, Materials Engineering? Since I am from Indiana and interested in Engineering, Purdue seemed an obvious choice. I wanted to go to a big school with a lot of resources and a stellar engineering program, and Purdue couldn't have checked more boxes if it had tried.

I hadn't initially intended to go into Materials Engineering, however, after learning more about it, talking to some of the current students, and learning about the coursework, it aligned most closely with my interests and career goals, and the students seemed the happiest.

What has been your greatest achievement during your time in the School of Materials Engineering? My greatest achievement during my time in the School of Materials Engineering was being chosen for the AAMP-EM (Advancing Army Modernization Priorities – Energetic Materials) under Professor Chelsea Davis. Not only was it a great honor to be chosen for this undergraduate research program, it was also an excellent learning opportunity for me, and I have been continuing with Prof. Davis ever since.

What has been your favorite MSE course; why? My favorite MSE course has been the materials processing lab. It was very hands-on, and we were able to cast metal and ceramics, and mold and extrude polymers. It gave me a chance to do what I had been learning about in classes.

Please discuss any participation in co-op or internship programs and how the experience was beneficial. I worked at 3M for this summer, and the experience was beyond beneficial. I worked with many concepts and tests that I learned in my MSE courses at Purdue, and it was enlightening to see them in action on a project for a real-world product. I am excited to go back to classes in the fall with this application knowledge on board.

Have you been involved in any student organizations while at Purdue? If so, which ones? Outside of class, I am heavily involved with club rugby and Boiler Gold Rush (the freshman orientation program) on campus. Playing rugby has been important to me since I started playing, acting as both a steam vent and a social outlet. The team is very close, so being their president and able to practice with them 3 times a week with games on Saturdays is always something I look forward to!

Why would you recommend this department to others who are still deciding on an area of study? I would recommend Materials Engineering to anyone who likes hands-on learning and chemistry. While our coursework is highly nano- or microscale in nature, it is seamlessly applied to macroscale concepts in labs and some junior year courses on processing. It is a course of study that will help you understand why everything tangible is the way it is.

Is there any additional information that you would like to share with our readers/alumni? I would like to thank the department of Materials Engineering, especially my undergraduate research advisor Prof. Chelsea Davis, for fueling my love of learning and encouraging me to chase the answers to all my questions.

Undergrad Research

IF YOU CAN'T SEE IT, CAN YOU SIMULATE IT?

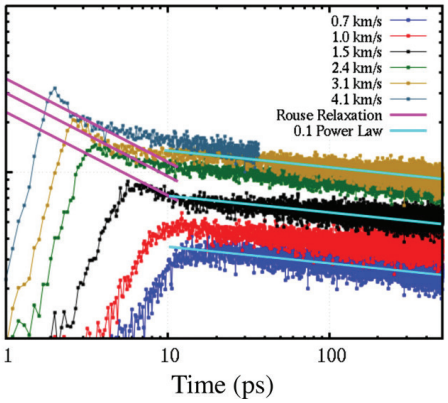
Jalen Macatangay, originally from Elmhurst, IL, is set to begin his senior year in MSE with a minor in physics. Outside of coursework, he enjoys being active. His favorite activities include tennis, basketball, running, and weightlifting. He is also involved with the Tau Beta Pi Engineering Honors Society and Club Tennis at Purdue. He looks forward to serving as the Ambassador Chair of Purdue University Materials Advantage (PUMA) to help promote MSE to First-Year Engineering and prospective students. Over the summer, he has been interning at Lawrence Livermore National Laboratory within the Materials Engineering Division.

In collaboration with Dr. Alejandro Strachan and Dr. Brenden Hamilton, Jalen's research focuses on studying the response of materials under extreme conditions. His specific project studies polymers subject to mechanical shockwaves which induce rapid compression. With their broad spectrum of properties, such as elasticity and versatility, polymers serve ubiquitous roles. Of recent interest are fast impact (shock loading) applications. Examples include the detonation of military-grade explosives, hypersonic erosion, and space exploration. Prior research observed that these high-rate conditions cause abrupt rises in temperature and pressure, and interestingly, glassy, brittle behavior in polymers. However, the underlying molecular mechanisms that govern a polymer's response and relaxation under shock loading remain poorly understood. Especially challenging is modeling across the glass transition temperature, which is critical for the design of safer and impact-resistant materials.

As the molecular phenomena caused by shock loading occur on extremely short time (ps) and length (nm) scales, it is impractical to assess experimentally. Therefore, Jalen's work utilizes all-atom molecular dynamics (MD), a computational tool to simulate atomic interactions and motion via classical mechanics. Relying on statistical mechanics, MD can accurately predict material properties based on atomic position and momentum over time. He uses a specific MD method, the multi-scale shock technique, to study polystyrene under a variety of loading conditions.

Analysis of the deviatoric stress, a measure of non-hydrostatic stress levels, reveals an unexpected behavior in glassy polymers under shock loading: short, transient melting to rapidly reduce such stresses. In other words, polystyrene acts like a melt on short timescales despite being below its glass transition temperature. The simulations show that at the atomic scale, a huge activation of dihedral angle fluctuations along the polymer's backbone occurs in response to high deviatoric stresses, and thus, accelerates relaxation mechanisms. As levels of deviatoric stress weaken, so does the rate of fluctuations. This quickly takes the system back to a glassy state where more manageable levels of deviatoric stress relax for significantly longer timescales (~ μs). Surprisingly, this phenomenon has been observed in metals, but with fundamentally different mechanisms at the atomic scale. Interestingly, the pressure necessary for this to occur in polymers (~ 5 GPa) is significantly lower than for metals (~ 130 GPa). These findings are important contributions to understanding glassy polymer dynamics under extreme conditions.

From his research, Jalen seeks to shed light on the molecular phenomena that drive the response of materials under extreme conditions, through powerful computational techniques that can overcome experimental limitations. Following his senior year, Jalen hopes to pursue a PhD in MSE. Afterward, he plans to obtain a research and teaching position at the university level, focusing on the predictive modeling and simulation of materials under extreme conditions.



Deviatoric stress time histories for several shock loading conditions. Short, transient melting is observed at the onset of 1.5 km/s (black curve) and is similar to expected decay rates of a Rouse mode relaxation in an unentangled melt (magenta lines). The cyan lines are power-law decays with an exponent of −0.1 to represent the slower relaxation regime.

2022 Student Award Recipients

The John L. Bray Memorial Award
Hannah Deboer
Pattiya Pubulchinda

Outstanding Graduating Undergraduate Research Award
Pattiya Pubulchinda

Donna Bystrom Undergraduate Service Award
Hugh Grennan

Outstanding Graduate Student Service Award
Benjamin Stegman

Outstanding Graduate Student Researcher
José Waimin

Estus H. and Vashti L. Magoon Graduate Teaching Award
Khaled Abdelaziz
Anyu Shang

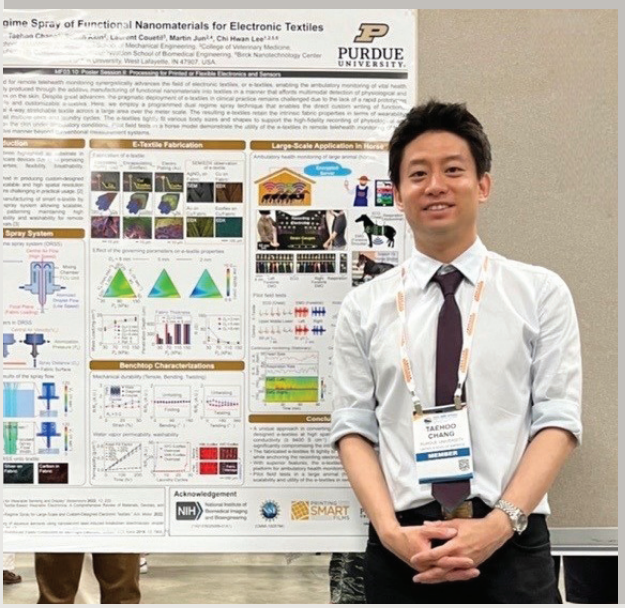
Briney Achievement Award
Morgan Chamberlain
Rahul Joseph Franklin
Swapnil Kishor Morankar
Daniel Sinclair

Teaching Academy Grad Award
James Barnard

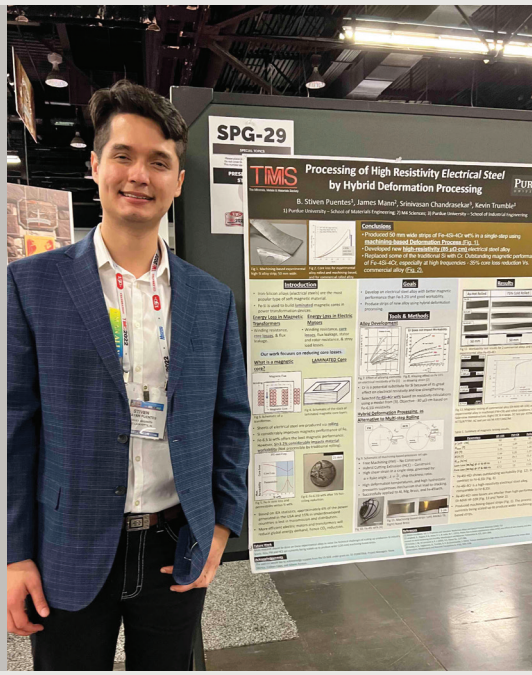
PURDUE UNIVERSITY

School of Materials Engineering

Congratulations to MSE graduate student, **Taehoo Chang** for receiving the best poster award at the MRS Spring 2022 conference! His poster titled Dual Regime Spray of Functional Nanomaterials for Electronic Textiles was selected for this symposium level award that stems from the feedback of the symposium organizers and session chairs. This research was multidisciplinary collaboration work with Prof. Martin Byung-Guk Jun in Mechanical Engineering and Prof. Laurent Couetil in Purdue's College of Veterinary Medicine. Taehoo is co-advised by MSE professor, Lia Stanciu, and Professor of Mechanical/ Biomedical Engineering (BME), Dr. Chi Hwan Lee (MSE professor by courtesy).



Congratulations to MSE graduate student, **B. Stiven Puentes Rodriguez**, for winning the 2022 TMS MPMD Graduate student poster competition in the Materials Processing & Manufacturing Division. He is advised by Professor Kevin Trumble, and his poster was entitled: "Production of High Resistivity Electrical Steel by Hybrid Deformation Processing." Learn more: bit.ly/Rodriguez-TMS-2022



GRADUATE STUDENT PROFILE

Caitlin Adams · West Lafayette, IN

FACULTY ADVISOR: PROFESSOR KENDRA ERK

How did you first hear about Purdue University? I grew up here!

What attracted you to Purdue University's graduate programs?
Purdue has a national reputation for excellence in engineering that I came to really understand when I left West Lafayette after high school for undergraduate in Massachusetts and got a non-local perspective on Purdue. By the time I had graduated with my bachelor's degree in chemistry and was considering graduate school, I knew I wanted to explore the impact of my research and its applications as well as the fundamental science at play, so it made sense to move from chemistry into engineering. I ultimately decided to attend Purdue MSE for graduate school because the program is strong across material types and filled with good, caring people I wanted to work with and learn from. It seemed like it would be the best place for me to push myself and develop as a researcher.

What has been most rewarding about your time in Materials Engineering?
Being a part of this community. I am surrounded and supported by peers, mentors, and mentees who want to work together to create and share knowledge. My relationships with the people I work with make my work better.

What is your area of research?
In short, I study hydrogel-calcium systems. My work started as an implementation-driven project funded by the Joint Transportation Research Program and the Indiana Department of Transportation with the aim to answer key questions that would inform the use of lab-proven durability of superabsorbent polymer internal curing of concrete in bridge decks and full-depth patches of Indiana roads. Now I'm engineering composite superabsorbent polymers through a biomineralization-inspired basic science investigation of hydrogel-mediated nucleation and growth of calcium compounds like those that give cement its strength. Such a composite could increase the value of incorporating SAP technology in concrete projects and promote commercial uptake of SAP internally cured concrete.

Have you been involved in any student organizations or community activities while at Purdue? If so, which ones?
Yes! Before I started grad school I didn't realize how many opportunities there would be to get involved. I've been a peer mentor for incoming MSE grad students through the Materials Engineering Graduate Student Association (MSEGSA) since my second year, and I served as the MSEGSA Safety Co-Chair for two years. As part of that role, I served on the MSE Safety Committee. In 2021, through Material Advantage Congressional Visits Day, I joined other MSE graduate and undergraduate students to discuss the importance and impact of federal STEM research funding with our congresspeople. I have also participated in the Engineering Academic Careers Club here at Purdue, which has allowed me to join a community of students and supportive faculty and staff mentors as I build the foundation of my own academic career. And outside of MSE, pre-pandemic, I sang in Purdue Musical Organization's All-Campus & Community Chorale, which was so fun. I love singing in ensembles.

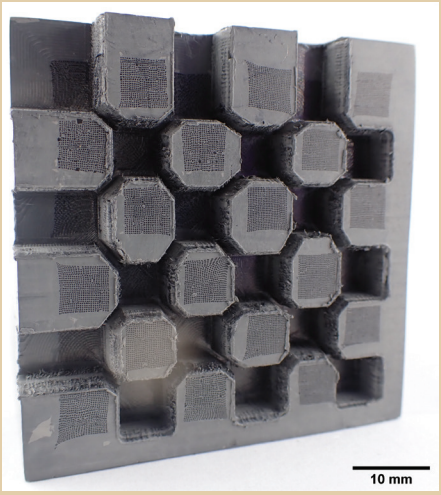
Why would you recommend this department to others who are still deciding on an area of study?
Materials engineering is relevant to almost anything and everything you could want to do. Any research pursuit is dependent on materials in some fashion or another. Characterizing and developing structure-property-processing-performance relationships is central to materials engineering and is also excellent at building analytical skills. Materials engineering spans the basic and applied research, meaning you can move along the continuum or find your favorite place within it. Materials research is often collaborative and interdisciplinary as materials are engineered for different applications, which builds teamwork skills. If you want to develop technically and professionally, studying materials engineering is an excellent way to do it.

How do you plan to use your knowledge and experience gained at Purdue University in the future?
What I've always wanted to do is share my enthusiasm for engineering and science with others. During my PhD at Purdue, I've been able to do so through teaching, mentoring, and working with undergraduates. I hope to continue that work in intellectually exciting, curious, collaborative, and caring environments going forward.

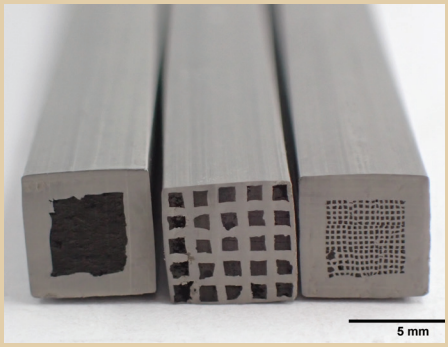
If you could give one piece of advice to undergraduates considering graduate school, what would it be?
Think about what makes you curious and think about what matters to you—what you value. Doing research means living with a lot of uncertainty. My curiosity about the research questions I'm investigating is both a driving and grounding force that helps me appreciate and continue even when things don't turn out as I hypothesized, expected, or hoped. Identifying my values helped me choose where to apply and who to ask to be my advisor once I was at Purdue—both decisions have had huge positive impacts on my graduate school experience and overall wellbeing.

Current Graduate Student Balances

RESEARCH AND LEADERSHIP FOR MSE



A prototype SiC heat exchanger where each of the units has 225 square channels with an opening of 120 microns.



The three different extrudates that are created during the co-extrusion process with each extrudate shrinking the square feature by a factor of 5.

Olivia Brandt is a 3rd year PhD candidate who is co-advised by Professors Rodney Trice and Jeffrey Youngblood. Olivia received her BS in materials science and engineering from the University of California, Riverside in 2019. Her research project, funded by ARPA-E and done in collaboration with PhD candidate Rodrigo Orta, is on using co-extrusion to fabricate a compact, ceramic heat exchanger.

Ceramics are challenging to form into useful shapes as traditional processing techniques such as casting, or melting are not suitable for ceramics. Ceramics are often formed from compacting powder which severely limits the shapes that can be made. To form ceramics into complex shapes, a polymeric binder is added to the ceramic powder. Techniques such as injection molding, tape casting, and direct ink writing, all utilize polymer binders to increase shape complexity. While these techniques all have their advantages, they are still limited in terms of feature size as these techniques produce samples that are on the scale of millimeters.

Ceramic co-extrusion is a processing technique that can produce samples with micron-sized features using a process of extruding and rebundling to shrink feature size. To create a ceramic feedrod that is extrudable, the ceramic powder must be blended with thermoplastic polymers. This allows for the ceramic to be formed using thermoplastic fabrication techniques which enables shaping via slight heat and pressure. The polymeric binder is removed via polymer pyrolysis before densifying the ceramic through pressureless sintering.

The co-extrusion process can be used to create an array of micron-sized square channels as shown in the top figure. This array of micron-sized channels can be used in heat exchangers as the small channels improve the thermal efficiency of the heat exchanger. To create the array of square channels, a feedrod made of a carbon black core, which will be removed during pyrolysis, is surrounded by silicon carbide (SiC) walls. This feedrod is then extruded through a reduction die which reduces the overall size without changing the geometric ratios of the original feedrod. The extruded feedrod is then rebundled into the same size of the original feedrod before going through another extrusion. The extrudates from three different extrusion and rebundling steps are shown in bottom figure. The final extrudates consist of 225 channels each with an opening of 120 microns. The co-extrusion process offers many benefits for fabrication of micron-sized ceramic pieces as this process is scalable and low-cost. The co-extrusion process is currently being explored for applications such as ceramic fuel cells and ceramic heat exchangers.

While research is a large part of what Olivia does at Purdue, she is also active within the American Ceramics Society where she is president of the student group, the President's Council of Student Advisors (PCSA). PCSA organizes outreach events for school age kids to get them familiar with materials science and helps organize events and panels at various ceramics conferences. Additionally, She is also a part of the Graduate Women in Engineering Network (GWEN) leadership team within the Women in Engineering program. This past year, Olivia helped to organize the first annual GWEN symposium where she was able to present her work and create a supportive environment for engineers to present their research in new and engaging ways.

MATERIALS MATTER @Purdue

School of Materials Engineering
Neil Armstrong Hall of Engineering
701 West Stadium Avenue
West Lafayette, IN 47907-2045

ALUMNI NEWS

Gail Fukumoto (BS, 2019) - Society of Women Engineers (SWE) Rising Technical Contributor Award! This award honors up to 10 individuals nationally who are engaged in engineering or technology and have individually contributed technical work resulting in significant break-throughs. **bit.ly/Fukumoto-SWE-Award**

Jack Lopez (BS, 2017) - Conexus Indiana Rising 30 for his work in additive manufacturing! This honor recognizes exceptional advanced manufacturing and logistics talent, and the honorees represent Indiana's top talent who will affirm Indiana as the center of innovation and digital transformation for advanced manufacturing and logistics into the future. **bit.ly/Lopez-Conexus-Indiana**

Dr. Valerie Weisner (PhD, 2013) - Grainger Foundation Frontiers of Engineering 2022 Symposium of the National Academy of Engineering. This group of eighty-four early career engineers is performing research and technical work in a variety of fields and each participant was nominated by fellow engineers or organizations. **bit.ly/Frontiers-of-Engineering-2022**

STAFF UPDATES

MSE is pleased to welcome **Josh Contreras** to Materials Engineering in the role of Administrative Assistant. From 2017-2020, Mr. Contreras worked at Jordan Manufacturing Inc. as a sales assistant where he handled several large accounts in terms of customer service, order processing, product content, etc.

From there, he started his Purdue career in the Bursar's Office working as a customer service representative handling a large volume of calls and emails received from students, parents, and other university office inquiries.

In his role within MSE, Mr. Contreras will be working with the graduate admissions committee to assist in the recruiting and onboarding incoming graduate students. He will also serve as an event planner to coordinate events such as the School's graduation reception and prospective graduate student visit and reception.

Earlier this year, MSE welcomed **Maddison Walsh** as an administrative assistant. Mrs. Walsh joins us by way of Junction City, KS where she spent the last two years as an administrative assistant for the 12th St. Community Center. She is returning to her roots at Purdue University, where in 2019, she earned her BS degree in Computer Graphics Technology & Web Design and Development. While a student, from 2017–2019, she worked as a web designer in the School of Forestry and Natural Resources.