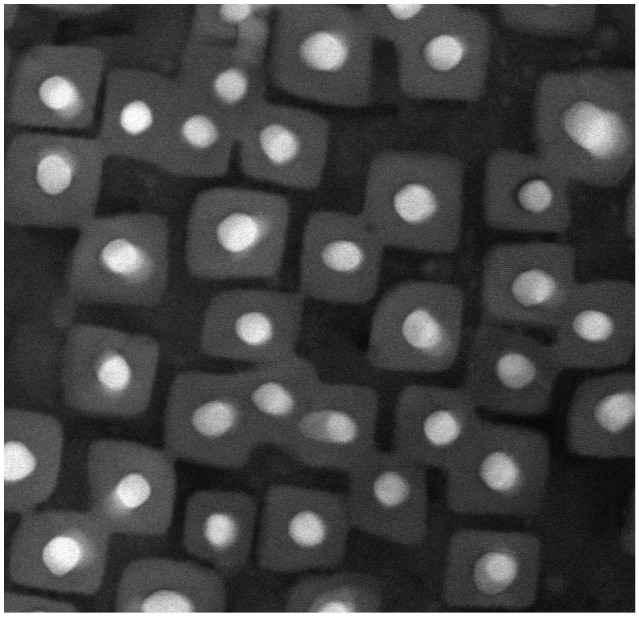
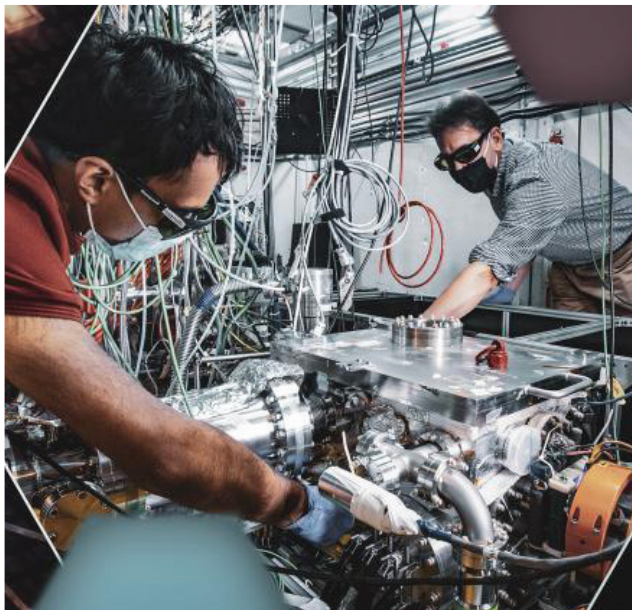
MATERIALS MATTER @Purdue

2021 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,

You probably know that engineers are often thought of as being pretty good at math. So, let me throw this out there with a straight face:

$$2022 \neq 2019 + 3$$

We're trying to make sure that we learn from the past 18 months. Challenges abound, and they aren't all tied to COVID-19; this year we have 78 seniors, and we expect about 50% more first year engineering students this year than in 2018. This is a nice problem to have, and we want all these students to be successful. To do this, we need to ramp up our ability to handle larger classes and give all our students the time, attention, and opportunities our alumni experienced over our more than 60-year history as a School. Our faculty has grown with enrollment, but we are getting to be space and equipment constrained. Our core undergrad curriculum was developed when we graduated 20 students per year. It's time for Purdue MSE to help lay out what the MSE of 2040 is going to look like, and I can also say that's not a simple 2040=2020+20. We're undergoing a re-envisioning process to develop labs for what the students of the future will need. We're offering courses in more formats (in person, summer, hybrid, online) than we ever did before because we know that not everyone learns well in the same manner, and helping all our students succeed is job #1.

Some takeaways from the past year:

- Online interaction with faculty, staff, students and alumni needs to continue. Not everyone comes to campus, and we were able to access our outstanding alumni network to provide students with opportunities to hear about career choices and new materials from Dallas to Dubai. We're going to keep doing this, and alumni, we need your help!
- Inclusivity remains a priority. From our sophomores to grad students, we found that we need to be even more deliberate in making sure we are providing a welcoming environment to every student. What some students called tight-knit others referred to as clique-ish and this was more evident online. Our recruiting and our on-campus mentoring will all be examined to ensure we're living up to our aspirations to be a diverse, equitable, and inclusive School.
- Providing financial support to students is also crucial, and we're going to grow our efforts at raising funds to provide scholarships, travel to conferences, and enhanced online and on-campus events that celebrate the breadth of our students' backgrounds and experiences. We'll continue to look for new ways to maintain, improve, and upgrade lab and computational facilities for our undergrads and graduate students.

I hope you enjoy seeing some highlights in this year's newsletter, and that you'll join us in proving "You can't make it without materials!"

Hail Purdue,

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

inside

3 **Gold, Silver and Bronze Aren't Just Materials!**

4 **Faculty News**

5 **Faculty Research Highlights**

7 **Departmental News**

7 **Staff News**

8 **Vicki Cline Retires after 43 Years of Dedicated Service to Purdue**

10 **Outstanding Materials Engineer Awards for 2021**
DR. MATTHEW KUSH
TRACY LOPES
PETER C. TORTORICI

12 **Steven Ferdon Named as College of Engineering Distinguished Engineering Alumnus**

13 **Undergraduate Student Profile**
HUGH GRENNAN

14 **2021 Student Award Recipients**

15 **Graduate Student Profile**
JOSE WAIMIN

16 **Congratulations to nanoHUB.org**

PURDUE UNIVERSITY

School of Materials 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**

Senior Director of Development ▪ **Robyn Jakes**

www.engineering.purdue.edu/MSE

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

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Gold, Silver and Bronze Aren't Just Materials!

The Ray Ewry Sports Engineering Center
Formed as a partnership between Purdue Athletics and the College of Engineering, the Ray Ewry Sports Engineering Center was inspired by Ray Ewry, the Boilermaker and record-setting Olympian with a powerful will to succeed.

Ewry, born in 1873, was orphaned at the age of 5 and suffered from polio at the age of 7. He overcame these hardships to earn a degree from Purdue Mechanical Engineering, as well as win a record-setting 10 Olympic gold medals in Track and Field – a global record that lasted 100 years.

The Ray Ewry Sports Engineering Center will reflect Ewry's passion for both sports and engineering. Its team will work directly with the International Olympic Committee (IOC) to develop cutting-edge technology that reduces athletes' injuries, improves performance, advances rehabilitation techniques, enhances the fan experience, and promotes fairness and integrity. Purdue is proud of our leadership in both engineering and athletics. By merging Purdue's two great strengths, the Center for Sports Engineering will raise the world's expectations for athletic excitement, integrity and health.

Professor Jan-Anders Mansson, Distinguished Professor of Materials Engineering and Chemical Engineering, and Co-Director of IN-MaC (Indiana Manufacturing Competitiveness Center previously served as the President of International Academy of Sports Science and Technology, an International Olympic Committee for more than 12 years. Professor. Mansson will be the visionary leader and a Core Area director for the center. He helped Purdue Engineering faculty build strong ties with the International Olympic Committee, highlighted by Dean Mung Chiang's recent visit to its headquarters in Lausanne, Switzerland. In addition to the Olympics, the Center's other partners will include: the International Academy of Sports Science and Technology (AISTS), KTH Royal Institute of Technology in Stockholm, Stanford University, and the Stockholm School of Economics.
bit.ly/Ewry-Sports-Engineering-Center

Anna Giesler is a first-year graduate student under Dr. Jan-Anders Mansson and student lead for the Ray Ewry Sports Engineering Center (RESEC). She is also a Purdue MSE alum ('20), member of the honors college, and a former Purdue varsity swimmer. "When I first began doing research with Dr. Mansson in 2018, I had no idea what sports engineering was, other than it combined my two biggest passions- sports and engineering. I had my first opportunity to do research in this field with a project for the International Swimming Federation (FINA), where I was looking into what factors influence the permeability of technical swimsuits (like what you see in the Olympics) and the extent to which they do," said Anna. Work on this project is still ongoing as they continuously look to improve the homologation process of swimsuits; it has already saved a company millions of dollars in fines. This project touches on one of the three pillars RESEC is built upon: integrity of sport. As technology continues to advance, it is imperative that the athlete remains the priority and that a level playing field is maintained.

Anna's graduate research is at the intersection of traditional sports engineering and the next generation, where topics like digitalization, fan experience, and sport as a lifestyle are in the spotlight. There is a huge opportunity to start bringing all these different aspects together into one system, which is what RESEC is hoping to do. By looking at data collection, analysis, and distribution methods, there is a chance to influence what the next areas of innovation are and redefine how research is conducted in sports engineering. One area Anna is exploring is how to enhance the fan experience, especially for sports that have lower viewership or less funding dedicated to this area. Being a swimmer and having grown up around sailing, these are two sports she is uniquely interested in, and there is a need for a better fan experience in both. But before addressing how to make it better, there should be a shared understanding of what the fan experience really is. "I see it as having three aspects: fan education, the streaming experience, and the in-person experience. Fan education is about teaching fans about the sport, everything from the general rules to who is competing, with the goal of bringing in new fans and hopefully increasing participation and viewership too. The streaming experience is rapidly growing as fans can have access to their favorite games wherever they are, but at the expense of community. One way that feeling of community can be created is through reverse streaming, where the fan at home is brought back to the game, creating more personal, engaging experiences that can unite fans across the globe. With streaming becoming more convenient and cost effective than attending the game, there needs to be innovation that draws people back to the stadium. The in-person experience will look to incorporate more digital technologies, like VR/AR, and perhaps offer exclusive content only available to ticket holders." One way to bring all three of these aspects together is through a Sports Execution System, where different stakeholders (e.g., event organizers, athletes/teams, governing bodies, broadcast networks, etc.) can all contribute data and then, using edge analysis and other secure processing methods, can obtain unique insights that can help athletes perform better and organizers execute events more efficiently. This is the future of sport and something Anna and the RESEC team are working to take from idea to reality.

FACULTY AWARDS & RECOGNITION

Chelsea Davis
National Science Foundation CAREER Award

Early Career Scientist Award from the Adhesion Society

Purdue College of Engineering Outstanding Graduate Mentor Award

Carol Handwerker
Materials Research Society (MRS) Fellow

Carlos Martinez
Outstanding Technology Development Award from the Far West Region of the Federal Laboratory Consortium for Technology Transfer

Reinhardt Schuhman Jr. Best Undergraduate Teaching Award

Maria Okuniewski
American Nuclear Society Mary Jane Oestmann Professional Women's Achievement Award

Lia Stanciu
Provost Fellow

Alejandro Strachan
R&D 100 Award

Jeffrey Youngblood
Richard E. Grace Best Faculty Award

TITUS WINS NATIONAL ASM TEACHING AWARD

Professor Michael Titus has received the 2021 Bradley Stoughton Award for Young Teachers from ASM International. This award was established in 1952 in memory of an outstanding teacher in metallurgy and dean of engineering who was president of ASM in 1942, recognizing young teachers of materials science, materials engineering, and design and processing, rewarding and recognizing their ability to impart knowledge and enthusiasm to students. Dr. Titus joins the previous ASM teaching award recipients who have taught/are teaching at Purdue, including Richard Grace, Mysore Dayananda, David Bahr, and Nikhilesh Chawla.

"For excellence in coupling computational and experimental methods to enhance student's learning across all levels, particularly focusing on processing-structure-property relationships in high Temperature materials."

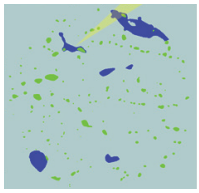
NAI FELLOW

Dr. Haiyan Wang, Basil S. Turner Professor of Engineering, has been named a fellow of the National Society of Inventors!

Prof. Haiyan Wang is the Basil R. Turner Professor of Engineering in the School of Materials Engineering and School of Electrical and Computer Engineering at Purdue University. Wang specializes in high temperature superconductors coated conductors, nanostructured functional ceramics for solid oxide fuel cells, plasmonics and photonics, ferroelectric and multiferroics, and radiation tolerance materials, and bulk structural metals and ceramics. She pioneered the designs of vertically aligned nanocomposites in oxide-oxide, oxide-metal, nitride-metal and many other systems.

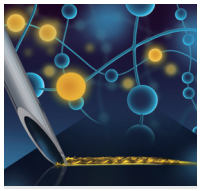
She is a leader in the design and processing of ductile high temperature ceramics via non-equilibrium processing techniques. She holds 14 U.S. patents that have been licensed to 3 companies. She has published over 590 journal articles (with 22500 citations and an H-index of 71) and presented over 300 invited and contributed talks at various international conferences. She serves as an associate editor for Science Advances, Vacuum, a section editor for BMC Materials and a MRS Bulletin volume organizer for 2021. Wang is a fellow of NAI, MRS (2019), APS (2017), AAAS (2016), ACerS (2015), and ASM International (2014). Her major awards include TAMEST O'Donnell Award in Engineering 2015, and the ASM Silver Medal Award for Outstanding Mid-Career Materials Scientist 2011. bit.ly/Wang-NAI-Fellow

Faculty Research Highlights



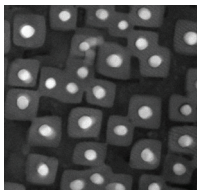
Machine-Learning-based Algorithms for Automated Image Segmentation Techniques of Transmission X-ray Microscopy (TXM)

Prof. Chawla's group is using machine-learning techniques to automatically and efficiently conduct image analysis on time-resolved x-ray microtomography datasets. X-ray microscopy is used to understand how materials behave under a mechanical, thermal, environmental, and/or electrical stimulus. Image analysis is used to track and quantify damage, cracking, and other changes in the microstructure. Machine learning techniques are being exploited and development to shorten the time from acquisition to statistical quantification of the time-resolved datasets. bit.ly/Chawla-machine-learning



An Engineer's Introduction to Mechanophores

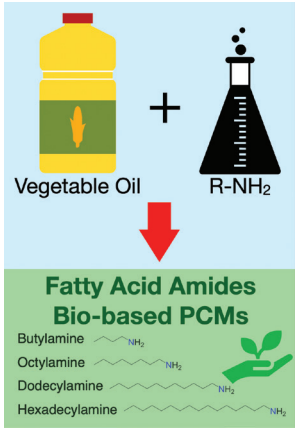
Molecular damage sensors, known as mechanophores, are a promising new technology for sensing deformation in soft materials. Doctoral student Naomi Deneke and recent graduate Dr. Mitchell Rencheck in the Davis Research Group recently published a review article that introduces these fascinating new detectors to engineers. bit.ly/Davis-Mechanophores



Self-assembled low-loss plasmonic hybrid metamaterials with a "nano-domino-like" structure

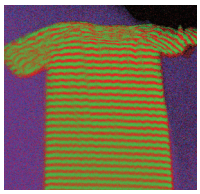
Professor Haiyan Wang and recent MSE PhD graduate, Dr. Di Zhang, have created a self-assembled oxide-metal hybrid metamaterial with a unique ordered "nano-domino-like" microstructure using a pulsed laser deposition technique. Such ordered structure is composed of Au-Ag alloyed nanopillars in a dielectric oxide matrix. The overall hybrid film exhibits enhanced surface plasmon resonance, low-loss in the UV-Vis-NIR region, and, excellent thermal stability. bit.ly/Wang-metamaterials

Synthesis and Characterization of Fatty Acid Amides from Commercial Vegetable Oils and Primary Alkyl Amines for Phase Change Material Applications



A team composed of Prof. Carlos Martinez, Prof. Jeffrey Youngblood, working with recent PhD Daniela Betancourt synthesized new bio-based phase change materials (PCM) from vegetable oils. PCMs store energy as latent heat, and this energy can be used for passive heating. On a related project, the team uses the bio-PCMs to melt snow and extend the lifespan of asphalt roads. bit.ly/Youngblood-Martinez-BioPCM

Superstrong, deformable metallic nanocomposites



Energy dispersive spectroscopy map showing a "T-shirt" morphology in the Cu 25 nm/Co 25 nm multilayer after the micropillar compression tests. Red is Cu and green is Co. The research group led by MSE professor, Xinghang Zhang, has discovered a method to produce super strong, deformable metallic nanocomposite. The finding was first published in Acta Materialia, 2020, and recently highlighted as a cover image in MRS Bulletin, 2021. bit.ly/Zhang-metallic-nanocomposite

Scientists take first snapshots of ultrafast switching in a quantum electronic device

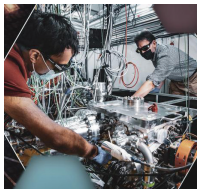


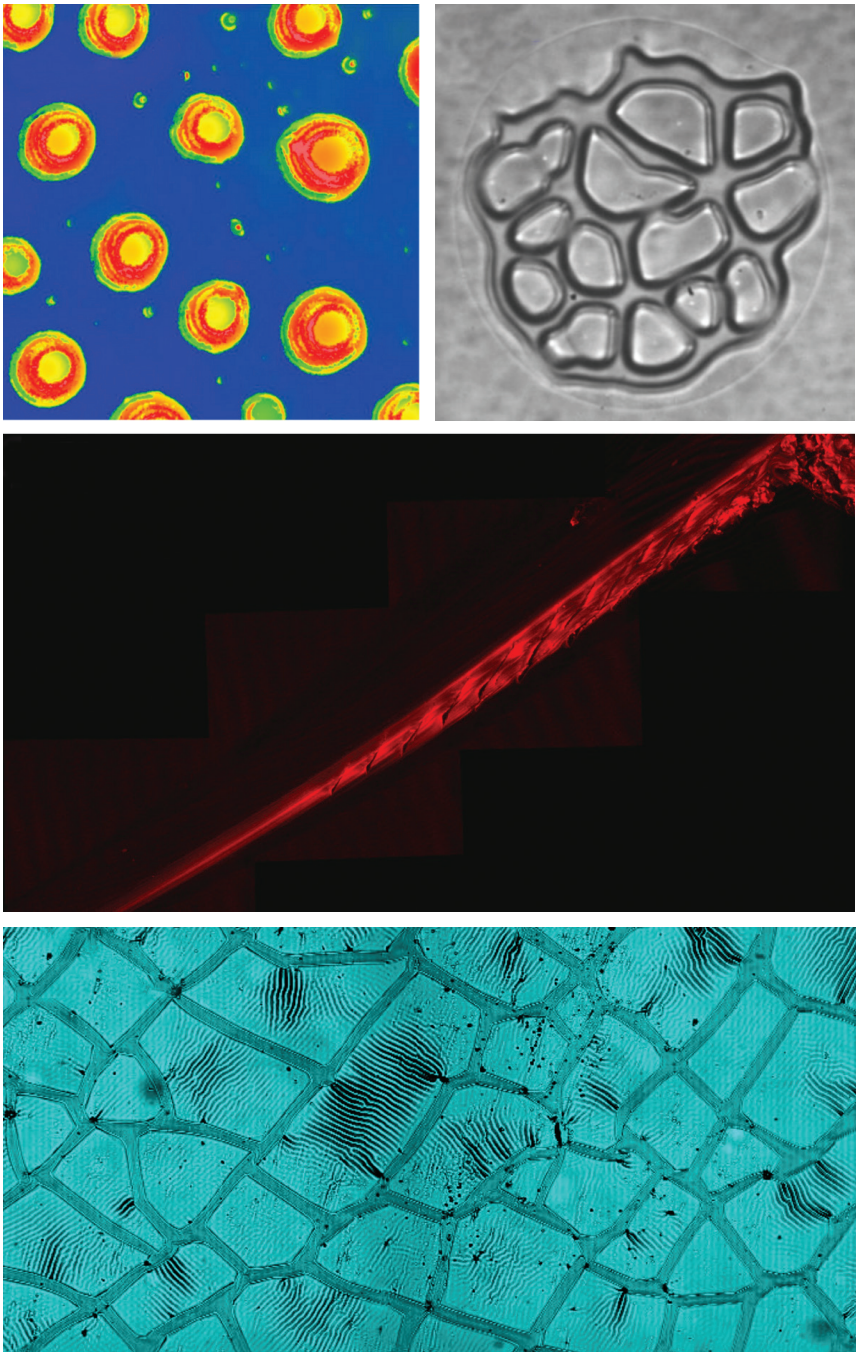
Photo credit: Greg Stewart/SLAC National Accelerator Laboratory

Purdue University, in partnership with Department of Energy's SLAC National Accelerator Laboratory, Stanford University, Hewlett Packard Labs, Penn State University has taken the first snapshot of ultrafast switching in a quantum electronic device. This could lead to faster and more energy-efficient computing devices and may also have applications in brain-inspired computing. bit.ly/Ramanathan-Science-Snapshot

Professor Davis and Purdue Galleries will Catch Your Eye with a SHINE-y Exhibition

One powerful image can capture the interest and imagination of anyone, scientifically inclined or not. Art can serve as a bridge between the non-technical public and STEM researchers, allowing a natural expansion of scientific literacy.

Professor Chelsea Davis will be working with Erika Kvam, Interim Director and Head Curator of Purdue Galleries, to develop a STEM as Art exhibit at Purdue University. Supported by the NSF CAREER Award, the **SHINE: SHowcasing Images in Nature & Engineering Gallery** will be a recurring art exhibition held each summer for the next five years, starting in June 2022. Researchers across Purdue will be invited to submit aesthetically pleasing or visually stimulating images from their research projects to the SHINE Program throughout the year. This annual exhibition will be an opportunity for the Greater Lafayette Community and summer visitors to Purdue's campus to be inspired by and learn about many facets of the ongoing research being conducted across campus. After each exhibition closes, the SHINE images and accompanying descriptions will be donated to high schools and made available for download as educational materials online. The ultimate goal of this program will be to establish a self-sustaining program that 1) unites researchers across Purdue University, 2) promotes technical communication skills development, and 3) inspires gallery visitors to cultivate a deeper appreciation and curiosity in science and engineering.



Examples of SHINE exhibit images acquired in Prof. Davis's lab.

ALUMNI, DO YOU REMEMBER CALLOUTS?

This past year has made it very clear that linking students and alumni in a growing network benefits the entire MSE family. Would you like to be more engaged with Purdue MSE while simultaneously helping MSE students? We have a variety of ways that you can help the School at various times of the year.

- Volunteer to help review student resumes. This activity is most prevalent at the start of fall semester as our students seek internships and full-time positions via Purdue's Industrial Roundtable. Most reviews are done via email, but some in-person or virtual interactions could also take place as needed. A smaller cohort of reviews is needed each spring.
- Volunteer to speak in the MSE undergraduate seminar by hosting a coffee break (10 student max) or seminar (to up to 100 students) and presenting about your company, your career, or a technical process in which you specialize. The time commitment is approximately one hour interaction time with the students.
- Would your company be willing to sponsor a senior design project in MSE? These projects allow MSE seniors to gain real-world, hand-on experience working on a practical materials problem. We would be happy to discuss specific projects in additional detail. Learn more: bit.ly/MSE-senior-design

To volunteer or to learn more, please email Robyn Jakes at rnjakes@purdueforlife.org.

MSE is pleased to welcome **Dr. Danielle Heichel** as a continuing lecturer in our teaching lab courses. Dr. Heichel holds a BS in chemistry from West Virginia University and a PhD in polymer science from the University of Connecticut, Institute of Materials Science. During the spring and summer of 2021, Dr. Heichel was an instructor for MSE 335 (materials characterization) and MSE 367 (materials processing), and we are excited to welcome here in a full-time capacity, enabling us to serve an increasing enrollment in MSE.

STAFF

MSE Advising Team Dedicated to Student Success

Rosemary Son has been named as the new Senior Academic Program Administrator and Academic Advisor for our undergraduate program, filling the position left vacant by the retirement of Vicki Cline. Rosemary previously held the position of graduate advisor in MSE and she holds an MS in higher education from Purdue University Global, a BS in Political Science from Bringham Young University and an AAS of Commercial Science: Accounting and Business Management from Stevens Henager Business College.

MSE is pleased to welcome **Dr. Yuan-Yu Karen Morgan** to our student advising team. Dr. Morgan joined MSE on July 26th, and she will serve as academic advisor for graduate students within the School. Dr. Morgan holds a BA in education from National Cheng-Chi University, an MS in foreign language education from the University of Texas at Austin, and a PhD in applied linguistics from Purdue University. Prior to joining MSE, from 2013-2020, Dr. Morgan served as the coordinator of international student services and academic advisor within the College of Liberal Arts at Purdue. From 2006-2012, she held the position of graduate lecturer and course coordinator of the Chinese program of foreign languages and literature, also at Purdue University.

Vicki Cline Retires After 43 Years of DEDICATED SERVICE TO PURDUE

Vicki Cline joined the School of Materials Engineering in 1989 as Administrative Assistant for Academic Affairs. She had by then already built 11 years of Purdue service credentials, 4 years as Secretary to the Head, Department of Veterinary Microbiology, and 7 years as Administrative Assistant for the Indiana Animal Disease Diagnostic Laboratory. After serving the MSE faculty, students, and alumni as Academic Program Administrator for 32 long years, Vicki retired in May 2021.

Vicki Cline was born in Evansville, Indiana. She graduated with a B.A. degree from University of Evansville in 1972 and received a M.S. degree from Purdue University in 1973 in secondary education.

Vicki Cline receives award from Purdue Provost, Jay Akridge

As the MSE Academic Program Administrator, Vicki Cline assisted the Head of the School and the Chairmen of the graduate and undergraduate committees in coordinating various activities of the academic programs including counseling of both undergraduate and graduate students. She served as the chief liaison with other schools and administrative units of Purdue University, including the Graduate School, Registrar, Bursar, International Services, Schedules and Space, Continuing Engineering Education, Placement Service, CIS, and Co-op Office. She monitored course catalogue, curriculum and scheduling of both undergraduate and graduate programs. Serving as the schedule deputy for the School, she coordinated faculty and graduate teaching assignments in consultation with the Graduate and Undergraduate Chairmen. She maintained meticulous databases on all MSE students, prepared needed materials for academic reports to university and outside agencies. For both undergraduate and graduate students, she handled all matters related to registration, appointments, plans of study, certifications, and recruitment activities.

Vicki was a most passionate MSE study-abroad program coordinator and played a major role in establishing academic contacts abroad. She visited Imperial College, London, in 2002 to explore a student exchange program. Also, she visited Shanghai JiaoTong University, Ningbo University, Tsinghua University and Peking University in China during 2006 as a member of a Purdue group investigating potential study abroad agreements. In Summer of 2007 she traveled to India in a similar effort visiting IIT Bombay, Tata Institute of Fundamental Research, Delhi University, Indian Institute of Science and INFOSYS. She has been a globalizing catalyst for our students to participate in the study-abroad program.

In May 1996, Vicki took the leadership role in organizing a networking group of Engineering Graduate Studies Representatives (EGSR) from various Schools of Engineering to address deficiencies in communication and coordination of all aspects of graduate admission across various offices on the campus. This group was expanded to the entire university to form Purdue University Graduate Studies Administrative Council (PUGSAC) in March 1998. Vicki served as the chair of EGSR and PUGSAC until fall 2005.

During her 32 years of loving service in the School of Materials Engineering, Vicki interacted and aided more than 1,400 undergraduate and graduate students who completed the MSE programs. She was extremely aware of the special help needed by the international students at the time of their admission at Purdue and she provided them the needed service and advice, day or night as requested. She was known for her down-to-earth straight talk and unconditional offer of help to students who sought her advice at all times of the day. She was particularly known for her expertise in handling academic and often personal problems of students with expert professionalism. She was known and loved for her natural ability for spontaneous interactions with all students, staff and faculty.

In 2017, Vicki was recognized by the College of Engineering for her work in student advising as a finalist for the Administrative Professional Customer Service Award. Nominated by Professor Anter El-Azab, her dedication to helping students and working closely with faculty to keep students on track to graduation and engaged in their courses was noted as exceptional across the college. In 2019, Vicki was recognized in a University-wide ceremony honoring her 40 year tenure at Purdue.

Vicki loves outdoors and animals. She has been a 4-H leader for many years and a project leader for horsemanship. She enjoys exploring wilderness, canoeing, photography, and gardening. She surely knows how to prepare herself to enjoy her golden years ahead with her children and grandchildren.

"Vicki was a guidepost for me throughout my entire time at Purdue. She helped me navigate courses, co-op rotations, and, ultimately, career decisions after Purdue. In the beginning, when MSE was entirely new to me and I knew no one, she was an immediately warm face during those early semesters and I credit her with helping MSE feel like home for those next several years. At the end of my time in MSE, Vicki was a great listener as we sat in her cozy office and discussed various options. Vicki always made MSE feel like a family and that has meant more to me than she could ever know. While MSE will continue to have that same wonderful family feeling, it won't be quite the same without Vicki."

— **Jessica VanDalen, J.D.**
BS MSE'2007

"As I look back now at my career path since graduating, I can't help but be forever thankful and grateful to Vicki Cline for her amazing influence and guidance. All those years ago as I tried to find my path, she was right there to guide me and help me with class selections and finding summer internships. With her guidance and support, I was able to gain valuable experience as a young engineer and then use those experiences to launch my professional career. I will always be thankful to Purdue for the tremendous opportunities, to my amazing professors for the skills and knowledge they equipped me with, but most importantly I will be forever grateful to Vicki Cline for helping me get my feet planted in a solid direction and helping me find open doors to launch such a rewarding career! Thank you Vicki for caring about us as individuals and pouring into us as students to help us find ways to successfully contribute to society in so many meaningful ways. I wish you all the best in your retirement and am blessed to have had the opportunity for our lives to have crossed paths. Best wishes always!"

— **Keith Lyons**
BS MSE'93

"Vicki helped to guide over 1000 students, more than half of all Purdue MSE alumni to date, through their academic careers; but we remember her service to the school not for the number of students she helped, but for the care, kindness, and dedication she showed to each individual student. She has been a tireless champion in supporting students, and sets the bar for all other academic advisors going forward."

— **Dave Bahr**
head and professor, MSE

To honor Vicki's long-standing commitment to MSE and Purdue University, a student support endowment — The Vicki L. Cline Student Support Fund in Materials Engineering — has been established. To make a gift, please visit connect.purdue.edu/VickiClineEndowment.

Outstanding Materials Engineer Awards for 2021

Dr. Matthew Kush

received his BS in Materials Engineering from Purdue University in 1992, followed by his MS and PhD from the University of Michigan in 1995 and 1998, respectively. Dr. Matthew Kush is currently a Sr. Technical Specialist in Materials Engineering, LibertyWorks division of Rolls-Royce North America (RRNA). He has close to 25 years of experience in Manufacturing Engineering and Materials Engineering within RRNA where he has held various positions from researcher, engineering manager, manufacturing manager and facility manager. He has been instrumental in developing RRNA's capability in the field of single crystal casting of nickel-base superalloys, advanced manufacturing technologies and high-temperature materials development for hot section turbine components. This work has resulted in more than 20 patents, with numerous patents pending, and six papers published in peer-reviewed literature. He currently serves as the Sr. Technical Specialist for Future Programs focusing on (1) developing materials for infrared suppression (2) developing coatings for ceramic matrix composites (CMC) including oxidation coatings, environmental barrier coatings and abradable coatings for SiC-SiC based CMCs and (3) developing advanced materials and manufacturing methods for fabricating advanced cooled, dual-wall turbine components.

During his time as an undergraduate student, Dr. Kush completed four Co-op rotations with U.S. Steel (formerly LTV Steel, East Chicago). Here he worked on steel cleanliness projects in the basic oxygen furnace facility, tundish control in the continuous casting facility and quality control projects in the hot and cold mills producing sheet steel for automotive.

Rocking Purdue at 13,060 feet, Mt. Danak Peak, Yosemite 2006

Tracy Lopes

received her BS in Materials Engineering in 1997 and currently serves as the Head of Flexible Robotics for Johnson & Johnson (J&J). In this role, she drives the end-to-end supply chain to support J&J's ability to continue to drive market expansion in the new robotic surgery space. Prior to this position, she served as the Vice President for Strategic and Service Marketing for Varian Medical Systems in Palo Alto CA, a company focused on cancer therapy. There she supervised a $1.3B portfolio of products addressing oncology and canter treatment. From 2015-2018 she was the Global Head of Clinical Solutions for Becton Dickinson BioSciences, and from 2012 to 2015 she was the Head of Portfolio Management for Ortho Clinical Diagnostics. Ms. Lopes entered into health care engineering with Johnson and Johnson in 1997, where she stared as a product development engineer, and moved up to eventually be the R&D director for Ethicon Eno Surgery.

Ms. Lopes holds 8 U.S. patents, six for surgical instruments using ultrasonic techniques and two for bone anchoring devices. Her work has been focused on both technical challenges in developing products for surgery and clinically relevant tools for doctors serving patients and the management and leadership of large teams within the healthcare industry. She has also presented for and been involved with ASM International's Shape Memory and Superelastic Technologies conference.

Ms. Lopes has been involved in mentoring and developing leadership programming to enhance the ability of women to advance within technical fields. She has been on the Frost & Sullivan advisory board for women's empowerment and has been a speaker at the Watermark conference for women, a Silicon Valley based networking and leadership event dedicated to advancing opportunities for women.

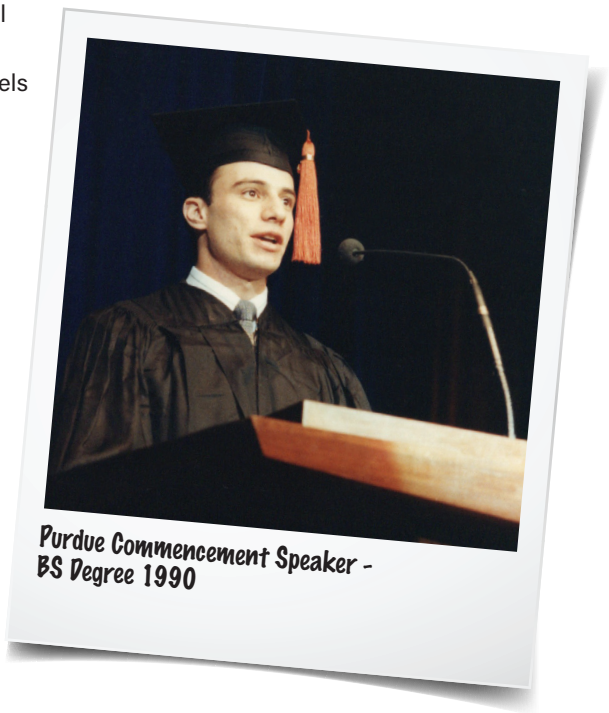
MSE study session 1995

Peter C. Tortorici is a Medtronic Technical Fellow, and a Senior Manager of Advanced Manufacturing Engineering Technology Development for the Active Implantable and Pumps (AIP) Engineering Group at Medtronic, located in Minneapolis, MN. He has been with Medtronic since 2001. Dr. Tortorici is currently leading a group developing manufacturing technologies for cardiac and neurological implantable medical devices; his group partners with device assembly facilities and technology groups on roadmaps and device manufacturing strategies. Dr. Tortorici also collaborates with research, operations, and technology to drive common business objectives and business strategy.

Dr. Tortorici has held a variety of wide-spanning positions during his Medtronic career. He has served as a microelectronics process engineer, the Medtronic corporate printed circuit board engineer, and worked on lead-free and solder alloy development and reliability in addition to serving as a microelectronics process development manager. He led complex problem-solving teams at Medtronic, resulting in the development of a curricula which has been taught at the corporate level. His recent work involves additive manufacturing of novel alloys for medical applications, in addition to the industrialization of augmented reality for operations use cases.

Prior to his career at Medtronic, Dr. Tortorici was a metal component program manager for the lighting division of General Electric and a microelectronics packaging engineer at Hewlett-Packard. He was a visiting research scientist at the Forschungszentrum Jülich, Germany and worked in the early development of Nd-Fe-B permanent magnets at General Motors during his Purdue Co-Operative Education experience in Anderson, Indiana. Dr. Tortorici has also instructed a ceramics engineering class at Arizona State University on an adjunct basis in 2019.

Dr. Tortorici holds BS, MS, and PhD degrees in Metallurgical and Materials Engineering from Purdue University in West Lafayette, IN. His PhD thesis focused on the diffusional interactions of molybdenum disilicide with metallic reinforcements for high temperature engine applications. His MS thesis work examined the diffusional interaction of austentic and ferritic cladding steels with metallic nuclear fuel fission products. Dr. Tortorici is a member of ASM International, The Materials Society (TMS), The American Ceramic Society (ACerS), SMTA, IMAPS and IPC, and he holds two U.S. Patents.

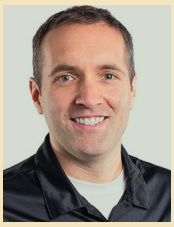


Purdue Commencement Speaker - BS Degree 1990

BIT.LY/OMSE-CEREMONY-2021

ALUMNI NEWS

Ms. Katelyn Bemis
Conexus Rising 30 Cohort. Learn more: bit.ly/Bemis-Rising30



Mr. Kyle Hummel
Executive MBA Honors Scholar award from Purdue University Krannert Executive Education Programs

Dr. Milea Kammer
Delta Zeta Top 35 under 35
bit.ly/Kammer-35-under-35

Image provided by NASA/JPL-Caltech

Dr. Keith Kruger
MSE alumnus and School of Materials Engineering advisory committee member, Keith Kruger, explains how a Haynes International alloy is sitting on Mars. Learn more: bit.ly/Haynes-on-Mars

Tina Landon
Command Award
Naval Surface Warfare Center (NSWC)
bit.ly/Landon-Outstanding-Scientist

Dr. Yongho Sohn
2020 Engineer of the Year Award from Korean-American Scientists and Engineers Association (KSEA) presented by Korean Federation of Science and Technology (KOFST)

Dr. Valerie Wiesner
Early Career Achievement Medal from NASA Langley Research Center

Steven Ferdon named as College of Engineering Distinguished Engineering Alumnus

Steve leads a global organization providing engineering analytical services and research, in the fields of materials science, chemical technology, structural mechanics, fluid mechanics, tribology, advanced manufacturing and configuration management for the Cummins Electronics and Fuel Systems Business Unit. His team supports the business across the entire product lifecycle, with over 90 engineers and technicians working in seven labs located in five countries: U.S., Mexico, China, India, and Sweden.

Ferdon argues that failing 'P-Chem' as a Purdue student was a key step toward learning how to succeed. In the real world, there is no answer book and to win in the market through innovation, you must challenge known boundaries and confront problems with indeterminant solutions. Thus, the reality is that on the way to success, you will also fail.

Ferdon and his team have a long list of successes putting emerging materials, manufacturing processes and analytical tools into practice before their much larger competitors. A few notable credits include putting ultra-high strength aerospace alloy steel into commercial transportation applications, applying plasma deposition coatings on fuel system components, co-development of a universal multi-fuel elastomer and a novel hybrid steel, usage of advanced fluid mechanics analysis to find and fix a design flaw in a gas nitriding furnace, utilizing monolithic ceramic materials in diesel injectors, and novel material property and structural analysis tools.

Ferdon says that being a key part of the CFS globalization is a source of great professional pride. He recalls starting with Cummins when it was a local, Columbus, Indiana, business with 40 people on staff. "Today, 28 years later, I am blessed to lead a fully integrated global organization of over 65 engineers and 45 technicians," he says. "I have had the privilege to visit all five of our global sites while they were under construction and witness firsthand how the vision of that small start-up team back in 1992 has provided employment, financial security and realization of dreams for our global associates."

His industry successes, as well as Ferdon's service on the School of Materials Engineering (MSE) Advisory Committee and support of the MSE Senior Design Project program through the Cummins Fuel Systems Business, contributed to his Outstanding Materials Engineer Award in 1998.

His over-achieving professional pursuits notwithstanding, Ferdon offers Purdue's current undergraduates some down-to-Earth advice: "Make the time to play more basketball with your buddies. All too soon, the legs wear out, your speed slows down, and injury recovery time takes longer and longer."

Ferdon also might suggest that students maintain ties with Purdue all their lives, just as he has done. He makes sure that there is a Purdue coffee mug in each of his global labs so the "sun never sets on the impact of Purdue University." To watch the ceremony visit: bit.ly/2021-dea.

STEVEN E. FERDON
BS MetE 1982

CAREER HIGHLIGHTS

2012-present
Director, Global Engineering Technology, Cummins Fuel Systems Business

2007-2012
Chief Engineer, Engineering Services, Cummins Fuel Systems

2004-2007
Chief Engineer, Materials Science Engineering, Cummins Fuel Systems

2002-2004
Assistant Chief Engineer, Materials Science Engineering, Cummins Fuel Systems

1997-2002
Technical Advisor, Materials Science Engineering, Cummins Fuel Systems

1992-1997
Technical Specialist, Materials Science Engineering, Cummins Fuel Systems

1988-1992
Manager, Materials and Process Engineering, Williams International, Walled Lake, MI

1985-1988
Failure Analyst, Materials and Process Engineering, Williams International

1982-1985
Metallurgist, Mechanical Nuclear Engineering, Duke Energy

"Far better it is to dare mighty things, to win glorious triumphs, even though checkered by failure, than to rank with those poor spirits who neither enjoy much nor suffer much because they live in the gray twilight that knows not victory nor defeat."

— Theodore Roosevelt

UNDERGRADUATE STUDENT PROFILE

Hugh Grennan • Morristown, NJ,

My name is Hugh Grennan, I am originally from Morristown, NJ, and I just completed my junior year as an MSE student. As a high school senior, I chose to come to Purdue for its superb engineering opportunities, but I didn't learn about Materials Engineering until I entered the First Year Engineering program. Chemistry and physics had always been enjoyable for me, so I was especially intrigued about how materials engineering bridges the gap between the nanoscale and the macroscale. Not to mention, I am always learning about different ways my materials education can be applied to other fields. I can easily say that, after first hearing about MSE my freshman year, it didn't take long for me to fall in love with the subject.

From January 2020 to present, I have been conducting research with Prof. Davis. This project, which is funded by the Indiana Department of Transportation, focuses on characterizing the performance of temporary pavement marking (TPM) tapes. These TPM tapes, which are often used in road construction sites, need to stay adhered to the pavement during use, but also need to be removed easily when a more permanent marking is required. So, with the help of the Davis Research Group, I have been studying the adhesion and tearing mechanics of TPM tapes, as well as their performance under extended periods of time. My continued participation in the Davis Research Group has not only helped me learn more about materials, but has helped me grow as a scientist, which is why my research is my greatest MSE accomplishment.

My favorite MSE class has been Sports Technology and Entrepreneurship with Dr. Mansson, without a doubt! For those who haven't taken the class (or might be interested), the majority of the lectures feature guest speakers who discuss their experience working as a scientist/engineer within sports applications. My favorite guest presenter was Dr. Tom Waller, the Chief Science Officer of Lululemon, who discussed his interesting experience and career path. The course was great because it opened my eyes to a whole realm of material applications I hadn't considered, and it also helped me make great connections with amazing people.

Outside of my classwork, I am involved in a few student organizations on campus, including the Purdue Varsity Glee Club and Purdue Triathlon Club. I am also the president of Purdue University Material Advantage (PUMA), which is a social and professional networking organization for Materials Engineering undergraduates. I love being a part of PUMA because I have grown close with so many of my classmates. Since MSE is a relatively small major, I enjoy hanging out with all my friends from class to share our love of materials! Also, due to MSE's smaller size, I also feel like I have a close connection with our faculty and staff. This close-knit community of faculty and students—as well as the subject material–are the reasons why I would recommend joining the MSE department at Purdue.

After graduation, I would like to use my Purdue MSE knowledge to earn a PhD in Materials Engineering. While I may not know exactly what I would want to do with my PhD, I am excited to have a virtual internship this summer with Pacific Northwest National Laboratory (PNNL) and learn about what research is like at a Department of Energy laboratory. I also look forward to the research and senior design opportunities I will have next year as I finish my undergraduate degree at Purdue. I am thankful for the school of Materials Engineering, especially my advisor Prof. Davis, for continuing to inspire me to learn about how much materials matter!

Performing 90° peel testing of road pavement tape on an asphalt core.

2021 Student Award Recipients

INTERNAL STUDENT AWARDS:

The John L. Bray Memorial Award
Mackinzie Farnell, Amanda Guyre, Genevieve McLaughlin, Haydn Schroader, Michael Thoenen

Outstanding Graduating Undergraduate Research Award
Mackinzie Farnell

Donna Bystrom Undergraduate Service Award
Brynna Keelin Kelly

Outstanding Graduate Student Service Award
Robynn-Lynne Paldi

Outstanding Graduate Student Researcher
Di Zhang

MSE graduate student, **Amrita Sen**, has been selected to receive one of 78 U.S. Department of Energy (DOE) Office of Science Graduate Student Research (SCGSR) fellowships. Amrita is advised by Professor Janelle Wharry and will conduct her project in the area of BES - Radiation Effects in Materials at Idaho National Laboratory (INL). bit.ly/Sen-SCGSR

Estus H. and Vashti L. Magoon Graduate Teaching Award
Saswat Mishra
Jung-Ting "Tim" Tsai

Briney Achievement Award
Jared Gohl, Ana Maria Ulloa Gomez, Joseph Yount, Amin Zareei

EXTERNAL STUDENT AWARDS:

AIST Steel Intern Scholarship
Clayton Barlow

Foundry Educational Foundation Internship/Co-Op Scholarship FEF Recertification of Purdue Metalcasting

Certificate in Collaborative Leadership
Garrett Behrje

AIST Steel Intern Scholarship

AIST St. Louis Member Chapter Scholarship AIST Ohio Valley Member Chapter Scholarship
Amanda Guyre

ACRP Graduate Student Research Award
Daniela Betancourt Jimenez

ACerS Ceramographic Competition, SEM category, 1st place
Xin Li Phuah

Dean's Teaching Fellowship
Brhayan Stiven Puentes Rodriguez
Technical Program Committee, AMPP: Association for Materials Protection and Performance Corrosion and Environmental

Effects Committee, The Minerals, Metals & Materials Society
Haozheng Qu

2021 TMS Best Paper Award, 2nd place
Zhongxia Shang

Bayer's Grants4Tech AG Sensor Competition, 4th place FLEX Student Poster Conference, 2nd place
Jose Fernando Waimin

PURDUE UNIVERSITY
School of Materials Engineering

For the first time in over 20 years, an MSE student was the student responder for Purdue's Commencement ceremony! Congratulations to MSE senior, **Brandon Wells** on his many accomplishments both in Engineering and across campus! Following graduation, Brandon started his graduate degree in materials engineering at Purdue, where he is focusing on finding overlap between materials and food technologies in order to reduce food waste and food insecurity. bit.ly/Wells-Commencement

GRADUATE STUDENT PROFILE

Jose Waimin • Tegucigalpa, Honduras

Jose Waimin is a 3rd year PhD student under the advisement of Professor Rahim Rahimi. He received his bachelor's degree in Bioengineering from Syracuse University, Syracuse, NY in 2018, and his research at Purdue combines his knowledge of biologic systems with utilizing materials in novel ways for the development of technology for medical and agricultural applications. Through this work, Jose has developed several sensors and devices for the in-situ detection and quantification of the activity of microbes within their ecosystem.

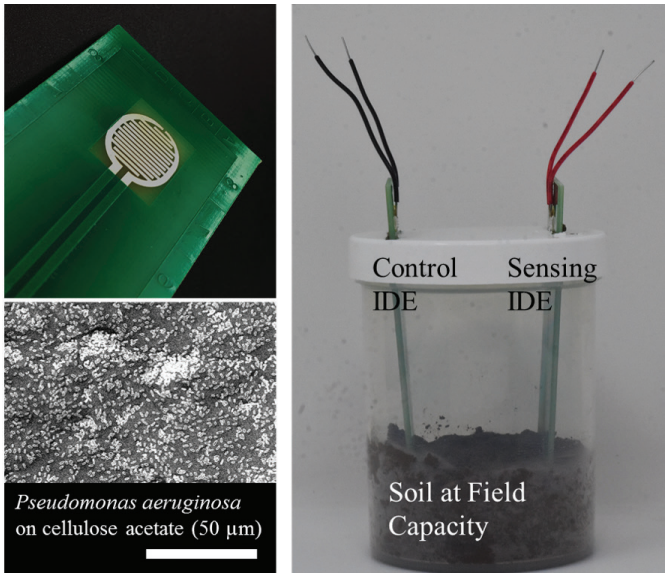
Within agriculture, monitoring microbial activity in soil through non-destructive methods is crucial in understanding how microbe's function affect soil performance. Agricultural soils with high microbial activity and diversity typically produce the highest yields of agricultural products. This means that constant monitoring of microbial activity could provide valuable insight to farmers regarding soil health and performance.

Current methods require invasive sampling of soils and lengthy turnover time. One method, the Cotton Strip Assay method, involves burying cotton fabric in soils for several months to qualitatively estimate the microbial activity by measuring changes in tensile strength of the film. Cotton has a high percentage of cellulose (>90%), which is a recalcitrant material selectively degraded by bacteria in soil. This accurate, low-cost, and easy to implement method, requires long waiting periods and the inability to integrate with electronics for real-time monitoring.

Jose has designed a microbial activity sensor capable of quantifying the metabolic activity of microbes directly in soil by monitoring the degradation of a cellulose acetate film coated onto an interdigitated electrode structure. Through this method, the degradation of the cellulose-rich film can be actively monitored by measuring changes in impedance at a fixed frequency. With the use of miniaturized impedance analyzing systems integrated with wireless communication devices, real-time assessment of microbial metabolic activity, directly in soils, is possible.

Jose's ongoing work is focused on utilizing other representative materials for quantification and detection of microbial activity in other systems. Monitoring degradation of polymer coatings through miniaturized impedimetric readout systems is a very powerful tool, with many applications in both agriculture and the medical field. The aim is to incorporate this technology for the detection of other significant parameters, such as pH, and further miniaturization of the readout system to create wearable and implantable medical devices capable of monitoring activity from within the body. Current work is focused on utilizing this sensing system for quantifying the metabolic activity of microbes within the digestive system.

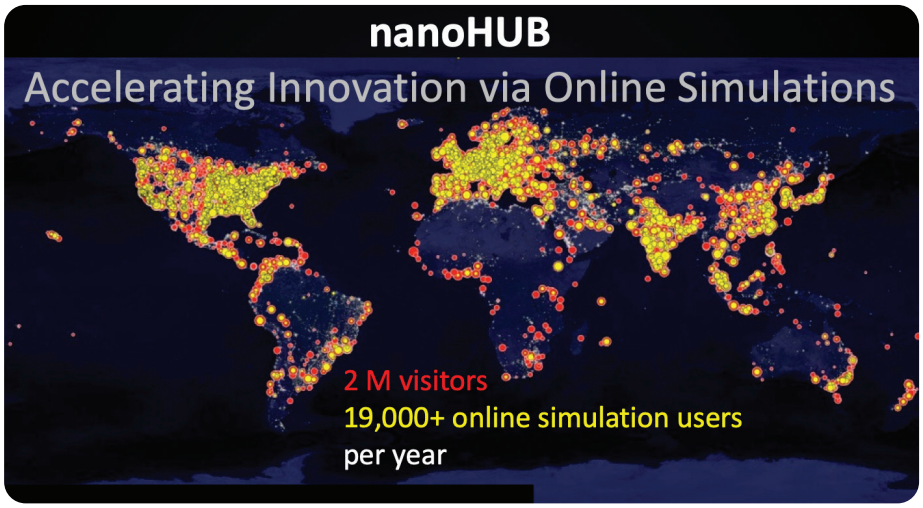
Understanding the role of gut microbiota in the digestion and fermentation of fiber, protein, and other nutrients is a topic of increasing interest as the metabolic activity and diversity of these microbes have direct effect on human health. A number of studies have found correlations between microbiota imbalance (dysbiosis) and various diseases including diabetes, obesity, and metabolic syndrome; diseases which affect approximately 30 million people in the U.S. Similarly, new insights regarding possible ways that gut bacteria may influence development and maintenance of the nervous system suggest a link between gut microbiome composition and the regulation of psychoneurological disorders including anxiety, depression, and dysbiosis in autism. This inexpensive technology could assist both physicians and patients by detecting early onset of infection or significant changes in microbial diversity that could serve as a marker for related diseases.



The interdigitated electrode structure was coated with a cellulose acetate (CA) film. The CA film is covered and degraded by microbes (SEM image), which results in a decrease in impedance. A twin sensor setup, consisting of a control IDE monitoring the impedance of the environment and the working IDE can directly monitor microbial activity in soil.

MATERIALS MATTER @Purdue

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



Congratulations

to nanoHUB.org, a national collaborative user platform partnership led by Purdue, on being chosen as the recipient of a 2020 R&D 100 Award! nanoHUB provides world class simulation tools for many engineering applications, including cutting edge materials science simulations used by 1000's of students and researchers around the world.
bit.ly/nanoHUB-RD-100

PURDUE UNIVERSITY
School of Materials Engineering

2021 AWARDS & RECOGNITIONS

MSE head and professor, David Bahr, presents the 2021 student awards. Watch here.

bit.ly/MSE-2021-student-awards