MSE ANNUAL REPORT

Materials Science and Engineering • Michigan Technological University

2017-18 Academic Year

Michigan Technological University

1885

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Greetings from the Copper Country, Michigan Tech, and the Department of Materials Science and Engineering!

It is my pleasure to again share with you a summary of the past year's highlights in MSE. It's been another good year, and I continue to be proud of the accomplishments of our students, faculty, staff, and alumni.

As we enter the 2018-19 academic year, the campus community is enthusiastically anticipating the significant change in leadership. President Emeritus Glenn Mroz has returned to the faculty in the School of Forest Resources and Environmental Science (SFRES) after 14 great years leading the University, and we welcome incoming President Richard J. Koubek. The campus is also welcoming four new college or school deans, including incoming College of Engineering Dean Janet Callahan, most recently the chair of the Micron School of Materials Science and Engineering at Boise State. I am personally grateful to retiring Dean Wayne Pennington for his leadership of the college and his support for the MSE program at Michigan Tech.

This year, MSE graduated 33 baccalaureate students (winter and spring), which is becoming an "about average" number for the department after several years of decreasing enrollments. We also saw seven graduate completions during the academic year, a down year following an above average completion of 20 graduate degrees in 2016-17.

In this annual report, we also welcome and feature Michigan Tech's new, state-of-the-art scanning transmission electron microscope (STEM). The approximate year-long installation of the FEI Titan aberration-corrected STEM has been completed in a stand-alone, mechanically quiet facility adjacent to the Advanced Technology Development Complex on Sharon Avenue. The facility is managed by MSE as part of the University's Advanced Characterization and Morphological Analysis Lab (ACMAL), and is already generating spectacular images and results for university researchers.

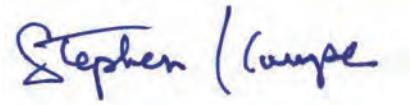
I call your attention to the back cover of this report, and to a new fundraising campaign to create an endowment to support the operation of Michigan Tech's pilot-scale metal casting facility, the Foundry. The ambitious project is conducted in partnership with the Foundry Education Foundation (FEF), an organization that exists to support metal casting programs at universities and the pipeline of talent they produce.

To be blunt, a foundry is an excessively expensive endeavor for a department to support; any financial analysis that considers variables such as equipment

costs, space, staffing, safety, maintenance, and student throughput will reveal it to be financially challenging and prohibitive in an environment where the affordability of education drives big decisions and priorities. It is no coincidence that very few university foundries remain in the United States. That said, I am impressed with Michigan Tech's strong and passionate network of alumni who work in the metal casting industries, and the impact and leadership that this group provides. I am hopeful that you can support this initiative, as it will help ensure that this signature capability continues to exist in MSE, and at Michigan Tech.

As always, I appreciate the support we receive from alumni and friends of the department. Your partnerships are very important to us, and have become a critical means by which we pursue our goals to ensure a top-quality educational experience for our students. Please help us keep our alumni records up-to-date by checking your address and current affiliation on file with Alumni Engagement at MyMichiganTech by visiting **mtu.edu/alumni/connect/contact**.

Until next time and with sincere regards,



Stephen L. Kampe
Franklin St. John Professor and Department Chair
Department of Materials Science and Engineering

William J. Jr. '69 and Ilene Bernard

Clock Tower Dedication

The William Bernard Jr. '69 (BS Metallurgical Engineering) Family Clock Tower was dedicated on Thursday, August 2, 2018. Located between the Memorial Union and R. L. Smith ME-EM buildings, the clock tower rises 37 feet into the air on a 3.5-foot base of concrete and Jacobsville sandstone salvaged from the University's original central heating plant, dismantled two years ago. The tower houses a bronze bell that rings for special occasions.

In addition to the clock tower, a generous gift from the Bernard family established the William J. Bernard Jr. Family Endowed Scholarship Fund to provide support to Michigan Tech students. Matthew Thomas, a fourth-year materials science and engineering undergraduate student, is the first scholarship recipient. The scholarship will generate a $4,000 award annually. Four of William's five siblings went to Tech, just like their father did before them. Also, William's son Ben is a 2002 MSE graduate (metallurgical engineering).

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609 Minerals and Materials Engineering Building
Michigan Technological University
Houghton, MI 49931-1295

Department Chair
Stephen L. Kampe

Editors
Kelley Christensen, UMC
Mare Grohowski, UMC

Writing and Design
Valentina O'Kane, MSE
Stephen L. Kampe, MSE
William Tembreull, UMC

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UNIVERSITY LEADERSHIP CHANGES

Welcome New President of Michigan Technological University

On July 1, Michigan Tech witnessed a historical change of leadership by welcoming a new president and new deans in four of five of its colleges and schools. **Dr. Richard J. Koubek** has taken over as Michigan Tech's 10th president, replacing Dr. Glenn Mroz, who retired after 14 years with the intent to return to his roots as a member of the faculty in the School of Forest Resources and Environmental Science (SFRES).

Koubek served previously as vice president and provost at Louisiana State University (LSU), with prior appointments as LSU's dean of engineering, chair of industrial and manufacturing engineering at Penn State, former department chair and associate dean for research and graduate studies at Wright State, and was a faculty member in the school of industrial engineering at Purdue University. He received his PhD in Industrial Engineering from Purdue, and a Bachelor's degree in Biblical Literature from Oral Roberts University.

In addition to Dr. Mroz, also retiring were Dr. Wayne Pennington (Dean of the College of Engineering), Dr. Bruce Seely (Dean of the College of Sciences and Arts), Dr. James Frendeway (Dean of the School of Technology), and Dr. Terry Sharik (Dean of SFRES). Michigan Tech welcomes its new deans Janet Callahan (COE, see below), Dr. David Hemmer (CSA), Dr. Adrienne Minerick (SOT), and Dr. Andrew Storer (SFRES). See article on page 13.

Welcome New Dean of Engineering

Dr. Janet Callahan joined Michigan Tech as its Dean of the College of Engineering, effective July 1. Callahan joins us most recently from Boise State University, where she was MSE chair, professor, and co-founder of the Micron School of MSE. She also served as the associate dean of engineering for academics at Boise State. Callahan received her PhD in Materials Science and Engineering, an MS in Metallurgy, and a BS in Chemical Engineering from the University of Connecticut. Before Boise State, she was an MSE faculty member at Georgia Tech. In addition to her administrative experience, she has an established international reputation as a researcher in the area of advanced materials processing—notably, chemical vapor deposition methodologies as applied to surface modification, chemical synthesis, and creating engineered surface functionalities.

A Lasting Legacy: Former President Ray Smith Dies at 101

The Michigan Tech community is mourning the passing of one of the most significant individuals in the University's history. Raymond L. Smith, Michigan Tech's metallurgy department chair and president from 1965 to 1979, passed away peacefully on Tuesday, September 18, at his home in Green Valley, Arizona. He was 101.

Smith earned a bachelor's degree from the University of Alaska and a PhD in Metallurgical Engineering from the University of Pennsylvania. A World War II veteran, Smith was working as a technical director and head of solid state physics at the Franklin Institute of Research in Philadelphia when he left to come to Michigan Tech in 1959.

He served as chair of the Department of Metallurgical Engineering for six years before becoming the University's sixth president in 1965. Under Smith, the University experienced unprecedented growth in terms of enrollment. Faculty numbers nearly doubled during that period as well. The University's physical growth under Smith was also impressive, with the construction or acquisition of several buildings, including the Mechanical Engineering-Engineering Mechanics Building (later named the Raymond L. Smith Building). Perhaps just as significant was Smith's creation of a culture of philanthropy at Michigan Tech. Smith established a foundation to benefit the University. In addition to philanthropy, research dollars increased 250 percent during Smith's tenure. A memorial service will be held at a later date.

FACULTY AND STAFF NEWS

MSE and ACMAL Welcome Pinaki Mukherjee

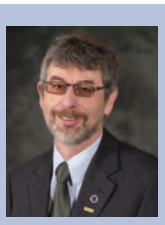
Dr. Pinaki Mukherjee joined Michigan Tech in January as a research engineer for the Applied Chemical and Morphological Analysis Lab (ACMAL). Specifically, Mukherjee was appointed the operational specialist for the newly acquired FEI Titan scanning transmission electron microscope (see feature article on page 6). He received his PhD in Materials Engineering from the University of Nebraska-Lincoln, and his M. Tech in Materials Science and Engineering from the Institute of Technology at Banaras Hindu University in Varanasi, India. Prior to Michigan Tech, he worked as a postdoctoral researcher at Rutgers University, and is an affiliate of the National Center for Electron Microscopy at Lawrence Berkeley National Laboratory.

FACULTY AND STAFF BRIEFS

MSE/ECE Professor **Joshua Pearce** has returned to Michigan Tech following a year sabbatical as the Fulbright-Aalto Distinguished Chair at Aalto University in Finland. During his time in Finland, Pearce guest edited the National Academy of Engineering's Fall 2017 *Bridge on Open Source Hardware*. He was honored as one of eight instructors globally who champion open-source education by Red Hat, an open-source software company. His research in the policy arena continues to receive widespread national and international media coverage. He was quoted in *The Economist*, *Materials Today,* Fox News, and the Weather Channel.

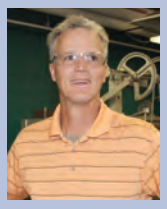
Charles and Carroll McArthur MSE Professor, **Yun Hang Hu**, spent the 2017-18 academic year as a visiting professor at the Shanghai Jiao Tong University in Shanghai, China. During his sabbatical, he delivered a plenary talk during the opening session of the American Chemical Society national conference in New Orleans, and delivered a distinguished keynote lecture to the school of engineering at the University of Edinburgh. Professor Hu was also named editor-in-chief of the Wiley journal *Energy Science and Engineering*.

APMI International named MSE Research Professor **Stephen Mashl** as one of two recipients of its 2018 Fellow Award. Mashl received the award at the International Conference on Powder Metallurgy and Particulate Materials in San Antonio, Texas, in June.

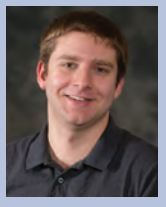


MSE Professor **Jaroslaw Drelich** was selected as a member of the inaugural class of Distinguished Professors at Michigan Tech. Drelich was selected for his impressive record of teaching, scholarship, research, and service to the MSE department and University.

MSE Associate Professor **Yongmei Jin** was recognized as a recipient of the Dean's Teaching Showcase for the 2017-18 academic year. Showcase recipients are selected by University deans in recognition of effectiveness and dedication to teaching.



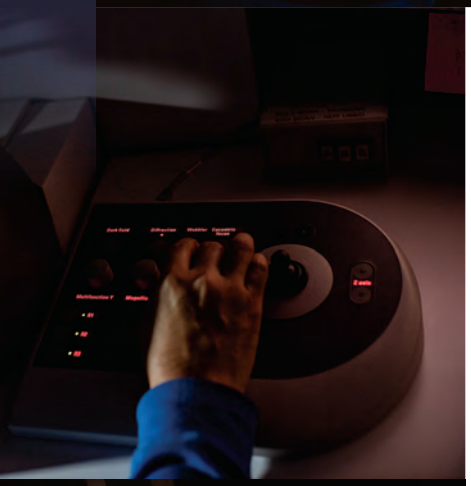
MSE staff member **Matt Otte** (not pictured) has returned to Eaton Corporation following a year as the supervisor of the MSE Metal Processing Lab. Matt will work remotely for Eaton from his home office in Houghton, and will seek to develop projects and other activities with the MSE department for Eaton. MSE staff members **Russ Stein** (right) and **Dale Dewald** (left) will share staff oversight of the MSE processing labs.



MSE staff member and Research Assistant Professor **Joe Licavoli** has accepted a tenure-track assistant professor faculty position in the Department of Mechanical Engineering at Western Michigan University in Kalamazoo. Joe will assume leadership of the department's metals casting and processing laboratory. We wish Joe well, and look forward to our continued collaboration!

ATOMIC ZOOM:
MICHIGAN TECH'S SCANNING TRANSMISSION ELECTRON MICROSCOPE

A new microscope lets researchers zoom in to understand the big picture at the atomic scale.



By Kelley Christensen
First published March 6, 2018 on mtu.edu/news

Housed in a specially constructed brick building at the south end of campus is the FEI 200kV Titan Themis Scanning Transmission Electron Microscope (STEM). One of only two Titans in the state of Michigan, the microscope is capable of imaging at the atomic scale, providing chemical information from a sample, and can also operate as a transmission electron microscope. The microscope is fitted with SuperX TM detector, a set of four X-ray detectors to collect X-ray maps from a tiny area quickly. It has a Quantum GIF TM (Gatan imaging filter) for measuring electron energy loss spectra, energy filter imaging in TEM mode, and spectrum imaging in STEM mode. To perform high-resolution STEM imaging and to support all these mapping facilities at atomic scale, this ultra-stable stand-alone facility was specially constructed to minimize temperature variations and mechanical vibrations generated both externally and internally that would adversely affect the resolution of the microscope.

Such a powerful tool is one of the newest in the ACMAL arsenal.

STEMs use an electron beam less than an angstrom wide (smaller than an atom) to create a digital image of an atom column, allowing researchers to see how atoms bond and the structure of a given sample. Stephen Hackney, professor of materials science, likened it to looking down a stack of transparent cannon balls–extremely tiny ones.

In numerous fields–materials science and engineering, chemistry, physics, geology, biomedical engineering, mechanical engineering, and others–STEM provides a way to understand atomic-level interactions that affect materials, chemicals, and other substances at a macro-scale. Analyzing STEM outputs means zooming in on the tiniest details to understand the big picture.

An Entire World Under the Lens

A few of the current projects under the Titan lens at Michigan Tech include:

- Studying the microstructure of high-temperature aluminum alloys. Because of its low density, aluminum is of interest as a light-weight substitute for military and transportation materials. The STEM enables the observation of extremely fine nano-precipitates that sometimes form and their role in strengthening materials. Light-weight rockets take satellites into orbit more easily than heavy ones, after all.
- Building better batteries. Hackney is working with Duracell, Inc. to improve the materials in its copper-top battery line so that the batteries last even longer. "[Duracell is] interested in the way they process the material—sometimes it comes out one way, and it works, and sometimes it comes out a different way and it doesn't work," Hackney says. "They want to know what happens at the atomic scale, why that makes it work in some cases but not in others."
- John Jaszczak, professor of physics, and Christopher Stefano, associate curator at the A. E. Seaman Mineral Museum, seek to understand how certain minerals form over the eons—how the atoms have stuck together in interesting ways as proof of the eons of fabrication they went through. Understanding mineral structures gives researchers the ability to manufacture them synthetically, which can be useful for society.

  Pinaki Mukherjee was recently hired as the STEM specialist (see page 5). Mukherjee processes samples and calibrates the microscope, which is extremely sensitive to temperature changes and vibrations, but also trains faculty and graduate students on how to operate the Titan.

The samples analyzed in the STEM must be extremely thin in order to form useful images from the transmitted electrons, which requires some expertise. Owen Mills, director of ACMAL, is an expert in several types of sample preparation for polymers, bio-materials, ceramics, and metals and assists most users in developing useful specimens.

Commenting on the extraordinarily small size of material examined in a typical experiment, Hackney says, "When I first arrived at Michigan Tech 30 years ago, Professor Tom Courtney pointed out that if you take all the material that's been analyzed by transmission electron microscopy or STEM up to 1985 and put it all together, you might make the head of a pin. However, now I think it is probably the whole pin."

All the World's a Stage

"Michigan Tech is known for being a hands-on school," says Mills. "We want to train students to do the work themselves so they can go out and do the work in industry or at other academic institutions."

A key function of the microscope is its ability to observe material behavior at atomic resolution while subjecting atoms to various stimuli. Samples can be placed on stages that elevate temperature, apply different voltages, deform materials by applying force, and allow examination of materials behavior in a liquid environment.

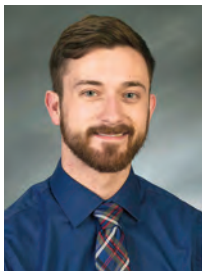
Another function of the microscope is creating three-dimensional models of materials using electron tomography to examine a sample from all angles. The STEM facility is also open to researchers and scientists from other institutions. Visit **mtu.edu/research/s-tem** to book the lab for sample processing.

"It's really a tool that is only limited by our imaginations," Mills says. "The microscope itself is a ticket into a new world. We're really fortunate; there are very few of these microscopes around."

STUDENT NEWS

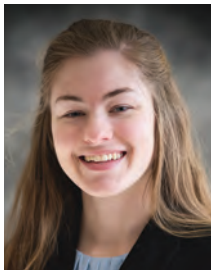
Richard Shorraw Memorial and Academic Achievement Awards

MSE senior **Christopher Pflug II** received the Richard Shorraw Award, presented at the 2018 senior banquet to the graduating senior with the greatest improvement in grade point average during the course of their studies in MSE at Michigan Tech. Chris is now a practicing metallurgist at Neenah Foundry in Neenah, Wisconsin.



Also at the April 19, 2018 senior banquet, MSE senior **Joshua Dorn** received the 2018 Alpha Sigma Mu Academic Achievement Award for the highest GPA among graduating seniors. Josh is now a materials engineer for NanoAl, Inc. in Chicago.

Departmental Scholar



Chelsey Rock was named the 2018-19 MSE Departmental Scholar by Michigan Tech Provost Jacqueline Huntoon, for her academic accomplishments, leadership, participation in undergraduate research, and service. As a sophomore, Chelsey received a McArthur Undergraduate Research internship to investigate nano-crystalline rare-earth magnet materials under the guidance of Professor Pete Moran. She also serves as a coach in the Math Learning Center, and is president-elect of the engineering honor society on campus, Tau Beta Pi. She is a member of the Mind Trekkers outreach troupe, a member of the Alpha Sigma Mu materials honor society, and plays French horn in the campus concert band.

MSE senior **Christopher Phlug II** was the inaugural recipient of the $3,000 Franklin St. John MSE senior lottery scholarship. Conceived and funded by Dr. St. John (MY '60), a ping pong ball with Chris' name emerged from a bingo cage at a special party following the student-run Engineering Explorations open house in November. MSE junior **Trudy Nuiver** was the recipient of the first St. John MSE junior lottery scholarship during the same event. Who says MSE is boring?

Several MSE seniors received scholarship awards from the Foundry Education Foundation (FEF) and American Foundry Society at the 2018 senior banquet. The awards were presented by Dr. Kathy Hayrynen (MY '86 '89 '93), vice president for research and development at Applied Process, Inc., who serves as education chair and director of the Detroit-Windsor AFS chapter and the Director of FEF. Receiving NE Wisconsin AFS cash awards were: **Katherine Russell, Lucas Itchue,** and **Simon Eddy. Erin Heidelberger** and **Katherine Russell** (below) received Detroit-Windsor AFS awards. **Ryan Spaulding, Christopher Pflug II, Nick Stuve,** and **Erin Heidelberger** received Foundry Educational Foundation scholarships.

Christopher Pflug II (above left) was recognized for his interest in a metal casting career with the Richard Frazier Scholarship at the 2017 Foundry Education Foundation (FEF) College Industry Conference in Chicago (CIC). Also at the CIC, was MSE fourth-year **Julia Scruton** (left), who received the Keith D. Mills Scholarship, in support of her pending graduate studies.

Rising MSE fourth-year **Katherine Russell** is one of two recipients of the 2018 Bert Krisher Scholarship awarded by the Materials Technology Institute in St. Louis.

Matthew Thomas, a fourth-year MSE student, was awarded the inaugural William J. Bernard Jr. Family Endowed Scholarship, announced at the dedication of the Bernard Family Clock Tower in August. The scholarship will be awarded annually.

STUDENT NEWS

Advanced Metalworks Enterprise Update

Enterprise at Michigan Tech adds value to the student experience by providing exposure to real industry problem solving. The Advanced Metalworks Enterprise (AME) offers a variety of metallurgical manufacturing projects that teams of three to five students take ownership of. Each team member has an integral part in not only performing the work, but also in the design, planning, and communication required for a successful project. Membership on an AME team helps students build a résumé, develop teamwork and leadership skills, form professional relationships with faculty and company representatives, and gain a general sense of what to expect while in the workforce.

During the 2017-18 school year, AME projects were sponsored by Ford, ArcelorMittal, Neenah Foundry, Applied Process, Mercury Marine, and Waupaca Foundry. Some examples of these projects include understanding the effects of boron on austempered ductile iron, improving a test that studies the effect of hydrogen embrittlement on martensitic steel, understanding the effects of the austempering process on grey iron, and innovating a method of rapidly prototyping expendable patterns that can be integrated into the current lost foam casting process. Some of these projects were completed and a number of them are being integrated into their sponsor's processes; others may continue as ongoing projects. I look forward to seeing the new advancements in metallurgy made possible by student involvement in AME.

—**John Falecki, AME President**

Materials United

Greetings! My name is Katie Amar-Fox. I'm the incoming president of Materials United (MU). MU is a student organization at Michigan Tech dedicated to providing students full exposure to all aspects of the MSE discipline. Membership in the organization provides opportunities to learn about industry, share research, develop personal skills, and participate in professional societies. MU houses two local professional society chapters: American Foundry Society, and Materials Advantage (MA). MA is itself an umbrella organization that serves four professional societies: ASM International, The Materials Society, the American Ceramic Society, and the Association of Iron and Steel Technology.

Last year, MU members attended multiple conferences including the Materials Science and Technology (MS&T) Conference in Pittsburgh, as well as the Casting Congress in Fort Worth, Texas. These meetings gave students a chance to expand their knowledge and engage with industry professionals. MU members also participated in casting competitions and a composite entry for DomesDay at MS&T. Lastly, members hosted professional events—a favorite is the "MSE Meet and Greet" with company representatives in advance of Career Fair—and participated in outreach activities such as organizing the departmental engineering open house, visiting local science fairs to showcase foundry-in-a-box, and hands-on events on campus to promote MSE. In the coming year, MU is again looking forward to facilitating conference attendance, coordinating the departmental open house, participating in competitions and outreach events, and ongoing professional development opportunities. MU continues to seek support from alumni and industry, and we appreciate guest speakers willing to make presentations at meetings. To get involved or for more information, please contact me at keamarfo@mtu.edu. Thank you for your continued interest and support.

—**Katie Amar-Fox, MU President**

SENIOR DESIGN TEAMS AND SPONSORS

DI FOUNDRY PROCESS

Team: Matt Gleason, Karl Hamina, Nick Verhun

Advisor: Dr. Dale Dewald

Consultant: Joe Keske (MY '97), Waupaca Foundry

HIGH TEMPERATURE ADI

Team: Erin Neil, Cam Smith, Carson Williams

Advisor: Dr. Joe Licavoli

Consultant: Dr. Kathryn Hayrynen (MY '86 '89 '93), Applied Process, Inc.

ALUMINUM BRAKE ROTOR

Team: Aaron Cook, Josh Dorn, Mark Ilenich, Phil Staublin

Advisor: Tom Wood

Sponsors: Advanced Metalworks Enterprise and Ford Motor Co.; James Boileau, liaison

BORON IN DUCTILE IRON

Team: Dani Jencks, Christopher Pflug II, Ryan Spaulding, Nick Stuve, Tom Weston

Advisor: Dr. Dale Dewald

Sponsors: Advanced Metalworks Enterprise and Waupaca Foundry; Joe Keske (MY '97), liaison

POLYMER FILAMENT DEVELOPMENT FOR EVAPORATIVE PATTERN PROTOTYPING

Team: Alex Ball, Kristen Bull, Simon Eddy, Lewis Marshall

Advisor: Dr. Jarek Drelich, Russ Stein

Sponsor: Mercury Marine; David Blondheim, liaison

PULTRUSION DIE FAILURE ANALYSIS

Team: Adam DeYoung, Ryan Hebner, Tyler Kiszelik, Emily Marciniak

Advisor: Dr. Larry Sutter, Russ Stein

Sponsor: Easton Technical Products; Ted Palomaki (MY '81), liaison

STAINLESS STEEL TUBE WELD FAILURE ANALYSIS

Team: Morgan Jons, Tristan Kolb, Curtis McKenney, Bailey Rudolph

Advisor: Dr. Walter Milligan

Sponsor: DTE; Dr. Richard Lynch (MY '89 '91 '95), liaison

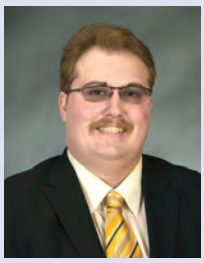
STUDENT NEWS

First Place, ASM Undergraduate Design Competition

Michigan Tech's Aluminum Brake Rotor project received first place in ASM International's 2018 Undergraduate Design Competition! Michigan Tech's entry has placed in the top three in every year that an entry was submitted (six of seven years). The team was recognized at the student awards banquet at the Materials Science & Technology (MS&T) Conference in Columbus, Ohio, in October.

Thomas Courtney and Richard Heckel Memorial Scholarships

In recognition of her leadership and service to the department, MSE rising fourth-year **Katie Amar-Fox** was awarded the 2018-19 Thomas Courtney MSE Leadership Scholarship. Amar-Fox served on the 2017-18 executive board of MU as social chair, and will continue on the MU executive board as president.



MSE fourth-year **Charles Newlin**, was awarded the 2018-19 Richard Heckel Memorial Scholarship, recognized by the MSE faculty for his perseverance and commitment to overcoming obstacles during the course of his studies.

2018 Inductees into the Order of the Engineer and Alpha Sigma Mu

ORDER OF THE ENGINEER

ΑΣΜ ALPHA SIGMA MU

Alex Ball
Kristen Bull
Aaron Cook
Adam DeYoung
Joshua Dorn
Simon Eddy
Morgan Herzog
Mark Ilenich
Danielle Jencks
Morgan Jons
Tristan Kolb
Emily Marciniak
Lewis Marshall
Curtis McKenney
Karry Modolo
Christopher Pflug II
Kassia Prystalski
Zachary Reuter
Bailey Rudolph
Philip Staublin
Nick Stuve
Yifei Wu
Thomas Weston
Carson Williams

Faculty and Staff:
Stephen Hackney
Jean Kampe
Stephen Kampe
Edward Laitila
Paul Sanders

Katherine Amar-Fox
Benjamin Gregory
Matthew Hasbrouck
Erin Heidelberger
Jarod Riemersma
Emily Tom
Christopher Wallenfang

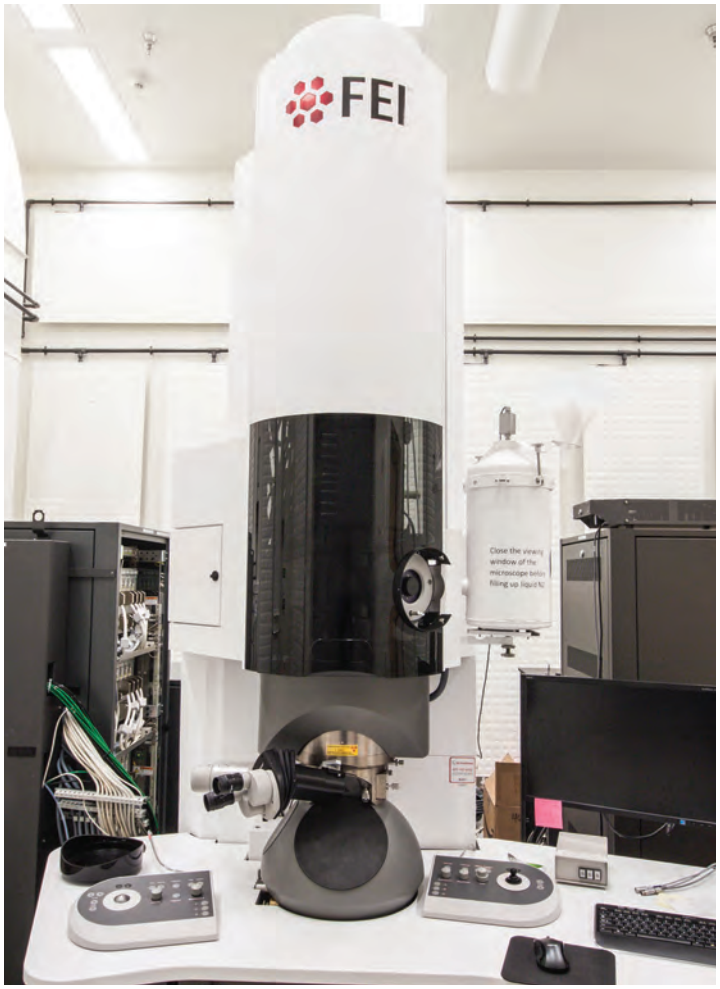
2018 Congressional Visits Day

Four MSE students participated in the Material Advantage Congressional Visits Day in Washington, DC, in April. Students from across the country gather for the purpose of advocating federal support for higher education and research in the physical sciences. Representing the state of Michigan (left to right) are MSE graduate students Jeffery Brookins (MSE '17 '18) and Violet Thole, and undergraduates John Falecki and Jonah Jarczewski. The delegation met with staff members in the offices of Michigan Senators Gary Peters and Debbie Stabenow, and Michigan Congressmen Justin Amash, Jack Bergman, Sander Levin, Paul Mitchell, and John Moolenaar.

GRADUATE STUDENT NEWS

2018-19 Graduate Degrees

Student	Degree	Faculty Advisor	Thesis/Dissertation Title
Zhiyong Yin	MS-T	Jaroslaw Drelich	Microstructural Evolution and Mechanical Properties of Zn-Ti Alloys for Biodegradable Stent Applications
Nate Peterson	MS-T	Paul Sanders	Measurement of Planar Fault Probabilities in Austempered Ductile Iron and 304L Stainless Steel
Pratiksha Rakhe	MS-NT	Stephen Hackney	Non-thesis
Luxi Wang	MS-NT	Stephen Hackney	Non-thesis
Liang Chang	PhD	Yun Hang Hu	Graphene Electrodes for Supercapacitors and Capacitive Deionization
Kaiming Chang	MS-NT	Stephen Hackney	Non-thesis
Vasundhara Shinde	MS-NT	Stephen Hackney	Non-thesis



2018-19 Graduate Recognitions

MSE graduate student **Alejandra Almanza** received the Dr. Katherine E. Mortimer Scholarship from the Foundry Education Foundation (FEF), awarded in November at the College Industry Conference in Chicago. Ale's father, Efrain Almanza, the FEF Key Professor at Instituto Technologico de Saltillo in Mexico, received the FEF/AFS Distinguished Professor Award at the same conference.

MSE graduate student **Jeffrey Brookins** ('17 '18) received third place in the biomaterials poster competition at the 2018 TMS Annual Meeting in Phoenix in March. The poster titled "Development and Characterization of Biodegradable Zinc Vascular Ligation Clips" was co-authored by biomedical engineering (BME) graduate student Roger Guillory; MSE research associate J. M. Seitz; BME Professor Jeremy Goldman; and MSE Professor Jarsolaw Drelich.

MSE PhD student **Liang Chang** was recognized as the Spring 2018 Outstanding MSE Graduate Student at the Graduate Student Government (GSG) banquet in April.

MSE PhD student **Morteza Shaker** was elected by his MSE graduate peers to serve as MSEs representative to the Graduate Student Government Council. In addition, MSE PhD students **Prasad Soman** and **Ninad Mohale** were elected to serve as the Public Relations and Social chairs, respectively, for GSG.

MSE PhD student **Adam Pringle** was one of nine finalists in the "Make a Difference" competition, which focuses on ideas and solutions for the needs of world refugees, health of society, education, and ecological sustainability. Adam traveled to Germany to showcase his project on the "Composite Filament Fabrication Process."

OUTREACH

MSE and Michigan Tech's Summer Youth Programs

The MSE department continues its active participation in the Michigan Tech Summer Youth Programs (SYP). During the summer, middle and high school students participated in weeklong workshops in Explorations in Engineering Materials (left), Women in Engineering (right), and the Engineering Scholars Program. Students learned about materials science through metal casting, blacksmithing, 3-D printing, shape memory alloys, and "processing" ice cream using liquid nitrogen.

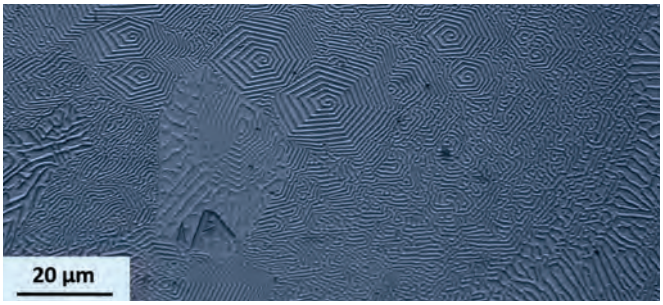
WITH SINCERE APPRECIATION

As a gesture of appreciation for 50 years of combined service, Provost Jacqueline Huntoon commissioned MSE to produce a set of custom Husky statuettes for each of the VIP retirees: President Mroz and four University deans. The solid bronze statuettes are replicas of the Husky statue on campus. Each rest on a pedestal of indigenous Upper Peninsula maples, including Birdseye, Spalted Birdseye, Curly, and others. MSE Chair Steve L. Kampe and MSE staff member Russ Stein coordinated the team effort involving personnel from each of the four colleges or schools with a retiring dean; bronze castings were poured in the MSE foundry, mold break-out and clean up was provided by Nick Hendrickson and Scott Meneguzzo in the School of Technology machine shop; artistic finishing was provided by Assistant Professor Lisa de Gordillo from the Visual and Performing Arts (College of Sciences and Arts), and the maple pedestals were crafted by Dave Stimac of the Alberta Ford Forestry Center (School of Forest Resources and Environmental Science).

Huntoon presided over the gift presentation in late June. "We wanted to do something special," she said. "We came up with this plan that required input between several departments. The result was University-wide, handmade gifts."

In MSE, the project was part of a larger effort, referred to as MakerMSE™, that exists to provide resources to students for projects that will showcase the processing capabilities in the MSE department, and to encourage student creativity and entrepreneurship. In this instance, students Oliver Schihl, Sidney Schroeder, and Sam Dlugoss created a pattern of the dog using 3-D printing from a photo-generated file. Sand molds were produced at Hoosier Castings (of Indiana), and a litter of six dogs were cast in silicon bronze in the foundry.

Other MakerMSE™ projects have included the re-introduction of cast 1960s vintage Michigan Tech bookends, an extruded UP bottle opener, and departmental plaques. The MakerMSE™ projects will be featured in a future *Annual Report*.



A Zn-3Mn eutectic alloy, showing Mg2Zn11 in a spiral pattern within the hcp Mg matrix. Optical micrograph by Ehsan Mostaed, MSE postdoctoral assistant.

ALUMNI NEWS

Dr. Amy (Mikkola-Streicher) Clarke (MME '00) has joined the External Advisory Board for the College of Engineering at Michigan Tech. Clark is currently an associate professor of metallurgical and materials engineering at the Colorado School of Mines.

Kimberly D'Augustino (MSE '15) was nominated for a two-year competitive advancement program within Boston Scientific; since graduating, she has worked as a manufacturing engineer at the Boston Scientific Maple Grove campus in the Twin Cities. She and her work in peripheral interventions (for healthcare; think stents and catheters) was featured in a "STEM Virtual Field Trip Extrusion Line Tour" as one in a series of educational videos she and colleagues made for outreach activities. View the tour at vimeo.com/261872762.

Amberlee Haselhuhn (MSE '11 '16) was named one of Advanced Manufacturing's "30 under 30 Future Leaders of Manufacturing." See advancedmanufacturing.org/2018-30-under-30.

Dr. Yang Shao-Horn (PhD MY '98) was elected to the 2018 class of the National Academy of Engineering. Dr. Shao-Horn is currently a professor of mechanical engineering at MIT.

Dr. Paul Jablonski (MY '87) was named a fellow of ASM International at the MS&T Conference in Pittsburgh in October 2017. Paul is a metallurgist with the National Energy Technology Lab in Albany, Oregon.

Brenda (Jones) Ryan (MY '76) began a three-year term as the chair of the Michigan Tech Board of Trustees, effective August 2018.

Congratulations Class of 2018

A portion of MSE's newest alums, pictured following spring commencement activities in May. Pictured are (left to right) Emily Marciniak, Alex Ball, Kristen Bull, Mark Ilenich, Thomas Weston, Phil Staublin, Aaron Cook, Bailey Rudolph, Morgan Jons, Joshua Dorn, Nick Stuve, Danielle Jencks, Curtis McKenney, Ryan Spaulding, Christopher Pflug II, and Carson Williams. Not pictured are spring graduates Morgan Herzog, Tyler Kiszelik, Tristan Kolb, Lewis Marshall, Karry Modolo, Jacob Prochnow, Kassia Prystalski, Yifei Wu; and fall 2017 graduates Emily Hunt, Erin Neil, Evan Olson, Anna Polk, Julia Scruton, Cameron Smith, Nicholas Verhun, and Zachary Verran.

Alumni Association Awards

Susan (Brechting) Kiehl (MY '83) is the 2018 recipient of Michigan Tech's Distinguished Alumni Award, presented during Alumni week in August. Kiehl recently retired from her position as a vice president of Lockheed Martin in Fort Worth, Texas. She now resides in Grand Haven, Michigan.

2018 Distinguished Alumni Susan Kiehl and MSE chair Stephen L. Kampe

EAB and FEF Boards

MSE's External Advisory Board (EAB) and Foundry Education Foundation (FEF) Board met in April to review department activities, attend the capstone Senior Design presentations, and to participate in the University Senior Design Expo.

Members of the combined boards attending were (left to right): Rick May MY '95, Cadillac Castings; Joe Keske MME '97, Waupaca Foundry; Greg Jarski MY '04, MTI Metalcasting; Stephen L. Kampe MY '81 '83 '87, MSE chair; Daniel Freiberg MSE '14, Ford; Elizabeth Pilibosian, GM; Karen Gasko MY '83, DuPuy Synthes; Danielle Rickert MSE '04, Carpenter Technology; Kathy Hayrynen MY '86 '89 '93, Applied Process, Inc.; and Kevin Baker MSE '04, Beaumont Health Systems. Attending but not pictured were Mike Klecka MSE '04, United Technologies; James Boileau, Ford; and Matt Meyer MY '98, Kohler.

BY THE NUMBERS

UNDERGRADUATE SCHOLARSHIPS

Undergraduate MSE students received $558,367 in institutional and sponsored scholarships during the 2017-18 academic year from Michigan Tech's Financial Aid Office and the MSE department.

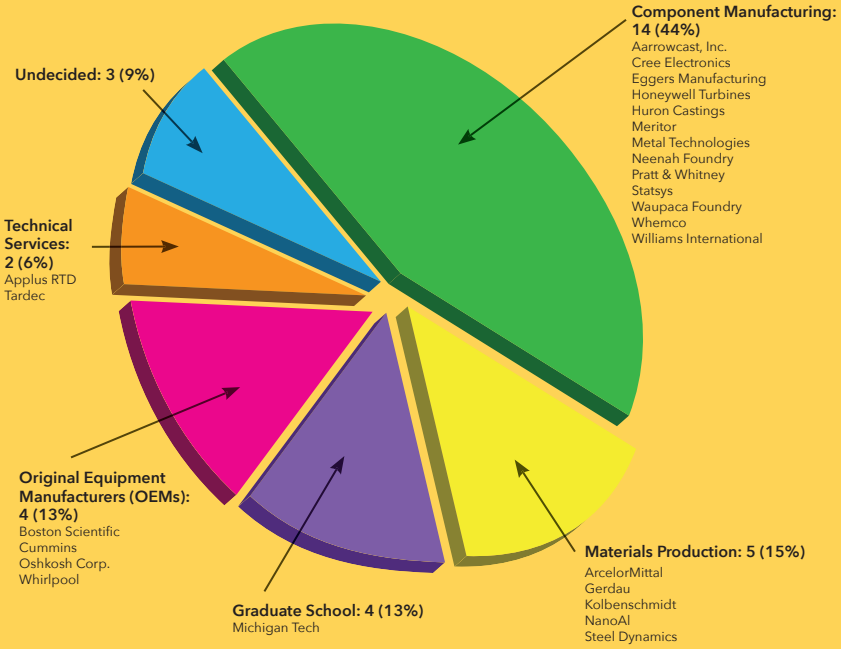
FACULTY/STAFF

16 tenure/tenure-track faculty
7 research faculty
12 technical staff

2017-18 GRADUATES

BS graduates	33
MS graduates	6
PhD graduates	1

CLASS OF 2018 PLACEMENT



2017-18 ENROLLMENT

Undergraduates	146
Graduates	41

RANKINGS:

U.S. News and World Report *ranked the graduate program No. 41 nationally in 2018, up 13 spots from last year.*

EXTERNAL RESEARCH EXPENDITURES

$2,400,570

Michigan Technological University

Materials Science and Engineering
Minerals and Materials Engineering Building
1400 Townsend Drive
Houghton, MI 49931-1295

ANNOUNCING THE KARL RUNDMAN/DENNIS MOORE MICHIGAN TECH FOUNDRY FUND

Metal casting has a proud legacy at Tech. Some may remember Professor Gilly Boyd's cupola in the McNair Hall foundry. Many may recall the foundry when it was located in the basement of the Chem-Met, established circa 1972, by professors Rundman and Mikkola, and supervised by Dennis Moore. Still others know the foundry in its present location on the ground floor of the Minerals and Materials Engineering Building and the role that professors Karl Rundman, Mark Plichta, and Paul Sanders, as well as staff members Dennis Moore and Pat Quimby, have had in its use for the educational and research programs of the department. While many have been involved, no two individuals have defined the legacy more so than Rundman and Moore. In their more than 80 collective years of dedication to Tech's foundry, they have prepared hundreds of students for careers in the metal casting industry, and established a strong network of professional contacts and lifelong friends. No two are more deserving to have their names associated with an ambitious fundraising campaign that will serve to strengthen and sustain the metal casting program at Tech far into the future.

The Foundry Education Foundation (FEF) Fundraising Campaign

Recognizing the impact that Michigan Tech has had as a pipeline for metal casting talent, FEF is leading a fundraising campaign to assist with the establishment of the Karl Rundman/Dennis Moore Michigan Tech Foundry Fund. Michigan Tech alums Paul Mikkola, David Gelwicks, Kathy Hayrynen, and Paul Sanders are working with FEF to contact alumni and several metal casting firms to assist MSE and Michigan Tech in maintaining a quality program and facilities.

We invite you to consider a tax-deductible contribution to the Rundman/Moore Foundry Fund directly to FEF at fefinc.org/donate or by texting 847-979-4721. All gifts will be directed to Michigan Tech for its exclusive use as support for the metal casting program. A FEF endowment for Michigan Tech's foundry will establish a permanent and dedicated source of support for its facilities, staffing, and Michigan Tech students.

Photo below from Michigan Technological Archives. Center photo from the *Keweenawan*. Far photo from FEF.

The "Gilly Boyd cupola" in McNair Hall, circa 1970.

Dennis Moore (right) and Karl Rundman (left, back) assisting students in a ductile iron pour, circa 1999.

Dennis Moore and Karl Rundman accompanying six students at the College Industry Conference, circa 1994.

For more information about giving to MSE and Michigan Tech, contact MSE chair Stephen L. Kampe at kampe@mtu.edu or Eric Halonen in the Office of Advancement at ehalonen@mtu.edu.