

Letter from the Chair

Greetings! Another academic year has come and gone, and as I consider all that has taken place over the past 12 months, I am left with a very positive feeling about Michigan Tech, the department, and, as always, our students.

This year's graduates have not only grown into fine young professionals, but their commitment to the department and their interest in helping to improve and grow the program has been inspiring. Their enthusiasm has been contagious, for I see the younger students developing a sense of pride and dedication in our program as well. We can only imagine what the future will hold for us when these energetic graduates focus their efforts on helping the department.

As has been the tradition, this newsletter concentrates on our students and their accomplishments. You will be impressed, I believe, with what you read.

In this particular communication, I feel compelled to recognize companies and individuals who have provided significant resources to support our students through scholarships. With the rising cost of higher education, it has become increasingly difficult for students to meet the financial burden. Our department has been blessed with friends who recognize this need. The faculty, staff, students and I wish to give a resounding thank you to the Alcoa Foundation (\$6,000), the Ladish Company Foundation (\$12,000), John Deere & Company (\$2,500) and the Foundry Educational Foundation (\$12,300) for their support this year. The department also has a number of

endowed scholarships in honor of past members of our departmental family which provide additional support. We are also thankful for these, and they include the John Biffel Memorial, the Katherine M. Bosch Memorial, Professor Gilbert W. Boyd Memorial, Elmer W. Cress Memorial, Dr. Corbin T. Eddy Memorial, the Charles Locke Memorial, and the James N. Wessell Scholarship.

Finally, in keeping with the theme of students and scholarships, you may be interested in supporting a new scholarship in honor of the late Professor Thomas H. Courtney. Details on how you can contribute to this endowment will be available soon and will be outlined on our website. As always, however, your continued support of our program through annual giving directly to the Department of Materials Science and Engineering is extremely important. I look forward to working with our alumni in the future and invite you to stop by for a visit whenever you are in the area.

Sincerely,
Mark R.
Plichta



Innovative Casting Enterprise students made a "zinc log" model for Enterprise Advisor, Department Chair and Professor Mark Plichta. The zinc alloy log structure was assembled like Lincoln Logs. It resembles the log home that Mark and Carol Plichta are building on Little Traverse Bay on Lake Superior.

Keeping Connected

We in the Department of Materials Science and Engineering are very proud of our alumni, many of whom have accomplished a great deal in their professional and personal lives. Please use the form below to update us on the recent developments in your life. We will include your responses in future newsletters, if you request.

Name (if applicable, please include your maiden name)

Graduation year and degree

Address _____

City/State/Zip _____

E-mail _____

Phone _____

Current job title, employer

Any other information

May we include this information in a future newsletter?
(circle) yes no

Please return this form to:
Department of Materials Science and Engineering
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931

Or fax a copy to (906) 487-2934, or e-mail this information to Mark Plichta at mrplich@mtu.edu.

MichiganTech

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Alumni

Alumni updates

In each edition of Alumni Alloy, we will run alumni updates. To be included in this section, please return the Keeping Connected form included in this newsletter.

Michael Lauriente (BS '43, MS '47) of Clarksville, Maryland retired as a metallurgical engineer from NASA's Goddard Space Flight Center. Lauriente was the manager of Environert, an online computer system on space environment.

Melissa (Friesen) Parks (BS, '83) is the manager of the Product Technology Manufacturing and Quality Technology Department for General Electric. A member of the

transportation aircraft engines engineering division, Parks currently leads a team identifying and leveraging existing technologies in component repair, production technology, the after-market technology pipeline, and GE inspection technology synergy and growth. Parks lives in Loveland, Ohio.

Yucong Wang (PhD '91) received a 2004 ASM International Fellow Award. Wang leads the Surface Engineering and Tribology Center of General Motors Corp. in Pontiac, Michigan. The award was given for pioneering contributions to surface engineering and tribology to improve automotive product quality and performance at reduced manufacturing costs, and for working to establish an ASM International presence in China.

Keith Williamson (BS, '94) is Supply Chain Manager of Processing for Goodrich Corp.'s Landing Gear Division in Fairview Park, Ohio. He recently married Heather Lynne Potter and the newlyweds live in the Cleveland, Ohio area.

Carlos Alonzo (BS '95, MS '98), works for Kodak as a senior materials science and microfabrication specialist. Carlos and his wife, Damaris, have two children, Natalia Isabelle, 4, and Alexander Dicarolo, 10 months. They reside in Rochester, New York.

Jason Koski (BS, '02) leads the Neutron Tube Defect Analysis Lab at Sandia National Laboratories in Albuquerque, New Mexico. He and his wife Janiece restore cars in their free time at their home in Albuquerque.

Alumni Alloy

Bonding alumni with the Department of Materials Science and Engineering at Michigan Technological University

Mooren, Young new Harris scholars

Two MSE seniors, Gregory Mooren and Jana Young, have received the H.H. Harris Foundation Scholarship.

The foundation was created to provide scholarships and other forms of educational aid to students and professionals in the metallurgical and metal casting fields.

Sternhagen gets 2 ASM scholarships

Victoria Sternhagen was awarded one of ASM International's major scholarships for the second year in a row.

Sternhagen was a 2004 recipient of a George A. Roberts Scholarship, including a \$6,000 cash award, which she received at the 2004 Materials Solutions Conference in Columbus, Ohio.

The scholarship was established in 1995 by Dr. George A. Roberts, former ASM president and retired Teledyne CEO, as an expression of his commitment to education and the materials science and engineering community.

Sternhagen also received the award in 2003.

"All junior and senior level students majoring in materials-related fields at a North American university are eligible to apply for these scholarships, so earning such an award once, let alone twice, is quite a feat," said Associate Professor Douglas Swenson.

In addition, Dr. Kathy L. Hayrynen, an MSE alumna and technical director of the Technologies Division at Applied Process, Inc. in Livonia, Michigan, presented Sternhagen with a scholarship from ASM's Detroit chapter.

MSE senior earns Provost's Award for Scholarship

Senior Rachel Rosten received the 2005 Provost Award for Scholarship, which is given to a senior who best represents student scholarship at Michigan Tech.

Students considered for this award are judged not only by academic standards, but for participation in research scholarship activity, levels of intellectual curiosity, creativity, and communication skills.

"Rachel is the perfect example of a scholar," said Associate Professor Douglas Swenson. "Her academic performance has been excellent, as demonstrated by her 4.0 overall

grade point average. This is even more impressive when one considers that she is pursuing degrees in both

materials science and engineering and physics."

Rosten works as an undergraduate research assistant, participates in the Research Scholars Program, is a Math Learning Center coach, and is an active member in Tau Beta

Pi engineering society. She ranks first in her class of 1,295 in the College of Engineering and also was the 2004-05 MSE department scholar.

"I'm very honored and grateful for everyone who has helped me in my academic career," Rosten said.



ROSTEN

Proving their Mettle



MTU's Women in Engineering program allows female high school students to investigate careers in engineering and science. Each session includes a laboratory experience, a team engineering project, and time to interact with role models and peers. Pictured are students in last summer's Materials Science and Engineering session which included casting and blacksmithing.

Students

Snapshots from the 2005 Graduation Reception held April 29. . .



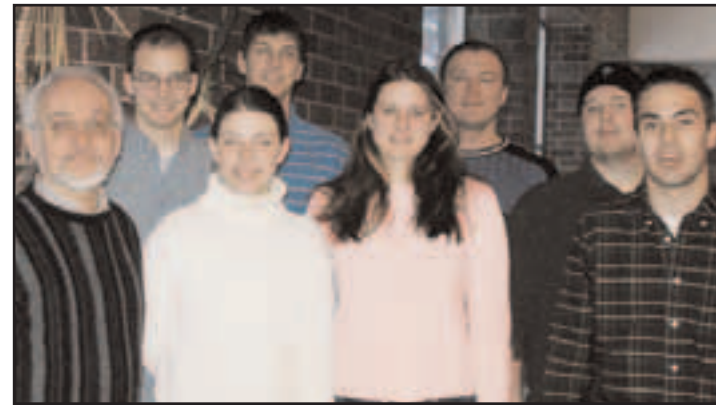
33 students get 38 sponsored scholarships

Thirty-three MSE students received more than \$28,000 in sponsored scholarships for 2004-2005.

Six students received awards from Alcoa, including Emily Braun, Erica Orth, Erin Johnson, Megan Ross, Rachel Rosten, and Lauren Snedeker.

The Foundry Educational Foundation (FEF) sponsored Jana Young, Lauren Snedeker, Carl Ballinger, and Greg Mooren.

The Ladish Company Foundation provided assistance to Carl Ballinger, Kevin Field, Tim Kurdziel, Andrea Hansen, Andrew Hafeli, Michael Lawrence, Andrew Zeagler, Tim Ciarkowski, Joseph Kaufman, Kiera Kampe,



Seven Michigan Tech students were recipients of Foundry Educational Foundation (FEF) scholarships for 2004-05 year. Pictured in the front row are Department Chair and Professor Mark Plichta, Jana Young, Lauren Snedeker, and Carl Ballinger. Pictured in the back row are Greg Mooren, Ryan Thut (ME), Timothy Traczyk (ME), and James Zakerski (ME).

Jared Cummings, Jacob Gorkowski, and Jana Young.

The John Biffel Memorial Scholarship went to Stephanie Oehlke, the Katherine Bosch Memorial to

Danielle Richmond, and the Professor Gilbert Boyd Memorial to Eric McDonald.

The Elmer Cress Memorial Scholarship was awarded to Danielle Richmond and Michael Jenson, the Dr. Corbin Eddy Award went to Jenny Collins, and the Charles Locke Memorial to Gregory Mooren.

The Ted Rozsa Endowed Scholarship was awarded to David Hunt, the James N. Wessell to Sara Bennett, and the Deere and Company Metallurgy Scholarship was shared by Joe Licavoli and Victoria Sternhagen.

Other awards were given to John Pomeroy, Eric Kubica, Eric Vincent, and Andrea Schmidt.

5 student groups participate in 2004-05 Senior Design projects

Five teams of seniors successfully investigated problems presented by industrial partners during the past academic year. The following is a summary of the problems addressed and the teams' findings:

Development of High Modulus Austempered Ductile Iron

Replacing an automobile's forged steel components, such as crankshafts, with austempered ductile iron (ADI) could result in significant cost savings to the industry, owing to lower processing costs. The purpose of this project was to increase the elastic modulus of ADI to that of forged steel by altering its microstructure through compositional variation and heat treatment. Twelve experimental alloy compositions were cast and heat-treated. Evaluation of the microstructures utilized X-ray diffraction and optical microscopy/image analysis; elastic moduli were measured by tensile testing.

Results showed that within the range of experimental error, it is possible to produce ADI with an elastic modulus comparable to that of forged steel. However, no clear correlation between modulus and microstructure was found, although a slight correlation between modulus and graphite nodularity was noted.

Some undesirable microstructural features, such as carbides, graphite flake formation, segregation, and nodule alignment were noted in a majority of the alloys. For these reasons, it was suggested that strict control of composition, casting conditions, and heat treatment is required if high modulus ADI is to be obtained.

The corporate sponsor was DaimlerChrysler. Team members were

Students worked on a variety of projects including studying ways to replace automobile's steel components with austempered ductile iron, developing new die cast materials, performing microstructural analysis on a fluidized bed heat-treated engine block, inspecting corrosion on cervical plates and studying chemical weight loss and thermal degradation on foam patterns.

Michael Jenson, Erica Orth, Danielle Richmond, John Schmitt, and Matthew Wolfe. The advisor was Associate Professor Doug Swenson.

Development of New Die Cast Materials

Perfect Equipment and Eastern Alloys sponsored a proprietary project with MSE on die casting improvements. Team members were Derek Aluia, Carl Ballinger, Michael Klecka, Gregory Mooren, and Jana Young. The advisor was Department Chair and Professor Mark Plichta.

Effectiveness of Fluidized Bed Heat Treatment on Large Components

Heat treatments required to produce desired properties in engine blocks often require considerable time, which is costly. The purpose of this project was to investigate the feasibility of a fluidized bed heat treatment process that could reduce the time needed for heat treatment.

The team attempted to confirm that the mechanical and metallurgical properties of the fluidized bed heat treatment process met specifications for the engine block of interest.

The team performed tensile tests, microstructural analysis, hardness

tests, determined a fracture surface roughness profile using fourier transform, and investigated strain hardening.

The results of these analyses concluded that the fluidized bed heat treatment process effectively heat treats the engine blocks, but there was a significant difference in properties of samples taken from the bolt bosses. Recommendations were made as to appropriate fluidized bed solutionizing times for the blocks alone, and alternate times if bolt bosses are of concern.

The corporate sponsor was DaimlerChrysler. Team members were Beth Blumhardt, Josh Farris, Shawn Martin, Andrea Schmidt, and Lauren Snedeker. The advisor was Professor Steve Hackney.

Corrosion and Failure Mechanisms for Spinal Implant Hardware

An anterior cervical plate fixates the spine, fusing multiple vertebrae. Currently, devices are explanted due to failure mechanisms that are poorly understood. Beaumont Hospital supplied sixteen explanted and three new anterior cervical plates for experimentation designed to correlate plate condition and degradation with device implantation time. Analysis included optical and scanning electron microscopy (SEM) for inspections of mechanical damage and corrosion sites, metallographic examination of the microstructure, atomic force microscopy (AFM) for surface roughness quantification, and potentiodynamic polarization and corrosion potential measurements to characterize the surface condition of the plates.

The most significant finding of this project was that the tested implant devices show signs of surface disso-

lution and a weakening of the oxide layer. Additionally, the team found that dissolution rates (15-35 μ /year) appear to be much higher than the accepted value (1 μ /year). SEM analysis also revealed cracking of the protective oxide layer in the regions where characters had been imprinted, rendering the implant more susceptible to corrosion.

The corporate sponsor was the William Beaumont Hospital Research Institute. Team members were Emily Braun, Anna Keranen, William Kiilunen, and Michael Lawrence. The advisor was Associate Professor Jarek Drelich.

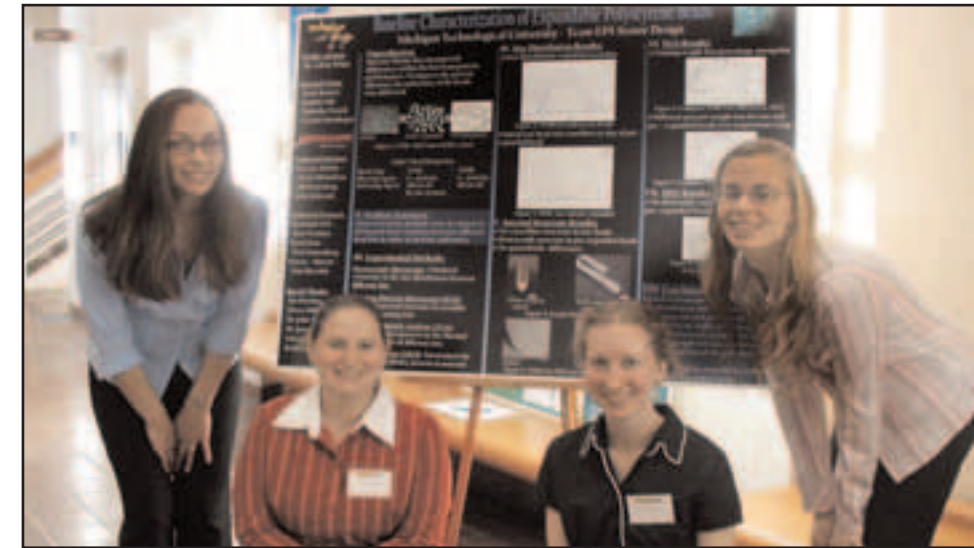
Characterization of Foam Cell Structure in Polystyrene Patterns

The objective of this project was to develop characterization methods to distinguish differences between different lot numbers of expandable polystyrene beads, and ultimately relate those differences to lost foam casting pattern performance.

Differences in size distribution, internal structure, volatile chemical weight loss, thermal degradation, and molecular weight were investigated in lots representing two different bead types. The students performed characterization utilizing stereoscopic microscopy and image analysis, scanning electron microscopy, thermogravimetric analysis, differential scanning calorimetry, and size exclusion chromatography.

The team observed variations in size distribution, weight loss, and thermal degradation that might influence pattern performance, and were able to make eight recommendations to minimize variability in beads. The work resulted in a provisional patent. (**See related story, "Project results in patent application."**)

The corporate sponsor was Mercury Marine. Team members were Sarah Bennett, Jennifer Erle, Amberlee French, and Victoria Sternhagen. The advisor was Professor Cal White.



Victoria Sternhagen, Amberlee French, Sarah Bennett, and Jennifer Erle looked at variations in polystyrene beads from which lost foam patterns are made.

Project results in patent application

For the third time since its inception, the work of an MSE Senior Design team has resulted in a patent application.

The Mercury Marine-sponsored project, "Characterization of Expandable Polystyrene Beads Used for Lost Foam Casting," investigated variations in polystyrene beads from which lost foam patterns are made.

With direction from team advisor Professor Cal White, team members Amberlee French, Sarah Bennett, Jennifer Erle, and Victoria Sternhagen developed a procedure for preparing the beads for scanning electron microscope examination without damaging the beads.

Another company heard of the team's success and contacted them about using the procedure for similar work. After a patent search was com-

"I am still shocked when I think about what can come from a group of college students."

pleted, Mercury Marine and Michigan Tech obtained a provisional patent. After one year, they can apply for a full patent.

"I was extremely excited when our team's hard work was recognized and granted a provisional patent," French said. "This was not something that was planned or expected. Honestly, I am still shocked when I think about what can come from a group of college students."

Other patents that have resulted from Senior Design projects are: "A Method of Mitigating Nonequilibrium Solidification in Tin-Base Solders by Reducing Liquid Phase Undercooling," with advisor Doug Swenson, and "Electrolytic Removal of Titanium Nitride Coatings from Cemented Carbide Substrates," with advisor Lloyd Heldt.

Foundation awards students' paper

The Forging Industry Educational and Research Foundation awarded a 2004 FIERF Achievement Award to five MSE students for their paper, "Failure Analysis of H13 Gear Blank Forging Dies."

Students John Bergeron, Erin

Burns, John Bushie, Haakon Sandberg, and Abby Vanden Heuvel each received \$400.

The FIERF also contributed \$1,000 to Michigan Tech. The paper was a result of the group's 2003-2004 senior design project.

