

May Meetings

May 23: ACRC and PMRC Steering Committee Meetings
 May 24: Project Overviews (8–11am); Focus Groups (11am–5pm); CHTE Board Meeting (4:30–6pm); Reception and Dinner (7–9pm)

May 25 Spring Symposium

This year's topic is Innovation; the symposium will be held immediately following the combined spring meetings of ACRC, PMRC and CHTE. Keynote speakers are John Moavenzadeh, co-director, International Motor Vehicle Program at the Wharton School; Rod Riek, chief engineer, Harley Davidson; John Hubbard, CEO, Bodycote International, UK; and Michael Kayat, president, UTEK-EKMS Inc.

May 27–June 7 Metals Conservation Summer Institute



Sponsored by MPI and the Higgins Armory Museum, MCSI allows participants to experience opportunities to investigate the fields of metallurgy and conservation from a new perspective. The program unites cutting-edge facilities and expertise in archaeological and historical metals benefiting the conservation of

ferrous and nonferrous materials. An internationally renowned faculty will expose students to the latest issues in archaeological and historical metal objects, resulting in the development of a new curriculum in the field of conservation. Seminar-style programs, hands-on labs, access to the museum's collections are included. Abstracts and lectures at www.wpi.edu/+mcsi.

May 28–June 2 MCWASP Conference

Modeling of Casting, Welding and Advanced Solidification Processes XI, Club Méditerranée, Opio, France. More information at www.mcwasp.org.

August 21–25 Summer School, Trondheim, Norway

In conjunction with NTNU and Sintef, MPI will sponsor a course on Solidification and Casting of Light Metals. More information at www.sintef.no/iss8.

September 11–13 s2P Conference

9th International Conference on Semi-Solid Processing of Alloys and Composites, Paradise Hotel, Haeundae Beach, Busan, Korea. More information at www.s2p.or.kr.

November 1–2 Symposium at WPI

ASM/CHTE Symposium, “Low Pressure Carburizing and High Pressure Gas Quenching”

MPI News

Over the past few months, major reports addressing critical needs in our nation have been published by such organizations as the Council on Competitiveness, Business Roundtable, National Academies, Business Higher Education Forum, and Association of American Colleges and Universities. These studies focus on the acute shortage of engineers and scientists in this country and the need for investments in science and technology.

MPI and its members should be proud to know that our collective efforts have focused on three recommended arenas: innovation, the future workforce, and students in the pipeline. Indeed, one of our most important outcomes is the innovative research our teams are pursuing and studying, but even more significant is the number of students attracted to careers in materials engineering—specifically to metal processing. The commitment of our members to sustain and to advance the knowledge base of the field as well as to nurture the pipeline of future knowledge-workers is genuine. And it is working.

This year brings many new developments at MPI. We're holding planning discussions with the leadership of the non-destructive evaluation community to establish a center dedicated to NDE, one that will complement and strengthen the existing MPI centers. Professor Reinhold Ludwig will oversee the new center. VJ Technologies, a leading manufacturer of X-ray inspection equipment, has donated one of its most advanced industrial X-ray systems to WPI. The VJE1000 X-ray unit is capable of conducting high-resolution, non-destructive material evaluation of such diverse engineering materials as automotive and aerospace components and semiconductor devices. We are grateful to Vijay Alreja, VJ founder and president, for his support, and for leading the discussions with industrial members of the NDE community in establishing this center.

Global competition dictates that to retain preeminence, the U.S. aerospace sector must transition to simpler, integrated, and streamlined material and product development processes. To support this thrust, MPI is exploring an opportunity to establish a national center that would address critical needs and development for aerospace (and defense) metals. This center would involve members of the aerospace supply chain and university researchers. Exploration of this opportunity is being led by Dan Backman, research professor at MPI, who has over 25 years experience in aerospace materials at GE.

I look forward to reporting to you on the progress we are making on both the NDE Center and the Center for Aerospace Metals.

—Diran Apelian

From the director:

Welcome to the inaugural issue of *MPI News*. Even though the hallmark of our institute is the close ties and strong communications we have with our industrial partners, we are committed to further strengthening our communication channels through this newsletter.



MPI News (to be published in February/March and August/September), in addition to the annual meetings (May and November/December) and numerous e-mails throughout the year, will ensure we're keeping our members up to date.

This newsletter is for you; we hope you'll enjoy reading it and contributing to it. In terms of content, it will follow a consistent format, covering news across the institute and all four centers of MPI.

Contact garofoli@wpi.edu with your feedback or articles you'd like to see in future issues.

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News of Faculty and Students

MPI Members on the Move **Mario Ciampini**, longtime supporter and past chair of the board of CHTE, has been named business development director of Bodycote International, following 15 years at Ipsen International, where he was CEO for the Americas and Asian markets in the supply of process heating equipment technology. In his new position, he will focus on continued organic growth and increased outsourcing opportunities for North American and Asian operations.

Ric Woldow has been promoted to facilities engineering/manufacturing engineering manager at Caterpillar. His responsibilities include melting, sand systems, met lab, environmental facilities, pattern making, and design for the Mapleton foundry as well as tooling for Caterpillar's Joint Venture in Saltillo, Mexico.

MPI Faculty **Diran Apelian**, Howmet Professor of Engineering and director of MPI, was recently elected a TMS Fellow [there are only 100 living TMS Fellows globally]. The Minerals, Metals & Materials Society recognized his pioneering research in materials processing and his outstanding leadership in materials education and industrial outreach. Apelian has also been honored with the TMS 2006 Bruce Chalmers Award for his primary work in molten metal processing, diffusion solidification, spray casting, and solidification processing of light metals.

Makhlouf M. Makhlouf has received the Hall/Heroult Scientific Merit Award from the Aluminum Division of the American Foundry Society Division Council. This annual award is given in recognition of scientific service that enhances the position of the aluminum foundry industry through contributions of original research, development of processes or materials, or by providing significant engineering advances. At CastExpo '06, **Makhlouf** and co-authors **Sumanth Shankar** and **Yancy Riddle** will receive the Best Paper Award from the Aluminum Division for "Mechanisms of Formation and Chemical Modification of the Morphology of the Eutectic Phases in Hypoeutectic Aluminum-Silicon Alloys," which was published in *AFS Transactions*.

Richard D. Sisson Jr., professor of mechanical engineering and director of the manufacturing engineering and materials science programs at WPI, has been elected vice president of the Heat Treating Society of ASM International; in 2008 he'll become president of the society.

Diana Lados was appointed research assistant professor in January. She earned her Ph.D. in materials science at WPI in 2004 and did postdoctoral work on fatigue of powder metallurgy components. She has made major contributions to our understanding of the role of residual stresses in crack initiation and crack propagation; plasticity contributions to fatigue crack growth and fracture toughness in materials; small crack/long crack relationships and closure corrections; and fracture mechanics.

Industrial Interns Grad student **Pierre-Alexandre Legait** is an intern at Air Liquide, where he is researching the formation and distribution of porosity in Al-Si welds, and is working on his master's thesis at the Welding Research Center of Air Liquide in France. **Arnaud Gateaud** is also an Air Liquide intern, working in partnership with GKN Sinter Metals in Worcester and the Oak Crest Institute of Science, Pasadena, to study the mechanisms of delubrication in Powder Metallurgy. Both Legait and Gateaud earned their engineering degrees at Ecole des Mines de Saint-Etienne, France, in February and will receive their M.S. degrees from WPI this spring.

Catherine Price '04 completed an industrial internship with GKN Sinter Metals in Wisconsin. Her project's goal was to understand the wear performance of four specific powder metal steel gears versus wrought steel gears. Two basic tests were conducted for initial results: FZG standard scuffing per ASTM D5182-97 and analysis of microstructures of gear teeth before and after testing results. Price is now a technical engineer at General Dynamics Electric Boat, developing weapons and mechanical systems for nuclear submarines.



China Workshop

Last summer MPI and the **Alfred P. Sloan Foundation** hosted a workshop at WPI on the business and economic impact of China on North America.

Economists Michael Belzer (Wayne State/Trucking), Thomas Rawski (Pitt/Steel), and Loren Brandt (University of Toronto) gave an overview of job loss in the United States. A session on China's impact on the U.S. economy and issues associated with entering the Chinese market was presented by a panel of managers with extensive experience in China: Paul Kennedy (CEO of Thermalcast), Jack Bresnahan (CBS Group), and Chris Deguitis (General Electric). Other sessions addressed the following issues:

Advanced Engineering Capabilities: Much of China's future growth will be driven by the development of advanced engineering and manufacturing. Gary Jefferson, who has done cutting edge research in the field, and Kevin Dowling of Color Kinetics, presented a rich set of data about the aggregate R&D capabilities in China and the challenges and accomplishments of a firm entering China.

Labor Relations: Mike Belzer and Shei-Wei Pan of Chinese Culture University gave an overview of the evolution of industrial relations practices in China.

Supply Chain: Supply chain management is a critical issue for the emerging Chinese economy as it moves to more sophisticated end products (e.g., autos and computers) and opens its markets to new products and retail forms (e.g., food and supermarkets).

Development Capabilities: Kun Chen presented a paper (co-authored with Martin Kenny) comparing the industry-university alliances and capability development in two Chinese cities (Beijing, a historic academic stronghold, and Shenzhen, a former fishing village that has developed dramatically in the last 25 years). Neil Berglund presented research conducted with Melissa Appleyard that focused on acceleration management—the management of shrinking technology life cycles and the impact on Chinese capabilities in IT hardware development. Jason Dedrick discussed the evolution of the PC industry—particularly notebooks and the movement of manufacturing to China and the increase in development work that will be on the mainland. John Movenzadeh of IMVP summarized recent IMVP conclusions about the structure and evolution of the Chinese auto industry and presented a case study of Chery, one of the "young tigers" of the industry.

This event, attended by scholars and managers from across this country and China, was the fourth MPI initiative funded by the Sloan Foundation. Industrial competitiveness is one of Sloan's key thrusts; its Industry Studies Program, with which MPI has been affiliated since 1994, includes 26 centers from major universities, including Harvard, Carnegie Mellon, Stanford, MIT, Pittsburgh, Texas, Minnesota, and Berkeley. Copies of papers and overheads can be found at wpi.edu/Academics/Research/Sloan/China.

Effective Practices

The Sloan Foundation's Industry Studies program was founded on the belief that industries are sufficiently different from one another—that they individually deserve rigorous and deep academic study. The industry studies community is composed of scholars who deeply understand industries by taking a direct approach to the companies and people of each industry for data and observations.

Multidisciplinary research conducted by industry studies scholars generally employs a wide range of quantitative and qualitative research methods (including direct observation and primary data collection), often conducted across multiple firms within a particular industry. This contextually rich picture of business phenomena and depth of understanding and insight uniquely complements more theoretical academic research and individual, firm-level studies. There are 26 centers in such fields as food, trucking, pharmaceuticals, autos, and health care—as well as metal processing, housed at WPI. For a complete listing of centers, visit www.industry.sloan.org/centershome.htm.

"The Industry Study centers comprise a unique national network," says Sloan Foundation president Ralph E. Gomory. "Housed in many of the nation's most prestigious universities, they listen to the current concerns of industry—attentive to the needs of business, and relying on the accumulated experience of business leaders—as they address solutions. With their partners in industry, Sloan Industry Studies researchers work to increase knowledge of the complex influences that shape business enterprises, from new technologies, to workforce issues, to the impact of globalization."

Last December, Diran Apelian and Jim McNutt, of Georgia Tech's Center for Paper Business and Industry Studies, organized a workshop for all the Sloan Industry Studies centers. The participants established a process for learning from each other and capturing our collective effective practices. A strategy for brand awareness was developed, recognizing the vital role centers play within the broader Industry Studies program and their potential for influencing public policy regarding matters of national importance.

Kudos for R&D

PMRC Steering Committee chair **Chaman Lall** (vice president, technology, Metal Powder Products) writes: “Our company has been a consortium member since the beginning of the decade, and has found tremendous value in both the depth and variety of the R&D projects conducted at WPI. While there is danger in picking out specific projects at the expense of those not mentioned, I found the ones on fatigue properties and test methods for part evaluation particularly interesting and novel. As a senior member at Metal Powder Products, I have enjoyed this access to fresh new ideas and the interaction with the teams to guide the course of the research work. Focus is maintained on activities that member companies are interested in, thereby making the output more relevant. At the same time, no single member company has a monopoly over the direction or level of work.

“Key to the consortium’s success is the number of members, so that costs can be shared and the individual burden minimized. Therefore, we will embark on a concerted effort to encourage additional companies to join in this rewarding activity. It should be pointed out that the companies getting value from this research work are not only powder metal companies but anyone interested in related industrial/commercial activities.”

Showing His Metal When **Virendra Warke** arrived at MPI in 2001, having earned a degree in metallurgical engineering at the Government College of Engineering in Pune, India, he became involved in groundbreaking research that is now helping aluminum casters clean molten metal. The work won Warke WPI’s 2003 Sigma Xi Award for best master’s thesis. He is now pursuing a Ph.D. in powder metallurgy, supported by a graduate fellowship established by the family of Morris

(Butch) Boorky with a major gift to *The Campaign for WPI*. Warke’s research team is developing a model that will not only reduce part losses, but help technicians better understand exactly how a particular heat-treating regime will affect a part’s properties. He believes the model will ultimately be used as a design tool.

Infrared Technology in P/M Processing

Active infrared (IR) imaging is an emerging NDE technology that has become the method of choice in many industrial applications requiring non-contact access to the parts under test. Advances made by Professor Reinhold Ludwig and doctoral candidate Souheil Benzerrouk have resulted in a rapid IR testing methodology for P/M compacts.

One of the primary goals of this work is to establish the suitability of online IR imaging of compacts for the detection of surface and subsurface defects in the pre-sinter, or green-state. Specifically, the IR imaging of subsurface defects is based on a transient instrumentation approach that relies on a control system to synchronize and monitor the thermal response due to an electrically generated heat source.

Preliminary testing reveals that this newly developed pulsed thermography system can be employed to detect subsurface defects in green-state parts. Practical measurements agree well with in-house finite element predictions. The technology that is being developed at MPI will ultimately be capable of providing 100 percent testability of green-state compacts as they exit the compaction press at speeds of up to 1,000 parts an hour.

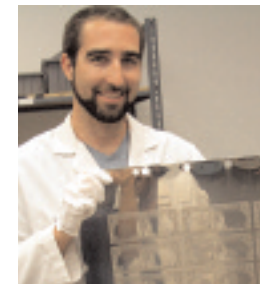
Presently, the IR technology has already undergone practical testing under different industrial settings at two facilities of our PMRC members involving a range of part geometries, densities, and part velocities.

Patrick Hogan ’06 will begin an industrial internship in June with SPX Contech Metal Forge, a division of SPX Corp. that designs and casts parts for the automotive market. His thesis will focus on die soldering in a HPDC operation and he hopes to develop an early-detection system for its prevention.

After **Leigh Duren ’06** receives her degree in mechanical engineering in May, she will begin working on her MS in materials science at WPI. An advocate of recycling on campus and in her hometown of Belgrade Lakes, Maine, Duren says her project will entail developing technology to improve scrap metal recycling efficiency. Her thesis sponsor is wTe, a recycling company with corporate office in Bedford, Mass.

Where Are They Now? Former research associate **Sumanth Shankar** is on the mechanical engineering faculty at McMaster University, Hamilton, Ontario (as the Braley-Orlick Chair in Advanced Manufacturing), where he’s initiating the Light Metal Casting Research Center. He is also preparing for fatherhood—he and his wife, Geetha, are expecting their first child in March. Sumanth has a message for potential guests: “Warning: If you visit us, you will be subjected to a mandatory visit to Niagara Falls!”

Yancy Riddle, former postdoc at MPI, is vice president of technology at UCT Coatings, where he is involved in business development, international development, government and industrial contract negotiation, proposal submissions and technical reporting, continuous improvement of production processes, ISO implementation, and setting the technical vectors for the company in general. He oversees the R&D and Engineering departments, and directs many of the application development efforts.



Having successfully defended his master’s thesis on semisolid processing last August, **B.J. Bernard** joined MPI member Bodycote North America as a lead engineer on 2nd and 3rd generation Densal® projects. He married Jessica Rothchild on November 5, 2005, in New Jersey; they are living in Boston.



Todor Kiryazov ’07 has begun a semester-long cooperative education program at Cytyc Corporation in Marlborough, Mass., as part of the Product Evaluation Team. He is working on developing quality assurance simulation tools for biomedical image processor servers. He will return to WPI next fall to complete his undergraduate degree in management information systems.

Cymat Joins ACRC The newest member of the ACRC consortium is a manufacturer of stabilized aluminum foam (SAF), a product it makes by injecting air into molten aluminum that has been infused with ceramic particles. The particles stabilize the air bubbles and keep the foam from collapsing. Cymat holds an exclusive license from Alcan International to produce SAF; in 2001 it purchased technology from Norsk Hydro that enabled it to go global with its business.

In its Ontario plant, Cymat forms SAF into flat panels (a product known as Alusion) that are used in architectural applications, including walls and ceilings, trade show booths, and furniture. Alusion panels were recently included in a memorial wall in New York City honoring members of the Service Employees International Union who were killed in the September 11 World Trade Center attacks.

Cymat is now working to develop applications of its products in the automotive and transportation industry. It is also promoting the use of SAF to replace sand in hollow aluminum castings, eliminating the need to tumble the parts to remove the sand. Other possible applications include crash boxes that will crush on impact, lessening damage to a car’s structural components, and a crushable SAF hood that could help protect a pedestrian hit by a car.

CEO Conference

John L. Jorstad, president of JJJ Technologies and a consultant specializing in the technology of light metal casting, spoke at the CEO Conference in Miami in February on "Future Technology in Die Casting." This annual conference sponsored by NADCA offers top management the opportunity to discuss pertinent issues with their peers and provides discussion forums for personnel in specialized areas.

Much of Jorstad's effort during his 36 years at Reynolds Metals Company was in R&D, devoted to the hypereutectic alloys, their development, casting, machining, and applications in premium engines at European and Japanese auto companies. At Reynolds he was responsible for developments in the areas of casting, machining, joining, and engines, most recently with operating divisions, supporting both the foundry and automotive industries.

Jorstad was elected a fellow of ASM International in 1979. He received NADCA's Achievement Award in 1987, the Nyselius Award in 1999, and the Gullo and Treiber Award in 2005. AFS presented him its Award of Scientific Merit in 1990, selected him to present the 1994 Charles E. Hoyt Memorial lecture, and awarded him the 1995 Joseph S. Seaman Gold Metal. He is the director-at-large for ACRC as is a past recipient of both the Flemings and Witt awards.

Summer School MPI is offering a summer program in conjunction with NTNU in Trondheim, Norway, from August 21 to 25. This year's topic is "Casting and Solidification of Aluminum and Magnesium Alloys." For details and registration, visit www.sintef.no/iss8.

New Projects

At the fall ACRC meeting, two new projects were selected to begin July 1:

Improving Aluminum Casting Alloy and Process Competitiveness— Motivation for this project is the continuing quest for aluminum castings with enhanced properties at a competitive price for applications in the automotive and aerospace industries. Over the past decade, one of the research emphases at ACRC has been to understand the evolution of microstructure in aluminum casting alloys. Along these lines, we have developed a thorough understanding of the formation of the Al-Si eutectic phases in aluminum alloys. An overriding research effort at ACRC has been to understand the nuances of the various casting processes. The objective of this project is to build on our previous work to optimize the composition of aluminum alloys and improve casting processes to enable production of quality, cost-competitive aluminum alloy castings.

Characterization of Alloy Castability— Castability is a term used to describe a complex combination of liquid metal properties and solidification characteristics that promote accurate and sound castings. Two important characteristics of an alloy that affect its castability are fluidity and tendency toward hot tearing. Methods for assessing these two characteristics of a melt exist; however, these methods are not accurate and discerning, and at best they produce semiquantitative results. The objective of this project is to develop a fundamental understanding of fluidity and hot tearing and to use this understanding to develop robust, accurate, discerning, quantitative methods for assessing the castability of aluminum alloys.

New Grad Students Join ACRC

During this academic year, four graduate students have joined the research team. **Brian Dewhirst** completed his M.S. at ACRC and is now a Ph.D. candidate after successfully passing the doctoral examinations. **Shimin Li** and **Kimion Simeonidis** are doctoral students; **Jayesh Deshpande** is pursuing his M.S. degree.

International HTDC Conference

The 3rd International Conference on High Tech Die Casting will take place in Vicenza, Italy, September 21–22. Offered will be an overview of all the scientific and technological innovations in the field of die casting, with papers and contributions from a highly qualified panel of academic and industrial experts. For more information: www.aimnet.it/htdc2006.htm.

ACRC staff will participate in this international conference, and conference proceedings will be available. If interested, contact Maureen Plunkett in the MPI office, 508-831-5992 or mrp@wpi.edu.

Commercialization of CHTE Products

Over the last seven years, CHTE researchers have been quite active in developing enabling tools and "products" that have commercial interest. Six such products have been developed at CHTE: Carbon Probe (carburation sensor); Quench Probe; Quench Miner; CHT-*bf*; CHT-*cf*; and CHT-*qt*. A special committee of past CHTE board chairs (M. Ciampini, B. Bernard and R. Woldow), have convened to develop a commercialization plan of these CHTE products. The CHT-*bf*, -*cf* and -*qt* products are software tools that truly increase productivity and efficiency.

New Projects The Board of Directors has approved two recommended projects, which will begin on July 1: "Characterization, Evaluation and Removal of Surface Contamination from Pre- and Post- Heat Treat Processing" and "Aging Cycle Optimization." Details will be available on the CHTE Web site soon.

Congrats, Shuhui Ph.D. candidate **Shuhui Ma** received the Best Paper award from ASM International HTS/Bodycote for "Modeling the Heat Treatment of Age-Hardening Cast Aluminum Alloys." She is a member of the quenching research team headed by Professor Sisson and will be competing for the Bodycote best presentation award in Prague March 20-21.

New Member Spirol Inc. (www.spirol.com) has joined CHTE as a Silver Member, thanks in part to company vice president Russell Radant '86. Spirol also plans to sponsor an MQP for undergraduates. A leading manufacturer of engineered fasteners, shims, pin and insert installation machines, and parts feeding equipment, Spirol's locations across North America and Europe give it a unique vertical position in today's dynamic marketplace.

CEO of the Year The January 2006 issue of *IndustryWeek* includes a feature on Deere & Company and its chair, **Bob Lane**, whom the magazine named 2005 CEO of the Year. "The editors look at the company's performance and improvements made to the business," said Pat Panchal, editor in chief of *IndustryWeek*. "We want a person who is a leader, a doer, and a real thinker. We value someone with integrity." Previous CEO winners include Jack Welch, Bill Gates, and Jeff Immelt. With more than 500,000 regular readers, *IW* is targeted toward senior-level executives in manufacturing. Congratulations to Mr. Lane and to our Deere & Company colleagues.

Heat Treater of the Year *Industrial Heating* magazine, in cooperation with the Metal Treating Institute (MTI), has awarded the eleventh annual Master Craftsman Award to CHTE member **American Heat Treating Inc.**

Company president Larry Roether accepted the award of \$1500 at the 2005 MTI Fall Meeting. The award, which is to be used as an education scholarship in material sciences or heat treatment, was given to **Derek Pepicelli**, a mechanical engineering undergraduate student. Derek is doing work study with Kevin Rong's research group, which is establishing a materials database of Temperature Time Transformation (TTT) graphs for the development of CHT-*qt*.



Derek Pepicelli '09 accepts scholarship from Larry Roether of American Heat Treating