

JOM



AUGUST 2019

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An official publication of The Minerals, Metals & Materials Society

MEETING PREVIEWS: HEA 2019, Plus MS&T in 2019, 2020 & Beyond

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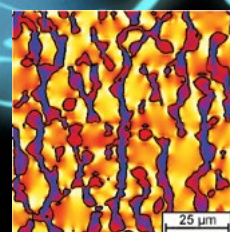
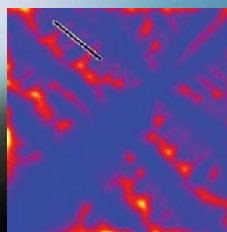
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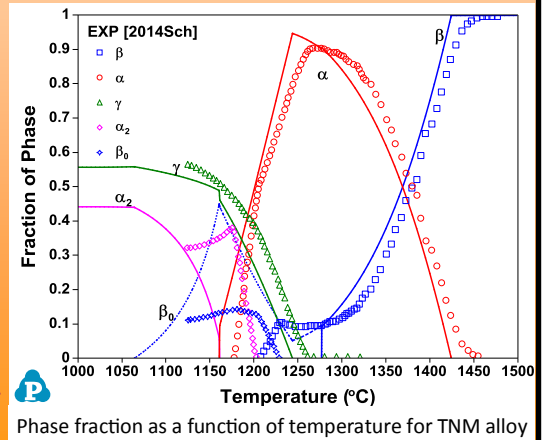
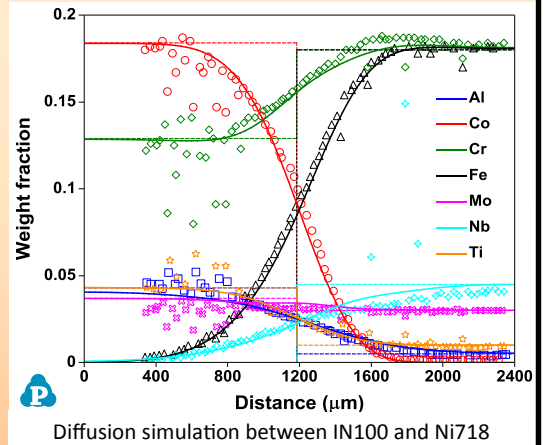
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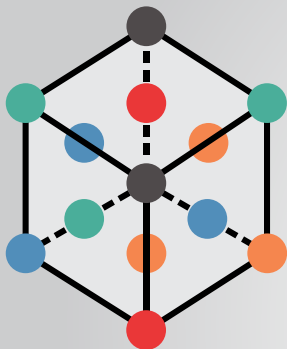
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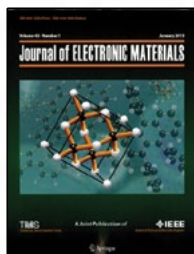
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From "A Forward Modeling Approach to High Reliability Grain Mapping by Laboratory Diffraction Contrast Tomography (LabDCT)" by Sridhar Niverty et al., the cover image shows a reconstructed 3D grain map of 23 silicon grains, colored by their orientations. The figure was created using diffraction contrast tomography.



August 2019 Guest Editors

Characterization of Advanced Sintering Materials

Materials Characterization Committee
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Multiscale Computational Strategies for Heterogeneous Materials with Defects: Coupling Modeling with Experiments and Uncertainty Quantification

ICME Committee
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Precipitation Mechanisms in Non-ferrous Alloys

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Nuclear Materials Committee
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David Gandy, Electric Power Research Institute

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The scope of *JOM* (ISSN 1047-4838) encompasses publicizing news about TMS and its members and stakeholder communities while publishing meaningful peer-reviewed materials science and engineering content. That content includes groundbreaking laboratory discoveries, the effective transition of science into technology, innovative industrial and manufacturing developments, resource and supply chain issues, improvement and innovation in processing and fabrication, and life-cycle and sustainability practices. In fulfilling this scope, *JOM* strives to balance the interests of the laboratory and the marketplace by reporting academic, industrial, and government-sponsored work from around the world.

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in the final analysis

“There’s no business like show business, like no business I know.”

—Irving Berlin

Who doesn’t know that there is no business like show business? Like many Irving Berlin compositions, the song is part of our cultural DNA, and there have been countless movies and plays with a show business backdrop to prove his point. Just off the top of my head: *Singin’ in the Rain*, *Gypsy*, *Funny Girl*, *Cabaret*, *The Phantom of the Opera*, *8½*, *Sunset Boulevard*, *Almost Famous*, *Broadway Danny Rose*, *The Producers*, and *A Star Is Born*. Show business is one of those professions that the artistic community just loves to portray—like law enforcement, journalism, jurisprudence, medicine, sports, the military, and science and engineering. Alas, the profession that no producer wants to touch is the one to which I have dedicated my career—association management. It, too, is like no business that I know.

Is association management so boring that no one could possibly be entertained by it? Not on my beat, and I’m pretty sure that I’ve accumulated enough experiences, recollections, and first-hand stories to fill a couple or three scripts. The good, the bad, and the unusual: Association management has got it all—except public awareness as to what it is.

The quick primer: As articulated by the American Society of Association Executives, or ASAE, an association is “an organization or group of individuals affiliated with one another who share a common purpose, interest, or mission and exist for the mutual enrichment and advancement of their membership.” So, what is “association management”? According to Wikipedia (in an entry that I suspect was drafted by ASAE), “Association management is a distinct field of management because of the unique environment of associations. Associations are unique in that the ‘owners’ are dues-paying members. Members also govern their association through an elected board or other governing body, along with association committees, commissions, task forces, councils, and other units.”

One of the more unique aspects of association management is that we practitioners operate the associations like businesses even though associations are not conventional businesses. They are nonprofits. They issue no dividends, are not publicly traded, have no stockholders, and enrich no sole proprietor. Those of us with leadership roles in an association are constantly challenged to successfully navigate the narrow pathway of sustainability that exists between solid business management and advancing the good of our community. You can opportunistically lean a little to one side or the other as you walk the path, but veer too much to the business side and you risk your members being disenfranchised as they perceive themselves as customers or commodities and not members of a community. Veer too much to the mission side and you risk having your lofty ambitions consume all of your assets and fast-tracking the association to oblivion.

How do we maintain balance at TMS? Pragmatically, we have to make enough money to pay the bills. We also try to annually add to our reserves to safeguard the Society against rainy days and to give the Board flexibility to fund costly new or strategic initiatives. Tidy financials aside, the bulk of our energy goes to enabling networking and cultivating a professional family community. We bridge science with engineering and promote the transfer of technology. We recognize accomplishment, and work to advance the good of the order. We celebrate grassroots ideation over top-down-ism. We view collaboration and platforms from which to provide informed input as important. We believe the Annual Meeting & Exhibition tagline that “the world comes here.” We like what we do, and we value that what we do has meaningful impact.

For today’s TMS and its antecedents, this is an approach that has worked for going on 150 years. We have just not inspired a movie in the process. Joel and Ethan Coen, give me a call. How do the titles *O Association Manager*, *Where Art Thou?* or *No Country for Old Association Managers* strike you?

JOM

Volume 71

Number 8

August 2019



James J. Robinson
Executive Director

*“The good, the bad,
and the unusual:
Association
management has
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public awareness
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Study Team Convenes on New TMS Report; AIME Offers New Oral Histories; TMS Participates in Congressional Briefing

Study Team Looks at Next-Generation MGI Workforce

Earlier this year, 11 of 16 team members met at TMS headquarters to begin work on a new study, *Creating the Next-Generation Materials Genome Initiative (MGI) Workforce*, which is being conducted by TMS on behalf of the U.S. National Science Foundation. Led by David McDowell of the Georgia Institute of Technology, this team of subject matter experts will draw on the outputs of such meetings and workshops to provide detailed, actionable recommendations within the report.

Creating the Next-Generation MGI Workforce aims to address one of the four key goals of the 2014 MGI Strategic Plan: “creating a world-class materials-science and engineering workforce that is trained for careers in academia or industry.” The MGI is

a multi-agency initiative from the U.S. government that is designed to support and accelerate the design, development, and deployment of advanced materials. The final report will address the current state of the academic curriculum and training approaches of the U.S. workforce to accomplish MGI goals, identify the key MGI skill requirements and needs for individuals entering the workforce, and outline curricula development and training guidelines to improve readiness of current students and the existing professional workforce. Learn more and sign up for updates at www.tms.org/MGIWorkforce.



Pictured row 1, left to right: Mark D. Asta, Lawrence Berkley National Laboratory; George Rodriguez, ExxonMobil Chemical; Will Joost, Pratt & Whitney; and Aaron Gilad Kusane, National Institute of Standards and Technology. Row 2, left to right: Matt Earnest, Virginia Polytechnic Institute and State University; Xin Sun, Oak Ridge National Laboratory; Kevin Anderson, Brunswick Corporation; and Stefano Curtarolo, Duke University. Row 3, left to right: Raymundo Arroyave, Texas A&M University; Cathy Tway, Johnson Matthey; and David McDowell, study team chair and Georgia Institute of Technology.



Brush Up on Your Materials History with AIME

The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), TMS's parent organization, has released a series of new video interviews as a part of its Oral History project. The project aims to “honor the legacy and traditions of AIME,” one of the four facets of the Institute's mission, by preserving and promoting achievements in the fields and sharing prominent member stories with future generations. From April through August 2019, a total of 11 new audio and

video captures from experienced members in industry, academia, and government have been added to the existing collection of histories, which features interviews from eight TMS members:

- **Ray Smith**, *President, Michigan Technological University (retired)*
- **Harry Paxton**, *U.S. Steel Professor Emeritus, Department of Materials Science, Carnegie Mellon University*
- **Patrick Taylor**, *Director, Kroll Institute for Extractive Metallurgy*

Colorado School of Mines

- **Peter Hayes**, *Professor of Metallurgical Engineering, University of Queensland*
- **Authur Pelton**, *Emeritus Professor, Department of Chemical Engineering, and Co-Directeur, Centre de Recherche en Calcul Thermochimique, École Polytechnique, Montréal*
- **Chris Bale**, *Adjunct Professor, Department of Chemical Engineering, and Co-Directeur, Centre de Recherche en Calcul Thermochimique, École Polytechnique, Montréal*
- **Sig Hecker**, *Director, Los Alamos*

National Laboratory (retired)

- **David Matlock**, *Professor Emeritus, Colorado School of Mines*

Visit the AIME Oral Histories web page at aimehq.org/programs/archives to learn the story of your profession in the words of those who have lived it. Additional histories are still under development and in production by AIME, with several new interviews scheduled for release in September 2019. Check the AIME Oral Histories page regularly for announcements when new TMS member interviews are available, or to submit a candidate for AIME's Oral History capture.

TMS and CSM Discuss Collaboration

On Thursday, May 9, TMS hosted Zhao Pei, Emeritus Secretary General of the Chinese Society for Metals (CSM), at TMS headquarters in Pittsburgh, Pennsylvania. During the course of the day, David DeYoung, 2017 TMS President, James J. Robinson, TMS Executive Director, and TMS senior staff acquainted Zhao with the Society's strategic goals and key initiatives. This included a review of past and current collaborations with CSM, such as the Energy Materials conference, co-located with the TMS 2017 Annual Meeting & Exhibition, and the Computational Design and Simulation of Materials conference, co-located with the TMS 2018 Annual Meeting & Exhibition.

The discussion then turned to the potential of future collaborations, with participation by Thomas Battle, 2019 TMS Vice President, and Xingbo Liu, a TMS volunteer from West Virginia University

who has helped facilitate joint initiatives between the two societies in the past, such as establishing the Energy Materials conference and leading the conference organization on behalf of TMS.



Pictured from left to right: Xingbo Lui, West Virginia University; Zhao Pei, Emeritus Secretary General, Chinese Society for Metals; James Robinson, TMS Executive Director; and David DeYoung, 2017 TMS President.

TMS Reviews Revolutionary Technology at Congressional Briefing

More than 80 Congressional staff members and others engaged with public policy development gathered on June 6 for a high-level overview of a potentially disruptive technology at a Congressional Briefing sponsored by TMS and the United Engineering Foundation, and hosted by the House Manufacturing Caucus.

The topic was metamorphic manufacturing, a new technology that forges metal objects to precise specifications through a combination of

robotic systems, intelligent machines, sensors, and integrated computational learning. The need to produce a die is completely eliminated, while the incremental deformation approach minimizes waste and optimizes part performance and properties. Metamorphic manufacturing is particularly well-suited for the production of highly specialized parts and, compared with other technologies, can potentially produce these parts cheaper, faster, at a higher quality,



(Left to Right) George Spanos, TMS Director of New Initiatives, Science, and Engineering, and Glenn Daehn, TMS *Metamorphic Manufacturing* study team lead, pause in their preparations for the Congressional Briefing on June 6 with James Foley, 2019 TMS President, and James J. Robinson, TMS Executive Director.

and with a lower carbon output.

The technology was explored in-depth in the recently released TMS technical report, *Metamorphic Manufacturing: Shaping the Future of*

On-Demand Components.

Glenn Daehn, the study team lead and Fontana Professor of Metallurgical Engineering at The Ohio State University, was the featured speaker at the briefing. He opened his talk with a history lesson, tracing how the implementation of key process innovations gave rise to the great manufacturing hubs of the United States, such as the automotive industry in Detroit. Metamorphic manufacturing, he noted, offers that same potential. “We need mindful policies to put metamorphic manufacturing into production,” he said. The workforce implications of this investment, Daehn maintained, would be

significant: “This new process will teach new skills and create a culture of doing.”

The briefing concluded with a question and answer session moderated by George Spanos, TMS Director of New Initiatives, Science, and Engineering, with Daehn and Tony Schmitz, University of North Carolina at Charlotte and study team member, providing responses.

To download TMS’s *Metamorphic Manufacturing* study, visit www.tms.org/MetamorphicManufacturing. A recording of the Congressional Briefing, including the question and answer session, can be accessed at housemanufacturingcaucus-reed.house.gov/events/events-of-the-116th-congress-0.

The Congressional Briefing on Metamorphic Manufacturing is part of an advanced manufacturing briefing series supported by the United Engineering Foundation. The following organizations comprise the United Engineering Foundation: The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), the American Society of Mechanical Engineers (ASME), the American Society of Civil Engineers (ASCE), IEEE USA, and the American Institute of Chemical Engineers (AIChE).



Alois Franke

In Memoriam: Alois J. Franke & Richard E. Cole

TMS extends its condolences to the family, friends, and colleagues of the following members:

Alois J. Franke passed away in April 2019 at the age of 78. Franke received his B.S. in physics, his M.S. in materials science, and his Ph.D. from Saarbrücken University in Germany. In 1993, Franke purchased the raw materials processing with specialty alloys, semi-finished products, and Soderberg paste businesses from German aluminum smelter Alusuisse to create Aluminium Rheinfelden. He served for many years as the company’s managing director and chair of the board. Franke was a TMS member since 1980.



Richard E. Cole

Richard E. Cole passed away at the age of 100 on March 6, 2019. Following his discharge from the U.S. Navy during WWII, Cole completed his bachelor’s degree at the Missouri School of Mines (now Missouri University of Science & Technology) and received his master’s degree from the Massachusetts Institute of Technology. He then began working at Reynolds Metals as an engineer intern, rising through the company over the years before retiring in 1980 as vice president, member of the board of directors, and head of the Primary Metals Division. Cole was a TMS member since 1965.



Do you have business or industry news of interest to the minerals, metals, and materials community? Submit your announcement or press release to Kaitlin Calva, JOM Magazine Managing Editor, at kcalva@tms.org for consideration.

In Case You Missed It: Business News from the Field

Maxion and Dongfeng Break Ground at New Plant

Suizhou, China: Maxion Wheels, a U.S.-based vehicle wheel manufacturer, and China's Dongfeng Motor Parts and Components Group broke ground at a new aluminum wheel plant. The plant, which will produce low-pressure, die cast aluminum wheels, is slated to begin production in late 2020. The facility will be operated by a joint venture known as Dongfeng Maxion Wheels Co. Ltd.

Mecfor to Test AGV at Aluminum Smelter

Québec, Canada: Canadian equipment manufacturer Mecfor has announced the launch of a technological showcase to test a new autoguided vehicle (AGV) in an operational aluminum smelter. The showcase, which received \$350,000 of support from the Government of Québec, will be used to highlight potential uses of Mecfor's Transporteur Électrique d'Autoguidé Mecfor (TEAM). Currently, the AGV TEAM prototype's function is

to transport crucibles of molten metal, but the final goal is to have the AGV TEAM complete metal flow orders coming from the smelter.

Global Energy Metals Expands Nevada Claim

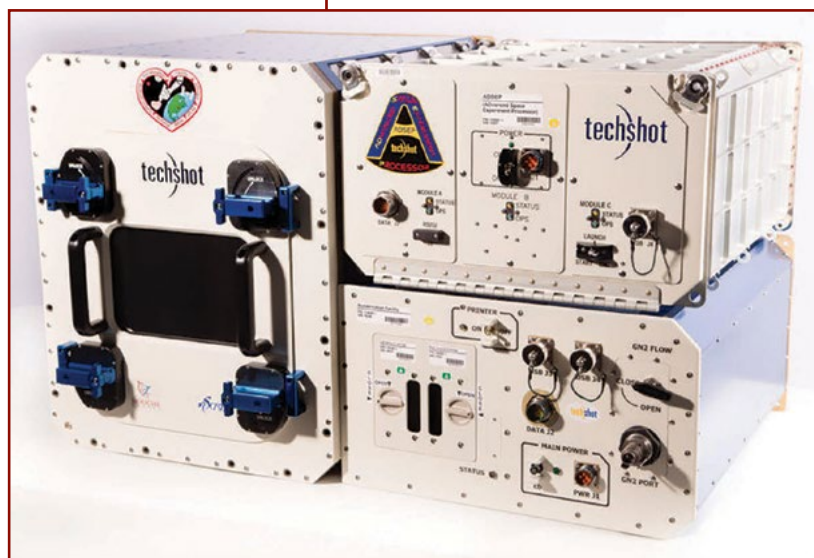
Churchill County, Nevada, USA: The Global Energy Metals Corp. (GEMC) has staked 11 new land claims in Nevada. The new claims make up about 75 hectares, contiguous to GEMC's 70 pre-existing claims in the area. Combined, the claims are sites of exploration primarily for cobalt, but also for copper and nickel. The company is currently in the process of compiling data and devising an exploration plan to move the project forward. The GEMC's original claims include the Lovelock Mine and the Treasure Box project.

HP Opens New Additive Manufacturing Facility

Barcelona, Spain: The 3D Printing and Digital Manufacturing Centre of Excellence, an advanced manufacturing research and development facility from HP Inc., opened in June 2019. Featuring flexible and interactive layouts, the facility was designed with the intention of fostering new and current collaborations with customers and partners. Potential partners named by HP span multiple industries and include BASF, GKN Powder Metallurgy, Siemens, Volkswagen, and more. The Centre of Excellence will convene experts in systems engineering, data, software, materials science, and design and applications.

Elysis Announces New Facility

Québec, Canada: Elysis, a joint venture by Rio Tinto Aluminium and the Alcoa Corporation, recently announced plans to open a new research and development center in the Saguenay–Lac-Saint-Jean region. The facility, which will be located at Rio Tinto's Complexe Jonquière, aims to be fully operational with a staff of 25 experts by the second half of 2020. Elysis also receives funding from Apple and the federal and provincial governments of Québec for its carbon-free aluminum smelting process, expected to be commercialized by 2024.



Orlando, Florida, USA: Space equipment developer Techshot and 3D printing system manufacturer nScript announced a collaborative effort to send a 3D bioprinter to the International Space Station. The 3D BioFabrication Facility (BFF) bioprinter is said to be capable of manufacturing human tissue in microgravity conditions. Bioprinting in space has been gaining traction, as the microgravity conditions could prevent printed tissues from collapsing under their own weight, as they often do under Earth's gravity, and holds the potential of helping to reduce the current worldwide shortage of donor organs. (Photo courtesy of TechShot.)

MS&T Travels to Portland for 2019

Kelly Zappas

MS&T19
 MATERIALS SCIENCE & TECHNOLOGY

Portland Photo Credit: © 2015 Jake Donahue

Important MS&T19 Deadlines

- **Discount Registration Deadline:**
August 30, 2019
- **Discount Housing Deadline:**
September 5, 2019

Visit
www.matscitech.org/MST19
 for more details.

For the 17th installment of the Materials Science & Technology (MS&T) conference and exhibition, MS&T19 takes its multi-disciplinary programming, technical exhibition, and networking events to a new location—Portland, Oregon—this fall, September 29 through October 3.

While it may be a new location, Portland fits in nicely with one of the overarching themes of the MS&T conference series. One of several nicknames for the city is “Bridgetown,” and MS&T is known for its ability to create bridges between the

various sectors, technologies, and societies within the materials science and engineering communities. (For a look at the city’s other nicknames, see the “Portland Fun Facts” sidebar.)

MS&T19 will feature presentations, courses, and events developed in collaboration with four materials-related societies: TMS, the American Ceramic Society (ACerS), the Association for Iron & Steel Technology (AIST), and ASM International. What follows is a preview of this year’s conference from a TMS perspective.

Programming Highlights at MS&T19

Each year, the MS&T program presents symposia that are divided into a dozen broad technical areas: Additive Manufacturing, Biomaterials, Ceramic and Glass Materials, Electronic and Magnetic Materials, Energy, Failure Analysis, Fundamentals and Characterization, Iron and Steel (Ferrous Alloys), Materials-Environmental Interactions, Modeling, Nanomaterials, and Processing and Manufacturing.

Within these categories lie a number of technical symposia and sessions of interest to the TMS community. Carl Cady, technical staff member, Los Alamos National Laboratory, who serves as the TMS representative to the MS&T Program Coordinating Committee, highlighted a few notable items from this year’s program.

“There will be several sessions with presentations that talk about machine learning, which I believe is the next step in developing new materials and predicting material response,” said Cady. “Along with

computational material science, the path toward developing advanced materials seems well on the way toward predicting response then creation, rather than creation then characterization and using the characterization to inform models.”

Because MS&T provides a broad range of topics to choose from, Cady recommends that attendees explore the full program, suggesting that all attendees look at the Special Topics section, which includes some non-technical topics such as education and diversity and inclusion. “There are always interesting things to learn from our colleagues that don’t necessarily overlap in the research topics that are of interest to us,” said Cady.

Additional topics that may be of special interest to TMS members, he said, include 10 symposia focused on additive manufacturing topics, including sessions on titanium-based additive manufacturing, powder metallurgy, and additive manufacturing education.

This year’s program will also



Carl Cady
*TMS Representative to
 the MS&T19 Program
 Coordinating Committee*

feature two sessions on Metamorphic Manufacturing: Incremental Deformation Processing for Agile, High-Quality Metallic Component Production. In the area of steels, he pointed to three symposia that show synergy with our AIST counterparts: Advances in Understanding of Martensite in Steels, Formability and Fracture of Metal Sheets, and Thermomechanical Processing in Shaping and Forming of Steels.

“This will be the last partnered meeting with ASM for the foreseeable future and

we hope that the joint programming seen by the partner societies’ membership is interesting and informative,” said Cady. “We hope to continue to be a society that leads the way in programming topic areas that are at the forefront of research and product development in the area of materials science.”

For more perspectives on the developing program for MS&T20, see “Previewing MS&T20: A Roundtable with Program Organizers,” also published in the August 2019 issue of *JOM*.

Hansson to Deliver Distinguished Keynote Lecture

Carolyn Hansson, professor of materials engineering at the University of Waterloo in Canada and a TMS Fellow, will deliver the TMS/ASM Joint Distinguished Lectureship in Materials and Society as part of the MS&T19 plenary session planned for Tuesday morning, October 1.

Hansson’s research has covered many aspects of environmental degradation of materials, particularly the corrosion and erosion of metals and alloys. Over the last 20 years, her major research focus has been the durability of infrastructure materials, particularly the chloride-induced corrosion of reinforcing bar and those properties of the concrete which affect this process. Her current research is focused on the application of corrosion-resistant alloys as reinforcing materials with a view to understanding the influence of the metallurgy on the corrosion resistance and prediction of the relative life-cycle costs of the different alloys.

Her presentation, “The Challenge of

100 Year Service-Life Requirement,” will look at the materials challenges of meeting new standards that are under consideration to raise the service-life specification for reinforced concrete highway infrastructure from the current 75 years to 100 years or more.

The goals of these standards are to reduce financial and environmental costs and improve the sustainability of the system, but, in many locations, salt from seawater and de-icing agents limit the durability of reinforced concrete. The chlorides destroy the natural passivity of reinforcing steel in concrete and allow active corrosion, which eventually causes cracking and spalling of the concrete. De-icing agents containing calcium- or magnesium-chloride can attack the concrete directly. Her presentation will describe the research at Waterloo on identifying the most appropriate stainless steels to combat the chloride attack over the long term.



Carolyn Hansson
*TMS/ASM Joint
Distinguished Lecturer
in Materials and Society*

MS&T19 Exhibit Activities

MS&T19 will feature an extensive exhibition of products and services, so attendees should schedule time to browse the exhibits on Tuesday, October 1, and Wednesday, October 2. All MS&T19 attendees are invited to meet with exhibitors at the Exhibitor Networking Reception from 4:00 p.m. to 6:00 p.m. on the first day of the exhibit.

Lunch will be served both days in the exhibit hall, offering attendees an additional opportunity to meet with exhibitors and network with colleagues. Lunch is included with the registration rate for full-conference attendees.



Additive Manufacturing Workshop Returns for MS&T19

Since 2015, attendees at MS&T conferences and TMS Annual Meetings have learned from the collected knowledge of a team of experienced instructors at the Additive Manufacturing Materials and Processes Workshop. This popular course will be held once again on Sunday afternoon, September 29.

Instructors David L. Bourell, University of Texas at Austin, Sudarsanam Suresh Babu, University of Tennessee-Knoxville, and Kirk Rogers, The Barnes Group Advisors, will lead the workshop, which is designed to familiarize participants with current

additive manufacturing (AM) processes; current AM practice for metals, polymers, and ceramics; modeling of AM processes, microstructural evolution, and service properties; and current challenges and research opportunities. The program is intended for those who have some familiarity with AM processes, but want to learn more.

Sign-up for this workshop is available through the conference registration form at www.matcitech.org/MST19. Please note that registration for the full MS&T19 Conference and Exhibition is not required to attend the course.

Join Us at MS&T19

Come and experience the new conference venue, the broad technical program, distinguished lectures, and special events for yourself. Registration and housing are now open for MS&T19.

TMS members are encouraged to book housing at the Doubletree by Hilton Portland, which will serve as the headquarters hotel for TMS and AIST activities, including committee meetings.

The deadline to book housing at the MS&T discounted room rate is September 5, 2019, and the deadline to register for the MS&T meeting and educational events at the early discounted rate is August 30, 2019.

Visit www.matcitech.org/MST19 to register, secure housing, and access additional program details, and plan to join us in Portland for MS&T19.

Portland Fun Facts

The city of Portland and the Oregon Convention Center are new venues for the MS&T conference series, so to introduce you to this new location, here are a few pieces of trivia about our host city, provided by the Travel Portland website:

- Portland's nicknames include City of Roses, Stumptown, Bridgetown, and Beervana.
- Portland is home to both the world's smallest dedicated park (Mill Ends Park at 61cm across) and the largest box of doughnuts (found at the 24-hour doughnut shop Voodoo Doughnut).
- Worth noting for shoppers, Oregon is one of only five U.S. states with no sales tax.
- And because MS&T is all about bridges: Portland's Hawthorne Bridge is the oldest vertical-lift bridge in the country; it turned 100 in 2010. The nearby Steel Bridge celebrated its 100th anniversary in 2012.

Portland also boasts one of the largest bookstores in the world (Powell's City of Books), a leading science museum (The Oregon Museum of Science and Industry), and a number of notable gardens, including the Lan Su Chinese Garden, the International Rose Test Garden, and the Portland Japanese Garden. Learn more about local attractions at www.TravelPortland.com.



Photo Credit:
Travel Portland
& Torsten
Kjellstrand



Previewing MS&T20: A Roundtable with Program Organizers

Kelly Zappas and Kaitlin Calva

MS&T20
 MATERIALS SCIENCE & TECHNOLOGY

The three organizing partners of the Materials Science & Technology (MS&T) conference series—TMS, the Association for Iron & Steel Technology, and The American Ceramic Society—are deep into planning MS&T20 and the robust technical program that takes full advantage of new opportunities and approaches to sharing important work across materials disciplines.

After 17 years, MS&T is the established destination for fostering technical innovation and professional collaboration through the synergies of major professional societies cooperating to advance the materials professions as a whole. This fact is reflected in the tagline adopted for MS&T20 and beyond—Where Materials Innovation Happens.

Highlighting the individual identities of each of the partner societies within this collaborative meeting will be a new feature introduced with MS&T20. TMS Fall Meeting programming, for instance, has been an integral part of MS&T from the very beginning. However, in 2020, it will play an even more prominent role, with TMS Technical Committees receiving acknowledgement for the symposia that they sponsor.

The success of MS&T, both now and in the future, rests with the contributions of the many volunteers who organize symposia, contribute papers, and attend the meeting. For a preview of how MS&T20 will build on that legacy, *JOM* has asked several of those volunteers to share their perspectives. Read on and make sure MS&T20 is on your professional “must-do” list: October 4–8, 2020, in Pittsburgh, Pennsylvania. For more information, visit www.matscitech.org/MST20.

Q. What is your history with the MS&T conference series?

Narayan: I first organized the Next Generation Biomaterials symposium at the 2005 MS&T meeting. The symposium has been held each year since 2005, and I have served in an organizer or co-organizer role since that time.

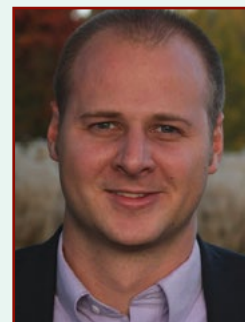
Carpenter: I first attended an MS&T conference in Columbus, Ohio, in 2011, where I gave two talks. Over the past few years, I’ve regularly attended and spoken but have not been an organizer at MS&T prior to the 2020 meeting.

Unocic: My association with MS&T began when I transitioned from being a graduate student at The Ohio State University to becoming an R&D staff scientist at Oak Ridge National Laboratory. My research fit well with a number of symposia at MS&T, so I started submitting abstracts. At the same time, I became very active in TMS committees, such as the Young Leaders and the Corrosion & Environmental Effects Committees, which prompted me to attend committee meetings and to get involved in planning future symposia.

Q. As an organizer, what differences do you see between MS&T and the TMS Annual Meeting? Does the participation of other societies impact the experience of attending and presenting at MS&T?

Carpenter: At TMS annual meetings (attending since 2011), I’ve organized 17 separate symposia over the years. What I had found was that the symposia I was interested in did not exist at TMS annual meetings until I helped create them. MS&T always seemed to have good symposia

Meet the Organizers



John Carpenter, Los Alamos National Laboratory
 Symposium Title: *Additive Manufacturing: Mechanical Behavior of Lattice Structures Produced via AM*



Roger Narayan, North Carolina State University
 Symposium Title: *Next Generation Biomaterials*



Kinga Unocic, Oak Ridge National Laboratory
 Symposium Title: *High Temperature Corrosion and Degradation of Structural Materials*

already in place. As I developed new symposia at TMS, the “exotic” locales of Orlando, San Diego, etc. always seemed like a better draw for pulling in invited speakers or international speakers. What I have found, though, is that a well-focused symposium, regardless of location or society participation, will draw the right speakers and audience.

Unocic: From what I have observed, I believe more representatives from industry attend MS&T meetings. Having a

diverse array of attendees from academia, industry, and government is important because it gives students, researchers, engineers, manufacturers, and scientists the opportunity to collaborate and connect at different research levels. Also, the participation of attendees from other societies further broadens the scope of MS&T conferences, providing even greater opportunities for technical interaction and networking. Having technologically relevant symposia is important for the future of materials research. The interaction between academia or national laboratories with industry can create a unique opportunity for future projects, collaborations, and advances in research.

Narayan: Our symposium is supported by the TMS Biomaterials Committee and The American Ceramic Society Bioceramics Division. Each society brings its own focus area of expertise and membership to the symposium.

Q. What are you looking forward to with the 2020 meeting?

Unocic: As an organizer, my desire is to deliver an outstanding symposium for the attendees. In our symposium, High-Temperature Corrosion and Degradation of Structural Materials, I am looking forward to learning about the new and exciting research areas from our diverse range of speakers, from early career to senior researchers, and from academia, industry, and national laboratories. I am also looking forward to meeting new people, establishing new collaborations, and seeing old colleagues and friends.

Carpenter: This is what I am aiming for at MS&T20: a focused symposium on a scientifically challenging topic that is at the forefront of manufacturing. I have high hopes that this symposium will be a success. I am also excited about altering the format. Instead of talk after talk, I plan to include a panel discussion with invited speakers and a “brainstorming” or roundtable discussion for developing a roadmap or strategy for work needed to support the acceptance of lattice structures. Given industry’s large presence at MS&T, I see this as a method for bridging the gap between researchers and industry.

Q&A with James Foley



As both the current TMS President and a volunteer who was instrumental in developing programming at MS&T in the conference’s early years, James C. Foley, Los Alamos National Laboratory, offers some insight into both the history and the future of the MS&T conference series.

Q. Could you briefly describe your history with MS&T?

A. My history with MS&T started when it was just TMS and the Association for Iron and Steel Technology. I then was part of the initial tenuous start with the other societies, ASM International and The American Ceramic Society. I was the first TMS representative to the MS&T Program Coordinating Committee and then was the first chair of that committee. (I had suggested after the 2005 installment of MS&T that the Program Coordinating Committee have a rotating chair so that there was someone to lead the discussion of the committee. No good deed goes unpunished, and I became the 2006 MS&T Programming Coordinating Committee chair.) I have attended all MS&T meetings that I can think of. I even snuck in a talk or two in between serving on the TMS Board of Directors and ASM Board of Trustees.

Q. What differences do you see between MS&T and the TMS Annual Meeting?

A. MS&T is a little more structured than the annual meeting to ensure that all the participating societies get a fair and equitable participation. Each society has their own special programming and stamp on the meeting to ensure that their members get value out of the event while working together for a better overall conference. Also, there are technical divisions within TMS that typically don’t participate in MS&T as much as they do in the Annual Meeting.

Q. Why do you think that MS&T is an important programming venue for TMS members?

A. MS&T is a great opportunity to program with professionals in the ceramics and steel sectors that isn’t as possible at the annual meeting or any other conference. Also, MS&T has historically been located in places where it is within easy driving distance for university students. That means that there is usually an abundance of materials students participating in MS&T.



HEA 2019: Exploring Recent Advances in a Rapidly Growing Field

Daniel Miracle

High entropy alloys (HEAs) are made from concentrated blends of five or more principal elements, changing a 5,000-year paradigm for alloy development, which started with the Bronze Age and uses a single dominant element as a base with small alloying additions to improve properties. This conventional approach has transformed civilizations, but there are signs that it's reaching natural limits, since there are no new stable elements to give new alloy bases with significantly better properties than existing alloys. High entropy alloys present hundreds of billions of new bases to explore, and their jumbled atomic structures can also give unexpected new mechanisms and attractive new properties to fuel industrial advancements. There has been extraordinary growth in scientific studies to explore new compositions and to understand new phenomena, and increasing commercial interest to establish potential engineering applications.

The World Congress on High Entropy Alloys (HEA 2019) will be held November 17–20, in Seattle, Washington, to present and discuss the most recent ideas and results in this fast-growing field. HEA 2019 will address this expanding field broadly—it will include the latest advances in single-phase and multi-phase metallic, intermetallic, and ceramic high entropy materials intended for structural and functional applications. Seven major themes in the technical program include: alloy design and exploration;

computational modeling and simulation; fundamental theory and mechanisms; mechanical properties; functional properties; processing; and applications. New ideas for industrial applications will also be covered, including high-temperature structural materials, lightweight structural alloys, oxidation and corrosion resistant materials, irradiation resistant alloys, bio-metallic implants, hydrogen storage, tribology and wear resistance, hard-face coatings for cutting tools, and shape memory alloys. Advances in emerging concepts such as machine learning, high throughput computations, high throughput experiments, and material processing (including additive manufacturing) will be highlighted. These ideas and technologies are essential not only for HEAs, but are also pushing the boundaries of how the field of materials science conceives, characterizes, and develops new candidates.

The congress features three plenary speakers (Chain Tsuan Liu, City University of Hong Kong; Dierke Raabe, Max-Planck-Institut für Eisenforschung GmbH; and Oleg Senkov, UES Inc.) who are thought leaders in the compositional and microstructural development of HEAs based on 3D transition metals and on refractory elements. Strategies highlighted in these talks include solid solution hardening, precipitation strengthening, and the intentional design of metastable phases and microstructures that transform during deformation to enhance properties.



Daniel Miracle

"These ideas and technologies are essential not only for HEAs, but are also pushing the boundaries of how the field of materials science conceives, characterizes, and develops new candidates."

—Daniel Miracle

"The goal of HEA 2019 is to invigorate the spirit of exploration, of finding new and unexpected results by asking bold new questions and searching for new answers."

—Daniel Miracle

While the bulk of the technical program is built from more than 170 contributed abstracts representing 26 countries, the lineup of additional keynote and invited speakers includes many international leaders representing a range of scientific disciplines:

- Donald Brenner, North Carolina State University
- William Curtin, EPFL/STI-IGM-LAMMM
- Michael Gao, National Energy Technology Laboratory
- Easo George, Oak Ridge National Laboratory
- Bronislava Gorr, University of Siegen
- Horst Hahn, Karlsruhe Institute of Technology
- Haruyuki Inui, Kyoto University
- Zhaoping Lu, University of Science and Technology Beijing
- Alfred Ludwig, Ruhr-University Bochum
- Gregory Olson, Northwestern University
- Eun Soo Park, Seoul National University
- Robert Ritchie, University of California, Berkeley
- John R. Scully, University of Virginia
- Cemal Cem Tasan, Massachusetts Institute of Technology
- Chris Woodward, Air Force Research Laboratory
- Fan Zhang, CompuTherm LLC

Participants at HEA 2019 will gain access to the most up-to-date ideas and

advancements in the field from all over the world. Vibrant oral and poster presentations will stimulate new ideas that can be further developed through networking opportunities in a multi-disciplinary environment. Scientists and engineers from industry, academia, and government will explore and discuss opportunities to form partnerships and collaborations on this promising technology. The program also features an accent on diversity and active contributions from young professionals, supporting TMS's aspirational goals (to learn more about TMS Aspires, TMS's new strategic plan, visit www.tms.org/TMSAspires). Closing out the congress is a tour of the massive Boeing assembly plant—the world's largest building by volume—where attendees will have the chance to see familiar Boeing planes in production.

High entropy alloys offer transformational possibilities and major new challenges. Scientists and engineers all over the world are responding to these challenges with new ideas, new alloys, and new experimental and computational methods. The goal of HEA 2019 is to invigorate the spirit of exploration, of finding new and unexpected results by asking bold new questions and searching for new answers.

Daniel Miracle is a senior scientist at the Air Force Research Laboratory and chair of the HEA 2019 organizing committee.

A 2018 TMS Fellow, Miracle is currently the chair of the TMS Structural Materials Division.



Registration is Open for HEA 2019

Don't miss the first World Congress on High Entropy Alloys (HEA 2019)—a new, cross-disciplinary technical forum designed to share the latest research advances in materials with high configurations entropy.

When: November 17–20, 2019

Where: Hyatt at Olive 8, Seattle, Washington, USA

Book your housing by October 25!

How to Participate: Register before October 7, 2019, to take advantage of discounted rates.

Learn More and Register Today: www.tms.org/HEA2019

Stay for the Tour: Enhance your HEA 2019 experience by participating in the Boeing Future of Flight Tour on Thursday, November 21. Registration is free, but tour size is limited. Additional details can be found on the congress website.





TMS meeting headlines

View all upcoming meetings online at www.tms.org/Meetings.

Other Meetings of Note

ANS/TMS Materials in Nuclear Energy Systems (MiNES 2019)
October 6–10, 2019
Baltimore, Maryland, USA

OTC Brasil 2019
October 29–31, 2019
Rio de Janeiro, Brazil

OTC Asia 2020
March 24–27, 2020
Kuala Lumpur, Malaysia

Congress on Safety in Engineering and Industry 2020
June 21–24, 2020
Philadelphia, Pennsylvania, USA

The 13th International Conference on the Technology of Plasticity (ICTP 2020)
July 26–31, 2020
Columbus, Ohio, USA

The 14th International Symposium on Superalloys (Superalloys 2020)
September 13–17, 2020
Seven Springs, Pennsylvania, USA

Materials Science & Technology 2020 (MS&T20)
October 4–8, 2020
Pittsburgh, Pennsylvania, USA



September 8–11, 2019
University of Birmingham Edgbaston Park Hotel and Conference Centre
Birmingham, United Kingdom
www.tms.org/LMPC2019

- Don't miss this opportunity to connect with leaders and discuss the latest developments in the field. Registration is still open for the 2019 Liquid Metal Processing & Casting Conference. Make your plans to attend now, before it's too late!



ANODE TECHNOLOGY
for the Aluminum Industry Course

September 9–13, 2019
Hydro Aluminium AS Årdal
Årdal, Norway

www.tms.org/Anode2019

- This program will feature small group sessions, providing you with access to valuable peer-to-peer discussion and insights as well as more one-on-one time with the expert instructors.



September 29–October 3, 2019
Oregon Convention Center
Portland, Oregon, USA

Discount Registration Deadline:
August 30, 2019

www.matscitech.org

- Carolyn Hansson, University of Waterloo, has been selected as the TMS/ASM Joint Distinguished Lecturer in Materials and Society. Hansson will deliver a presentation as part of the MS&T19 plenary session on Tuesday morning, October 1.



November 17–20, 2019
Hyatt at Olive 8
Seattle, Washington, USA
Discount Registration Deadline:
October 7, 2019
www.tms.org/HEA2019

- The World Congress on High Entropy Alloys (HEA 2019) is a new, cross-disciplinary technical forum designed to share the latest research advances in materials with high configurational entropy, including both single-phase and multiphase (compositionally complex) alloys.
- All attendees are invited to participate in the Boeing Future of Flight tour on Thursday, November 21, after the congress. There is no registration fee, but tour size is limited. Learn more on the congress website.

THE WORLD COMES HERE
TMS 2020
149th Annual Meeting & Exhibition

February 23–27, 2020
San Diego Convention Center and
Marriott Marquis & Marina
San Diego, California, USA
www.tms.org/TMS2020

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call for papers

JOM is seeking contributions on the following topics for 2019 and 2020. For the full Editorial Calendar, along with author instructions, visit www.tms.org/EditorialCalendar.



February 2020:

Manuscript Deadline: September 1, 2019

Topic: 7th European Conference on Renewable Energy Systems

Scope: This special topic will publish invited papers presented at the 7th European Conference on Renewable Energy Systems. The areas of coverage will include semiconducting materials, alloys, and composites in energy applications. In addition, submissions related to synthesis and characterization of materials for solar energy, wind energy, fuel cells, and energy storage materials are welcome.

Editors: Shadia Ikhmayies and H. Hilal Kurt

Sponsors: Invited

Topic: Cleaner Manufacturing of Critical Metals

Scope: Research that aims at preventing or reducing the generation of industrial waste while increasing resource and energy efficiency in critical metals production is invited for this special topic. Waste minimization from both primary and secondary sources will be considered. Manuscripts intended for a broad readership are especially encouraged.

Editors: Fiseha Tesfaye, Naiyang Ma, and Mingming Zhang

Sponsors: Recycling and Environmental Technologies

Topic: Mechanical Properties of Metastable Materials Containing Strong Disorder

Scope: Metastable systems have received considerable attention because, as thermodynamically non-equilibrium states of matter, they provide ample opportunities for properties control, and have found applications in structural and functional materials. This special topic focuses on advances in the fundamental understanding of mechanical properties of metastable systems containing disorder (e.g., grain boundaries, glass-crystal interfaces, amorphous solids). Papers are invited on topics including state-of-the-art characterization of disordered materials, advanced computation and modeling, non-equilibrium thermodynamics, and/or kinetic theory.

Editors: Yue Fan, Liang Qi, and Amanda Krause

Sponsors: Mechanical Behavior of Materials

March 2020:

Manuscript Deadline: October 1, 2019

Topic: Additive Manufacturing: Validation and Control

Scope: While research continues on the fundamental aspects of additive manufacturing (AM), it is the ability to produce repeatable properties and microstructures that is required to incorporate AM as a primary manufacturing process. Modeling and simulation strategies are being developed to provide benchmarks for the validation and control of the AM process. Manuscripts are solicited that address approaches toward validating process modeling and incorporation into process control.

Editors: Judy Schneider

Sponsors: Additive Manufacturing

Topic: Advanced Manufacturing for Biomaterials and Biological Materials

Scope: Manufacturing and processing are becoming increasingly important for biomaterials, bioinspired materials, and biological materials. This includes additive manufacturing techniques like 3D printing, which allow for increasing degrees of complexity to mimic the structures observed in nature. However, this special topic welcomes any other processing and manufacturing techniques applicable for these materials, such as plasma treatments.

Editors: Hannes C. Schniepp, Steven Eric Naleway, Vinoy Thomas, and David Restrepo

Sponsors: Biomaterials

Topic: Solid Freeform Fabrication 2019

Scope: This special topic will feature invited papers from the 2019 Solid Freeform Fabrication symposium, covering all aspects of additive manufacturing. Best papers from the symposium dealing with materials issues will be recommended for publication in *JOM*.

Editors: David Bourell

Sponsors: Invited

April 2020:**Manuscript Deadline: November 1, 2019****Topic: Aluminum and Magnesium: New Alloys and Applications**

Scope: This topic covers the development of new alloys, optimization of commercial alloys, additions for structure modification, and improvement of mechanical and functional properties, as well as new applications of aluminum and magnesium alloys. Papers are invited that contain essentially new data based on advanced characterization and analysis techniques as well as thermodynamic analysis and testing for properties.

Editors: Dmitry Eskin

Sponsors: Aluminum

Topic: Biologically Induced Corrosion

Scope: Papers in all areas of biologically induced or influenced corrosion are welcome. Examples include microbially induced corrosion, corrosion in biomedical devices, etc.

Editors: Vilupanur Ravi

Sponsors: Corrosion and Environmental Effects

Topic: Characterization of Advanced Biomaterials

Scope: Papers are invited on advances in processing or relevant property measurement of novel biomaterials. In particular, papers on synthesis, processing, and characterization of biomaterials are welcome. Of interest are multifunctional nanomaterials and modified mineral-based biomaterials with unique combinations of desirable mechanical performance, biocompatibility, and bioactivity for clinical applications.

Editors: Zhiwei Peng, Rajiv Soman, and Yunus Eren Kalay

Sponsors: Materials Characterization

Topic: Hydrogen Effects on Material Performance

Scope: Numerous energy generation and transportation systems constructed of high-performance metal alloys are routinely exposed to hydrogen. The integrity of these systems is often challenged by a variety of hydrogen degradation modes. The hydrogen-material interactions that ultimately lead to degradation occur across multiple length scales. Therefore, of particular interest for this special topic are studies involving multiscale experimental and theoretical methods for probing hydrogen-materials interactions in complex materials systems.

Editors: Janelle Wharry and Samantha Lawrence

Sponsors: Nanomechanical Materials Behavior

Tools for JOM Authors and Volunteers

Visit jom.tms.org to access manuscript preparation guidelines and information on how you can become involved as a JOM peer reviewer. JOM advisors will also find tools to support them in managing a JOM topic.

For further information on contributing to JOM, contact JOM Editor Maureen Byko at mbyko@tms.org.

May 2020:**Manuscript Deadline: December 1, 2019****Topic: Advancing Development and Application of Superalloys**

Scope: Superalloys are essential components of propulsion and power generation systems due to their unique combination of strength, creep, and fatigue resistance at elevated temperatures or in demanding environments. This topic focuses on the current advances in the development and application of Ni- and Co-based superalloys. Areas of interest may include (but are not limited to): alloy development, advanced processing, deformation behavior, structure-property relationships, long-term stability, environmental damage, and joining.

Editors: Martin Detrois

Sponsors: High Temperature Alloys

Topic: Emerging Mechanisms for Enhanced Plasticity in Magnesium

Scope: Inadequate ductility often hinders the application of magnesium alloys, which otherwise offer an excellent lightweight alternative for increasing energy efficiency. This special topic covers emerging methods that overcome this limitation. The scope is inherently multi-scale; ranging from fundamental mechanisms at the atomic/crystal defect level, up to large-scale production techniques. Optimizing mechanical properties via microstructure and crystallographic texture modification are considered; chemistry control and alloying, casting, powder-based strategies, as well as thermomechanical processing are addressed.

Editors: Petra Maier and Jishnu J. Bhattacharyya

Sponsors: Magnesium

Topic: Heat Transfer Utilization in Pyrometallurgy

Scope: This topic covers some of the fundamentals and applications of heat transfer in pyrometallurgy. In particular, this topic aims to highlight how the knowledge and investigation of heat transfer modes drive furnace design and operation. Included in this topic are practical applications to industrial furnaces, with an emphasis on furnace heat management and heat utilization for process optimization.

Editors: Camille Fleuriault and Joseph Grogan

Sponsors: Pyrometallurgy

Topic: In-Situ Characterization Techniques for Investigating Nuclear Materials

Scope: In the last few years, in-situ characterization techniques have taken off as a way to directly observe the evolution and evaluate the damage in nuclear materials under pertinent reactor conditions. For this topic, we are soliciting papers on in-situ experimental techniques at all length scales probing mechanical, chemical, thermal, or electrical responses, as well as irradiation damage. Papers that include modeling and simulation are welcome, though computational-only papers will not be accepted.

Editors: Clarissa Yablinsky, Peter Hosemann, David Frazer, and Shradha Agarwal

Sponsors: Nuclear Materials

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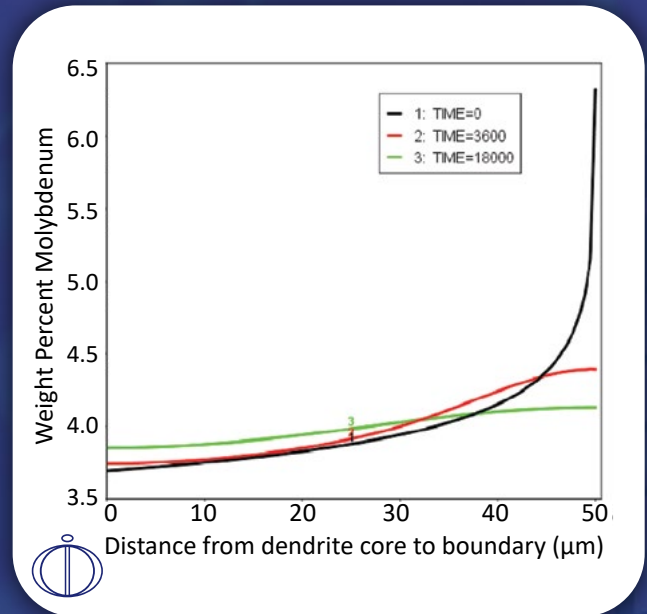


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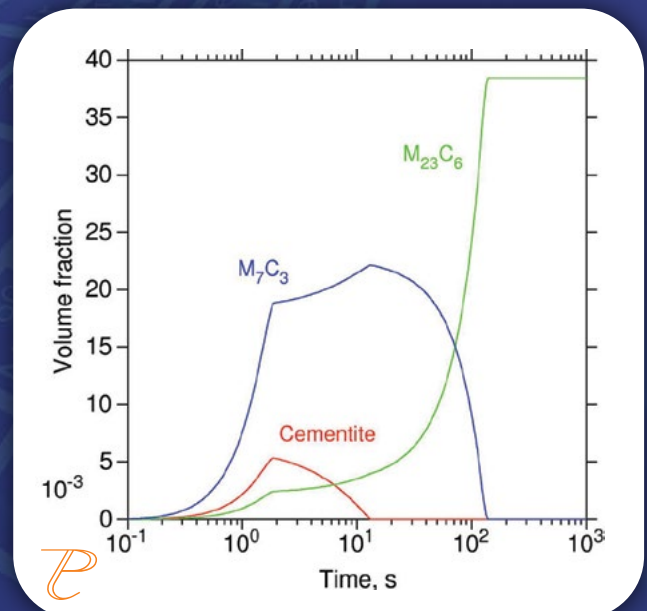
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Highlights of 2019b release:

- ✓ **New Process Metallurgy Module** - a new calculator within Thermo-Calc that makes it easy to set up calculations for steel and slag mixtures. The new module is designed for applications to steel-making and steel refining processes including converters, such as basic oxygen furnaces, electric arc furnaces, ladle furnace metallurgy, etc.
- ✓ **New Growth models in Precipitation Module** - Paraequilibrium (PE) and Non-Partition Local Equilibrium (NPLE) are now supported.
- ✓ **New Databases TCOX9, TCCU3, MOBCU3** - Ti has been added to the elements included in the refractory oxide database, TCOX9. Ge has been added to the elements included in the databases for copper alloys, TCCU3 and MOBCU3

Homogenization of casting segregation in Ni Alloy 713



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