JOM

JANUARY 2020

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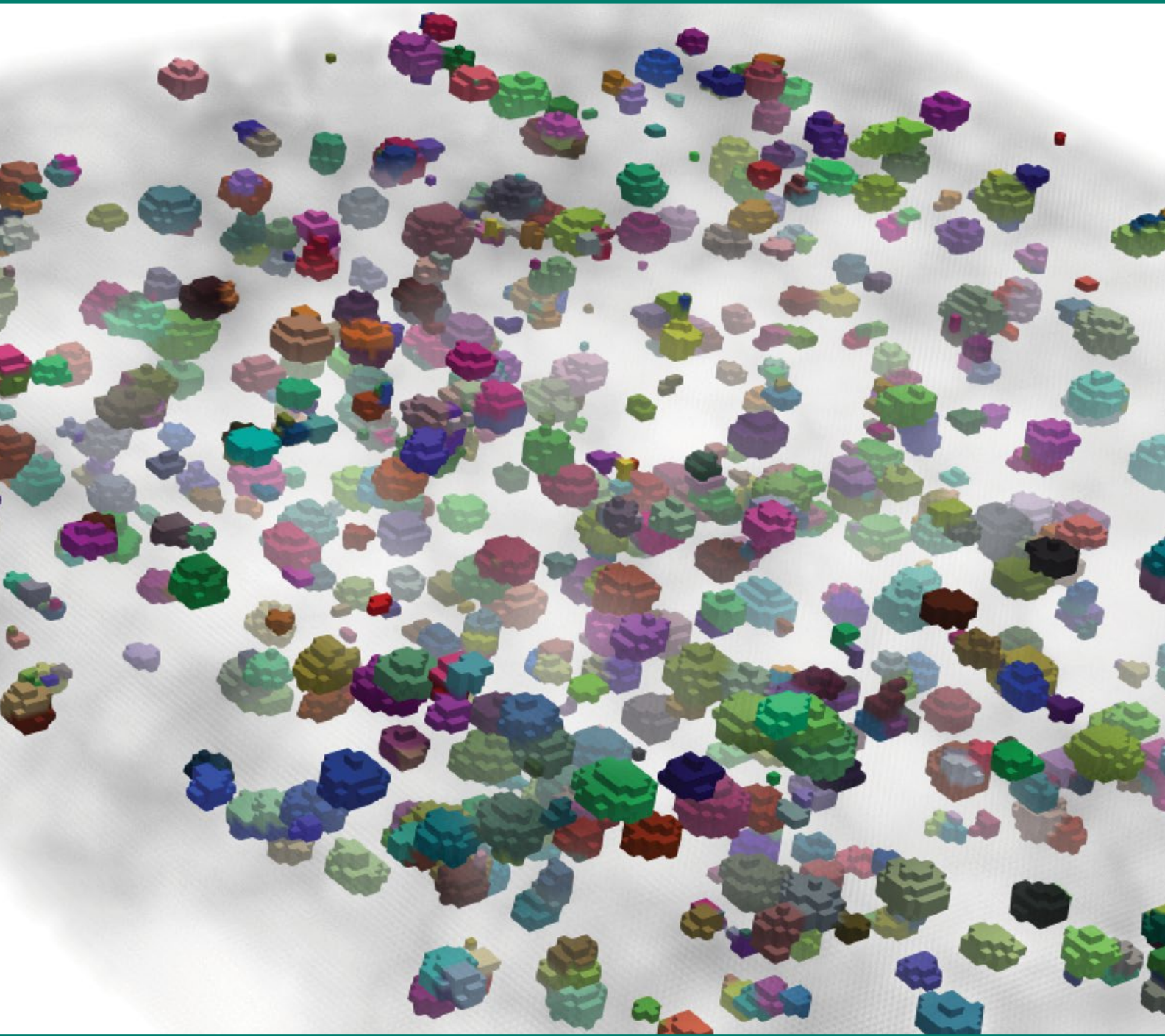
An official publication of The Minerals, Metals & Materials Society



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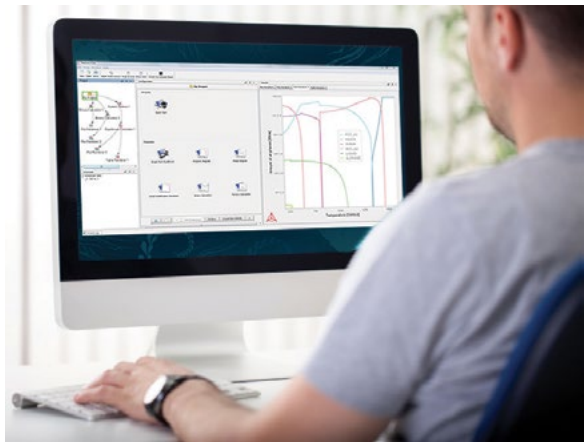

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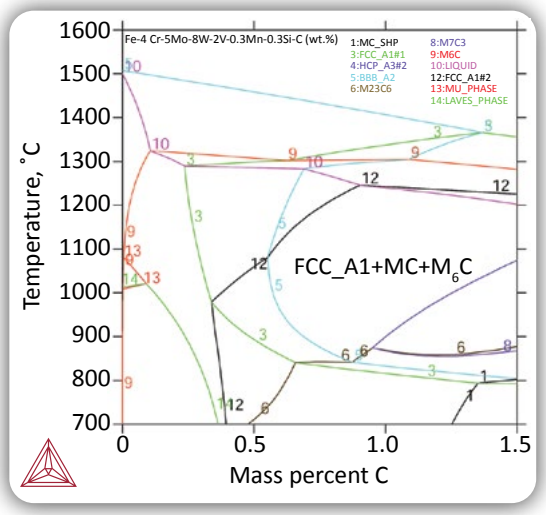
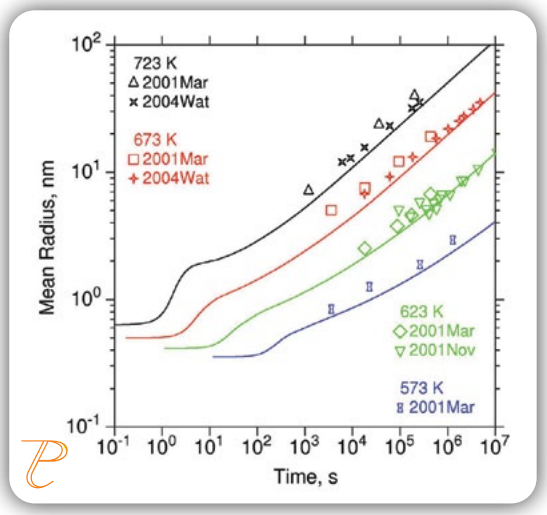


Multicomponent Phase Diagrams



Precipitation Kinetics

www.thermocalc.com

EXHIBITORS *(as of December 9, 2019)*

Company	Booth Number
ABB Inc.	519
AdValue Technology LLC	621
AIME - American Institute of Mining Metallurgical and Petroleum Engineers Inc.	420
Allied High Tech Products Inc.	307
Almex USA Inc.	601
ALS	715
ALTEK LLC	419
Ampere Scientific	627
ANSYS Inc.	415
Anton Paar USA	620
Asia Pacific Electrode Technology Inc.	626
Bruker	506
Carl Zeiss Microscopy LLC	515
CIMM Group Co. LTD	614
Claudius Peters Projects GmbH	406
CompuTherm LLC	518
EAG Laboratories	710
EBSD Analytical	516
EDAX	520
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GLAMA	407
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Hycast AS	619
IPS Ceramics USA	329
KLA Corporation	525
Leica Microsystems	720
Light Metal Age	605
Microtrac Inc.	625
MTI Corporation	301
Nanovea	600
Netzsch Instruments NA LLC	615
Outotec Ltd.	606
Pace Technologies	526
PolarOnyx Inc.	617
PROTO	628
Pyrotek Inc.	521
RHI Magnesita GmbH	714
Robomet 3D / UES Inc.	425
Rtec-Instruments Inc.	401
Sente Software Ltd.	308
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STAS Inc.	511
Synton Mdp AG	707
TA Instruments	724
Taylor & Francis	717
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Thermo Fisher Scientific	618
Thermo-Calc Software	414
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Wagstaff Inc.	501
Zircar Ceramics Inc.	427

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PRE-SHOW REPORT

CompuTherm, LLC

Software · Database · Consulting

Over the past 20 years, Pandat software has evolved from a software for multicomponent phase diagram calculation to a powerful simulation tool for accelerated materials design and development

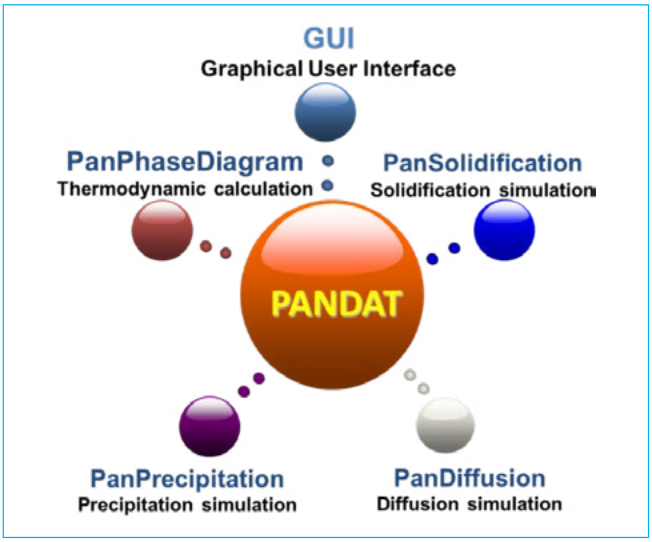
In 1996, CompuTherm LLC was formed as a University of Wisconsin-Madison spin-out

In 2000, Pandat software was first released for multicomponent phase equilibrium calculation

In 2012, Pandat software was redesigned as a software package including three modules: PanPhaseDiagram, PanPrecipitation, and PanOptimizer

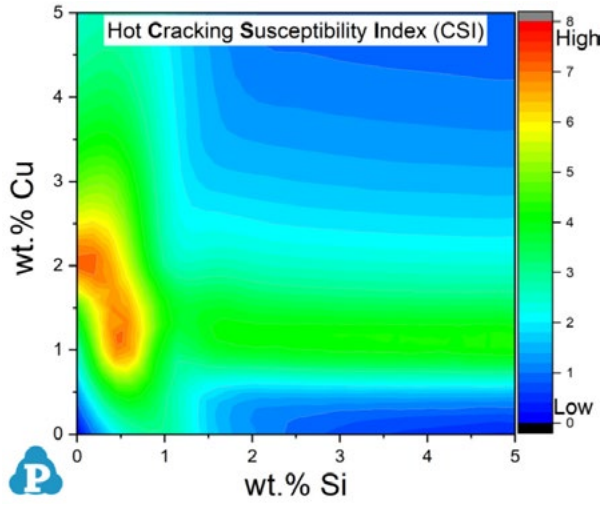
In 2018, PanDiffusion module was released

In 2020, PanSolidification module is released

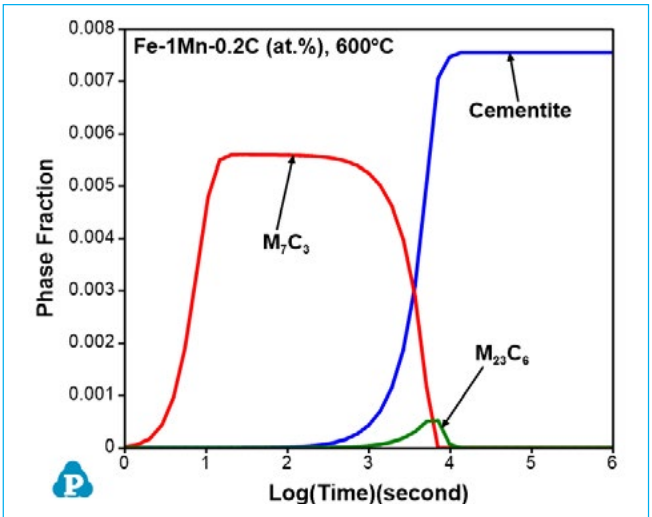


Advantages of Pandat Software:

- Simulate the process of materials processing by one software from solidification to homogenization and heat treatment
- Optimize alloy composition and processing condition through understanding the correlations among alloy composition, processing condition, microstructure and mechanical properties
- Accelerate materials development by screening multidimensional composition space to quickly identify the compositions that meet user's selected criteria
- Go beyond phase diagrams to simulate any user-defined properties that depend on phases
- Develop customized applications by accessing thermodynamic properties through PanEngine API



CSI PREDICTION FROM PANSOLIDIFICATION

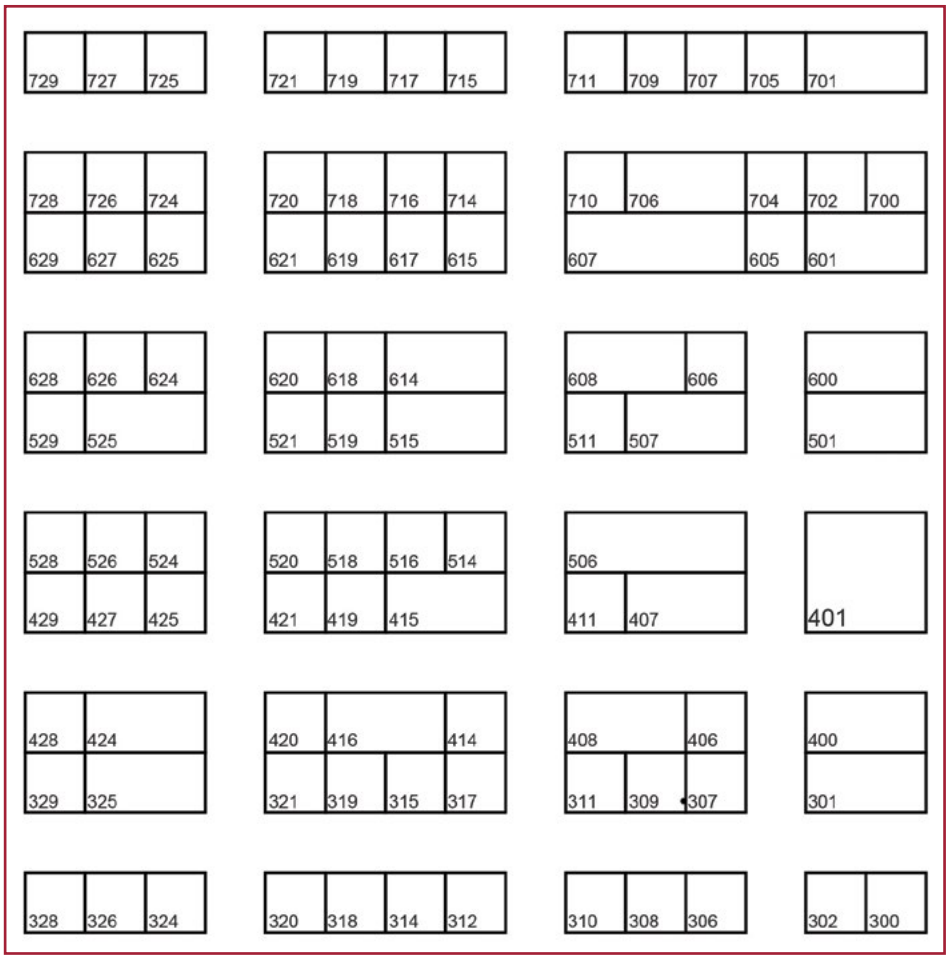


PRECIPITATION SIMULATION OF AN FE-BASED ALLOY

FOR MORE INFORMATION, PLEASE VISIT US AT **BOOTH 518** AND OUR WEBSITE: www.computherm.com

EXHIBIT FLOORPLAN *(as of December 9, 2019)*

Poster Sessions



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Bauxite to Aluminum: Advances, Automation, and Alternative Processes

Design, Development, and Manufacturing of Refractory Metals & Materials

ICME-Based Design and Optimization of Materials for Additive Manufacturing

Technical Articles

JOM

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About the Cover

From "In-Situ Grain Resolved Stress Characterization During Damage Initiation in Cu-10%W Alloy" by Reeju Pokharel et al., the image shows a 3D initial state characterization of Cu-10%W. A microstructure map, obtained from HEDM measurements, shows the crystallographic grains of W embedded on a Cu matrix shown in gray. After the initial state characterization, the same specimen was loaded under uniaxial tension to monitor the local stress and strain accumulation due to imposed load. It was observed that high stress triaxiality developed in W grains, which led to decohesion of the Cu-W interface. Upon further loading, the debonded regions grew and coalesced with neighboring pores, eventually leading to macroscopic failure.

January 2020 Guest Editors

3D Materials Science
Invited
Matthew Miller, Cornell University
Philip Withers, The University of Manchester

Advanced Characterization and Testing of Irradiated Materials
Advanced Characterization, Testing, and Simulation Committee; Nuclear Materials Committee
Dhriti Bhattacharyya, Australian Nuclear Science and Technology Organization
Fan Zhang, National Institute of Standards and Technology
Peter Hosemann, University of California Berkeley

Bauxite to Aluminum: Advances, Automation, and Alternative Processes
Aluminum Committee; Hydrometallurgy and Electrometallurgy Committee
David S. Wong, University of Auckland
Hong Peng, University of Queensland

Design, Development, Manufacturing, and Applications of Refractory Metals and Materials
Refractory Metals & Materials Committee; Steels Committee
Ravi Enneti, Global Tungsten and Powders Corp.
Chai Ren, University of Utah

ICME-Based Design and Optimization of Materials for Additive Manufacturing
Additive Manufacturing Committee; ICME Committee
Jing Zhang, Indiana University-Purdue University

About JOM:

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.

About TMS:

The Minerals, Metals & Materials Society (TMS) is a professional organization that encompasses the entire range of materials and engineering, from minerals processing and primary metals production to basic research and the advanced applications of materials.

Publishing Information:

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in the final analysis

JOM
Volume 72
Number 1
January 2020

"In a short time, this will be a long time ago."

—Observation in the movie *Slow West*

Having spent much of my professional career in the employ of TMS, I frequently marvel at how the annual cycles of membership, meetings, publications, and myriad other activities seem to turn faster with each passing year. It seems like only yesterday that we returned from San Antonio for TMS2019, yet in just a few weeks we leave for TMS2020 in San Diego. Time is not constant in TMS terms.

Time has been much on my family's mind in recent weeks as we have been going through the household storeroom, separating what-used-to-be wheat from what-is-now chaff as transmuted over decades of entombment. Among the abandoned treasures that once seemed so important to preserve: Books that I have not opened in more than 40 years—they have been either boxed (and boxed and boxed) and donated or stored more lovingly on new shelves in my office; at least a tonne of homemade VHS recordings of my favorite movies that have been replaced and re-replaced in turn by commercial videotapes, laser discs, DVDs, Blu-Rays, and, ultimately, I hope, streaming services—they were sent to their final rewind in the trash; generations of paper records and documents—these were parsed and piled for many coming weekends of lengthy shredding sessions. It was an interesting mix of dull drudgery and dusty nostalgia.

Among the more interesting artifacts unearthed during the household archeology was a paper with rusty staples from my graduate school days almost 30 years ago. My master's degree is in corporate communication from Pittsburgh's Duquesne University, and I earned it over two years while attending night school, having a full-time day job with TMS to otherwise keep me busy. While I rarely slept, I was savvy to certain opportunities to serve all masters concurrently. For example, I focused my school work whenever practical on projects that might be applicable to TMS—it was one of my ways to give back. My re-found paper was dated March 1991 (pre-Internet days) and comprised a proposal for TMS to employ hypertext and telnet (a telephone network) to create a service called TMS OnLine. To quote:

> "The service would be fee-free to the user-members and nonmembers alike. TMS Online could be operational within eight months after approval of the concept and funding. In addition to being a member service, TMS Online should increase meeting registration and publication sales. It will also be a useful information/customer service tool for the headquarters staff, and it will be invaluable in the development of specialized marketing lists. If successful, the service could be expanded in other ways that would offer greater member service, directly generate income, and enhance society prestige as a leader in the field of association management for materials science and engineering."

I subsequently submitted the class paper to staff leadership, and two years later it was up and running within TMS. It was a text-only interface and quite primitive by today's standards. We had a phone number rather than a URL or domain name. Still, you could get Society news, publication abstracts, and meeting information with searchability and immediacy. It is all described in my October 1993 *JOM* article, "Introducing TMS OnLine: An Interactive Electronic Gateway to Information Dissemination" (SpringerLink). It felt profoundly new and portended to us that member service would never be the same. It wasn't. Less than two years later, TMS OnLine would migrate from the telnet platform to the new Worldwide Web protocol, and we've been in the mode of continuous improvement ever since.

Many talented and committed people—volunteers and staff—have worked on every aspect of the Society's virtualization over all of these years, and I'm delighted to see their efforts succinctly recognized at next month's TMS2020 with the issuance of a commemorative pin to all attendees. It simply recognizes the 25th anniversary of www.tms.org. In associations and otherwise, corporate communication has never been the same, and it has never been better.

James J. Robinson
Executive Director

@JJRofTMS

"It felt profoundly new and portended to us that member service would never be the same."

This commemorative pin celebrating 25 years of www.tms.org will be available to all attendees at the TMS 2020 Annual Meeting & Exhibition (TMS2020) in February.

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JOM themagazine

In Case You Missed It:

Business News from the Field

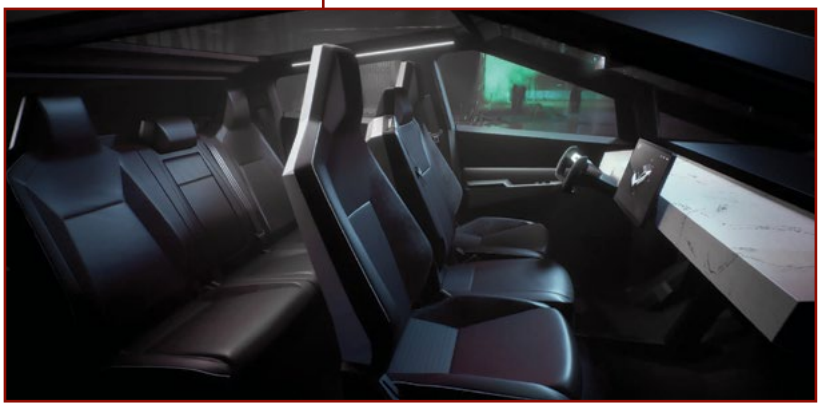
Do you have business or industry news of interest to the minerals, metals, and materials community? Submit your announcement or press release to Kaitlin Calva, JOM Magazine Managing Editor, at kcalva@tms.org for consideration.

Corbec Breaks Ground on Ontario Plant

Hamilton, Ontario, Canada: Corbec Inc. began construction of its first galvanizing plant in Ontario. It will provide hot-dip galvanizing of steel products that include engineered structures, such as bridges, windmills, towers, fencing, and farming equipment. The 100,000-square-foot plant is expected to produce 100 million pounds annually. Corbec will complete the $40-million project by the end of 2020.

Researchers Develop New Polymer Units

Newark, Delaware, USA: A team from the University of Delaware and University of Pennsylvania, with primary support from the U.S. Department of Energy Biomolecular Materials Program, created a new fundamental unit of polymers that could lead to the discovery of new materials. "Bundlemers" are a series of nanoscopic cylinders, each made of four peptides, which are linked end-to-end by controlled chemical reactions. The bundlemer chains are rigid, customizable molecules that can be modified with other components to create new nanomaterials, such as high-performance fibers and biologic medicines.



Palo Alto, California, USA: In addition to its stainless-steel exterior, Tesla's new Cybertruck features a marble-like interior dashboard that is actually made from paper composite materials. While paper composites are typically used in industrial kitchens, labs, and fabrication shops, their use in the Cybertruck marks the material's first appearance in mass-produced vehicles. The truck, which made its debut in November 2019, is slated for production in 2021. (Photo courtesy of Tesla.)

New Process Manufactures AlScN

Freiberg, Germany: Scientists at the Fraunhofer Institute for Applied Solid State Physics IAF are the first to successfully use metal-organic chemical vapor deposition (MOCVD) to manufacture aluminum scandium nitride (AlScN). Aluminum scandium nitride is a promising material for its potential use in transistors required for data transfer, satellite communications, and radar systems, and could offer an alternative to the use of silicon in these devices. Until now, researchers have been challenged to produce AlScN on a scale large enough for industrial applications.

Dow Offers New Silicon-Polyethylene Hybrid

Midland, Michigan, USA: Dow Inc. introduced a silicone-polyethylene hybrid technology, called AMPLIFY™ Si Silicone Enhanced Polymer Systems (SEPS), that improves product performance and uses recycled plastic. The new material is expected to allow a variety of recycled plastics to be used in wood composite manufacturing processes, reduce the carbon footprint associated with the manufacturing process, and divert more plastics from landfills. The first SEPS product is a wood-plastic composite designed for decking.

Saudi Aramco Held Initial Public Offering

Riyadh, Saudi Arabia: The Saudi Arabian Oil Company (Saudi Aramco) became a publicly traded company on the Saudi Stock Exchange at the end of 2019. The oil giant is considered among the most profitable companies in the world with a value of about $1.2 trillion. The action is part of an overall goal to reduce the country's dependency on oil and diversify its economy. Overall, Saudi Aramco hopes to grow its sustainability and lower its climate impact through leveraging technology and innovation.

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https://doi.org/10.1007/s11837-019-03937-3

Celebrating 50 Years of *Metallurgical and Materials Transactions*

Kelly Zappas

Tresa Pollock

The year 2020 marks 50 years of publishing for the *Metallurgical and Materials Transactions* (*MMT*) journals, a pair of highly respected, peer-reviewed archival journals covering metallurgy and materials science. During the lifespan of these publications, there have been a number of changes in the field, reflected in adjustments to the journal's format and title, but one thing has remained constant: the publication of high-quality, high-impact articles that have helped to move the field and its technologies forward.

The Impact of *Metallurgical and Materials Transactions* Over Time

Tresa Pollock, who took over as principal editor for the journals in 2016, noted several areas where they have been particularly influential in the decades since the first journal was published in 1970.

"*MMT* has impacted all classes of metallic materials, from emerging materials such as high-entropy alloys and lightweight magnesium systems to foundational materials such as steel, superalloys, aluminum, titanium, and composites," said Pollock.

Of particular importance, she noted, "are the contributions of technical leaders in our field to the fundamental understanding of mechanical properties, materials processing, and physical metallurgical phenomena." The research reported in the *MMT* journals has supported a broad range of industries internationally, she said, through advances in materials processing, including solidification and casting, friction stir processing, continuous casting, deformation processing, and welding.

Pollock is the Alcoa Professor, Materials Department, University of California, Santa Barbara. Along with her graduate students, she has published 49 papers in the journal throughout her career.

"It has served as an important outlet for my research across a number of areas, particularly for nickel-based alloys and

A Brief History of the *Metallurgical and Materials Transactions* Journals

First published in January 1970 as *Metallurgical Transactions*, the *MMT* journals began as a merger of the *Transactions of The Metallurgical Society of AIME*—published by TMS's parent society the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME)—and the *Transactions Quarterly* of the American Society for Metals, published by ASM International.

In 1975, the journal was split into two sections: *Metallurgical Transactions A* and *Metallurgical Transactions B*. Then in 1994, the journals' titles expanded to encompass "materials" in addition to metallurgy, bringing them to the journals that we know today: *Metallurgical and Materials Transactions A* (*MMTA*) and *Metallurgical and Materials Transactions B* (*MMTB*).

MMTA is published monthly and focuses on the latest research in all aspects of physical metallurgy and materials science, and explores relationships among processing, structure, and properties of materials. *MMTB* is published bimonthly and focuses on the processing science and engineering of metals and materials.

By logging in to the Access Member Benefits website at members.tms.org, TMS members can read both current and archived issues of *MMTA* and *MMTB* (click on "Read Journals"), as well as the archived content of its predecessor, *AIME Transactions*, published from 1871 to 1970 (click on "Access the AIME Digital Library").

magnesium alloys," she said. "All of our research on single-crystal solidification of superalloys, relevant to aircraft engine turbine blades, has been published in *MMTA*. This is *the* venue for this area of research."

Anniversary Collection Planned for 2020

To celebrate the many important technical advances that have occurred over the past five decades, the *MMT* journals will publish a special 50th anniversary collection this year that will highlight recent progress, current status, and future directions in scientific areas important to the field today.

Approximately 30 invited articles are planned for the collection. Articles will appear in issues throughout the year and will be organized online in one location for each journal. Examples of topics to be covered include additive manufacturing, high throughput materials science, in-situ synchrotron studies of materials, data science and materials imaging, nanocrystalline materials, continuous casting, grain refinement in solidification, and electrochemical materials processing.

When the articles become available, TMS members will be able to read them by logging in to www.tms.org/Journals and clicking on the *MMTA* or *MMTB* journal cover. From there, choose "Browse Volumes & Issues," select the "Topical Collections" tab, and choose "*Metallurgical and Materials Transactions* 50th Anniversary Collection" from the list.

Publish Your Work in *Metallurgical and Materials Transactions* in 2020

Join in the celebration of *MMT*'s anniversary year by submitting your latest research to one of the journals.

The *MMT* journals aim to advance the basic understanding of the relationships among structure across all length scales, physical and mechanical properties, and processing of materials, examined via theory, experiments, advanced characterization, data-driven and machine learning approaches, and validated modeling.

"We do not prescribe the length or format of papers, instead aiming for depth and quality," said Pollock. "Our editorial model is based on multiple, rigorous peer reviews."

To submit your paper, go to www.tms.org/Journals and click on the "Submit an Article" link for *MMTA* or *MMTB*.

Recent improvements in journal processes are speeding up publication times, and the journals' impact factors continue to rise, making it a better time than ever to publish in the *MMT* journals.

"We are excited about the dynamic range of topics being addressed by the *MMT* community and will continue to pursue high-quality, high-impact research," said Pollock.

Highly Cited Articles from the Last 20 Years

To demonstrate the diversity of science and technology addressed by the *Metallurgical and Materials Transactions* journals over the years, Principal Editor Tresa Pollock provides the following examples of highly cited articles published in *Metallurgical and Materials Transactions A* (*MMTA*) and *Metallurgical and Materials Transactions B* (*MMTB*) from the last 20 years:

- "Recent Metallic Materials for Biomedical Applications," M. Niinomi, *MMTA*, March 2002
- "The Effectiveness of Hot Isostatic Pressing for Closing Porosity in Titanium Parts Manufactured by Selective Electron Beam Melting," Samuel Tammas-Williams et al., *MMTA*, May 2016
- "Precipitation and Hardening in Magnesium Alloys," Jian-Feng Nie, *MMTA*, November 2012
- "Microstructure Characterization of AlxCoCrCuFeNi High-Entropy Alloy System with Multiprincipal Elements," C.J. Tong et al., *MMTA*, April 2005
- "A Review of Very-High-Temperature Nb-Silicide-Based Composites," B.P. Bewlay et al., *MMTA*, October 2003
- "The Modified Quasichemical Model I - Binary Solutions," A.D. Pelton et al., *MMTB*, August 2000
- "Derivation and Variation in Composition-Dependent Stacking Fault Energy Maps Based on Subregular Solution Model in High-Manganese Steels," A. Saeed-Akbari et al., *MMTA*, December 2009
- "The Evolution of Al-Li Base Products for Aerospace and Space Applications," Roberto J. Rioja and John Liu, *MMTA*, September 2012
- "An Integrated Study on the Evolution of Inclusions in EH36 Shipbuilding Steel with Mg Addition: From Casting to Welding," Xiaodong Zou et al., *MMTB*, April 2018

TMS members can read any of these articles by logging in to www.tms.org/Journals and clicking "Read This Journal" for *MMTA* or *MMTB*. Members can read online articles published from 1975 to the present.

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https://doi.org/10.1007/s11837-019-03938-2

MS&T19: Materials Meetup in Portland

Ann Ritchie

The Materials Science & Technology 2019 (MS&T19) conference once again established and strengthened connections among professionals and continued to extend learning opportunities to students and early career professionals. More than 2,800 attendees traveled to Portland, Oregon, from September 29–October 3, to participate in lectures, short courses and tutorials, a poster session, committee and business meetings, student events, and numerous networking and social events. The MS&T19 Exhibit Hall also featured 80 companies with a footprint of more than 10,000 square feet.

As always, the conference's high-quality technical programming allowed attendees to browse across their interests to explore structure, properties, processing, and performance in a technical program encompassing 12 topic areas from five of the leading materials societies: the American Ceramics Society (ACerS), ASM International, the Association for Iron & Steel Technology (AIST), and TMS, with NACE International serving as a conference co-sponsor.

The Tuesday morning plenary session featured three speakers selected by each of the MS&T sponsoring societies. Carolyn Hansson, professor of materials engineering at the University of Waterloo, Canada and the 2019 TMS/ASM Joint Distinguished Lecturer in Materials and Society, presented a talk on the longevity of highway bridges titled, "The Challenge of the 100 Year Service-life Requirement."

"The highway bridge codes in the USA and Canada require a design life of 75 years and the discussions are underway to increase this to 100 years. A 100-year lifetime is not something most engineers think about when we're making a product, but that is what we're faced with," Hansson said.

A common reinforcement material of many highway bridges is carbon steel rebar, but it is vulnerable to harsh weather. For example, de-icing salts applied to icy bridges carry destructive chlorides through the concrete to destroy the passive film on the carbon steel rebar. This interaction leads to corrosion and distress on the concrete. The speaker noted that stainless steel rebar offered an obvious but costly solution: "Stainless steel in concrete can withstand about six times the amount of chlorides."

Hansson suggested using rebar made from a grade of stainless steel that does not contain molybdenum to lower costs. Although molybdenum is an alloy used to

James Foley (left), 2019 TMS president, and David Furrer (right), ASM immediate past president, present Carolyn Hansson (center) with the 2019 ASM/TMS Distinguished Lectureship in Materials and Society award after her presentation at the Tuesday morning plenary session at MS&T19.

Looking Ahead: MS&T20

TMS is currently planning Materials Science & Technology 2020 (MS&T20) with partnering societies ACerS and AIST and programming partner NACE. Having already gained a 10% increase in symposia proposals over 2019, the 2020 iteration will continue its tradition of innovation and collaboration October 4–8, 2020, in Pittsburgh, Pennsylvania. Abstracts for MS&T20 are due **March 15, 2020**. For more information and to submit your work, visit **www.matscitech.org/MST20**.

enhance resistance to corrosion, implementing good quality control of bridges would help protect the rebar in a benign environment that concrete naturally offers. Cracks in the concrete allow the chloride from de-icing salts to enter the concrete quickly, which speeds corrosion. Her research included cracked concrete studies using different grades of stainless-steel rebar, where the concrete was exposed to multi-chloride brine.

The plenary also featured Minoru Tomozawa, professor in the Department of Materials Science and Engineering, Rensselaer Polytechnic Institute, and Wolfgang Bleck, chair of the Department of Ferrous Metallurgy, IEHK Steel Institute, RWTH Aachen University. Tomozawa presented the ACerS Edward Orton Jr. Memorial Lecture titled, "Glass and Water: Fast Surface Relaxation," and Bleck presented the AIST Adolf Martens Memorial Steel Lecture titled, "The Fascinating Variety of New Manganese Alloyed Steels."

How to Make the Most of Internships

Conversations flowed during the Curricular Innovations and Continuous Improvements of Academic Programs (and Satisfying ABET along the Way): The Elizabeth Judson Memorial Symposium—Improving Materials Education session. The Judson symposium is organized every year by the TMS Accreditation and Education Committees. The Mentoring Best Practices for Interns: Panel Discussion offered advice to employers on giving students hands-on learning experiences. With forethought and planning, internships may be productive and mutually beneficial for both the student and the professional overseeing the work.

The talented panel offered the following advice to both employers and students:

1. Have a Plan That Enables Interns to Visualize Results

- **For Employers:** "Have something tangible to which they can apply themselves when they arrive, but also help them to see the breadth of opportunities that are available." —*Clarissa Yablinsky, Los Alamos National Laboratory*
- **For Students:** "Too often internship work is a stop gap and not interesting. Learn about the institution first before accepting a position. The better programs will be well-defined, with a statement of work and a problem to solve. The best will provide mentoring and the opportunity to contribute to a project that produces an outcome for the broad organization." —*Paul Prichard, Kennametal*

2. Encourage Students to Find Mentors Who May or May Not Be You

- **For Employers:** "If the student seems to be struggling with what you've assigned, seek out another professional to step in and try to help. Learning styles vary between students, and sometimes someone with a different mentoring approach may be effective for the student." —*Rachel Seibert, Oak Ridge National Laboratory*
- **For Students:** "Prepare an elevator speech about your work and interests. You never know when you may wind up standing next to a prospective mentor or future employer." —*Jonathan Zimmerman, Sandia National Laboratories (moderator)*

3. Value the Student's Mistakes, Mishaps, and Dead Ends as Part of the Learning Process

- **For Employers:** "Invest time up front to determine the student's baseline knowledge. Interns may be reticent to admit where they may have gaps in knowledge or skill, but it's worth your time to figure it out. Their output will be better if interns have a firm understanding of what they're doing from the start." —*Chris San Marchi, Sandia National Laboratories*
- **For Students:** "Some of the best advice I received as an intern was, 'Either focus on exactly what you want to do for the rest of your life or try something completely new and interesting where you can apply your skills.' Many industries and labs are looking for students who have a skill set and the ability to apply it, and not necessarily those students who have a narrow focus." —*Yablinsky*

The Mentoring Best Practices for Interns panel discussion included (left to right): Rachel Seibert, Oak Ridge National Laboratory; Paul Prichard, Kennametal; Chris San Marchi, Sandia National Laboratories (SNL); Garritt Tucker, Colorado School of Mines; Clarissa Yablinsky, Los Alamos National Laboratory; and moderator Jonathan Zimmerman, SNL. Not pictured: Bill Clark, Intel.

Scenes of MS&T

A word, please? TMS members stepped up to the challenge of distilling membership benefits into one word during a photo opportunity in the TMS Member Lounge. On the left: "new beginnings"; on the right: "dynamic."

Attendees had a chance to connect with representatives from 80 companies over three days in the MS&T19 Exhibit Hall. Special events included competitions for students and an Exhibitor Networking Reception, where attendees enjoyed refreshments while making important business contacts.

Akane Suzuki (right), from GE Global Research and the 14th International Symposium on Superalloys organizing committee, presents the 2020 International Symposium on Superalloys Scholarship to Kyle Ventura (left). Ventura, a Ph.D. candidate in materials science and engineering at the University of Florida, is passionate about understanding the root cause of materials performance, and how to change the structure to improve performance. "After earning my Ph.D., I plan to go into industry. I want to be able to apply my education to make a substantial impact in the alloy development and materials selection team of a company. In the long term, I would like to be able to return to academia and teach future materials scientists and engineers about alloy development and how superalloys developed, as well as where they're going in the future," Ventura said.

Hannah Walker (left), a materials science and engineering major at the University of Wisconsin–Madison, receives the 2020 International Symposium on Superalloys Scholarship from Suzuki (right). Walker chose to study materials science for its broad applications. "TMS and Material Advantage have been crucial in helping me explore my academic interests and connect with fellow students and professionals within the materials discipline. I am very grateful to the TMS International Symposium on Superalloys Committee—this scholarship is substantial in the accessibility of my education. After graduation, I'm looking to pursue a graduate degree in materials science and engineering to further broaden my impact in the field," Walker said.

Down the Road and Back Again: Career Advice for Young Professionals

Mentoring for early career professionals continued at the TMS Young Professional Tutorial Luncheon/Lecture featuring speaker Mark Asta, director of the Materials Science Division at Lawrence Berkeley National Laboratory (LBNL) and professor of the Department of Materials Science and Engineering at University of California, Berkeley. Asta's presentation, "Perspectives from a Career Trajectory through the National Labs to Academia (and Back Again)," drew from his own deep and diverse experiences that crossed national laboratories and academia to discuss potential career path with students.

The value of teamwork, both for interdisciplinary strengths and access to mentors and managers, proved to be important aspects of his career. "Good mentors will perceive leadership qualities in you and nurture them," he said.

His work at national laboratories taught him that "no challenge is too difficult; you just have to apply enough people and the right people to a problem." Networking and professional societies became important to his career growth as an early career scientist.

He also discussed some of the difficult decisions along the way, including the choice to leave a coveted position as staff scientist at Sandia National Laboratories in 2000 to pursue a tenured faculty position at Northwestern University.

At universities he not only developed his teaching role but also expanded into course development and grant writing while further developing his management skills.

Asta eventually nudged his career into an executive role as a university administrator, while also returning to research in a director's role at LBNL. At both workplaces, Asta finds fulfillment in mentoring and advising students and early career professionals. "I feel compelled to give back to the organizations that gave me my education along the way," he said.

This tutorial luncheon and lecture was organized by the TMS Young Professionals Committee.

Mark Asta (standing) presents "Perspectives from a Career Trajectory through the National Labs to Academia (and Back Again)" as the featured speaker at the Young Professional Tutorial Luncheon/Lecture on Tuesday, October 1.

TMS Members Honored at MS&T19 (*Assembled by Carol Matty*)

TMS applauds its members who received recognition at MS&T19 for outstanding contributions to their fields from the American Ceramic Society (ACerS) and ASM International.

ACerS 2019 Honors and Awards Banquet
Monday, September 30

2019 Class of Fellows
Kristen H. Brosnan, *GE Global Research Center*

Xingbo Liu, *West Virginia University*

Du-Co Ceramics Young Professional Award
Surojit Gupta, *University of North Dakota*

Robert L. Coble Award for Young Scholars
Jessica A. Krogstad, *University of Illinois, Urbana-Champaign*

W. David Kingery Award
Sanjay Sampath, *Stony Brook University*

2019 Distinguished Life Member
Winnie Wong-Ng, *National Institute of Standards and Technology*

2019 ASM International Awards Dinner
Tuesday, October 1

2019 Class of Fellows
Ravi Chandran, *University of Utah*

Hanchen Huang, *University of North Texas*

Walter W. Milligan Jr., *Michigan Technological University*

Raul B. Rebak, *GE Global Research Center*

Jeffrey M. Rickman, *Lehigh University*

John P. Shingledecker, *Electric Power Research Institute*

James A. Warren, *National Institute of Standards and Technology*

Henry Marion Howe Medal
Peter C. Collins, *Iowa State University*

Hamish L. Fraser, *The Ohio State University*

Santhosh Koduri, *Intel Corporation*

Henry Clifton Sorby Award
Helmut Clemens, *University of Leoben*

Alpha Sigma Mu Lecturer
Diana A. Lados, *Worcester Polytechnic Institute*

TMS/ASM Distinguished Lectureship in Materials and Society
Carolyn M. Hansson, *University of Waterloo, Canada*

Bradley Stoughton Award for Young Teachers
Susan P. Gentry, *University of California, Davis*

J. Willard Gibbs Phase Equilibria Award
Patrice E.A. Turchi, *Lawrence Livermore National Laboratory*

Bronze Medal Award
Danielle L. Cote, *Worcester Polytechnic Institute*

Dharma Maddala, *Arconic Davenport Works*

Silver Medal Award
Cong Wang, *Northeastern University, China*

Gold Medal Award
David N. Seidman, *Northwestern University*

Honorary Membership
Gregory B. Olson, *Northwestern University*

Sharing Experiences and Encouraging Progress: Diversity, Inclusion, and Intersectionality

Broad issues in diversity and inclusion came to light in the Activating Allies: Navigating the Intersectional Landscape of Diversity & Inclusion—Abolishing the "Other"—How Intersectionality Challenges our Current Approaches to Inclusion of People of Minority Identity session on Monday, September 30. The session was sponsored by the TMS Diversity Committee.

Decatur Foster, Portland State University, presented "Ally, Advocate, Accomplice: How Both Knowledge and Action are Vital to Creating Inclusivity within Science," focused on "change the institution, not the student," and encouraged attendees to stretch beyond simply expressing support for people from diverse backgrounds and start taking action against disparities. "Similar to 'alloy,' the Latin root of 'ally' means 'to bind.' Finding commonalities between each other is a positive step, but to bring equity into the workplace, we need to move from being an ally to becoming an accomplice who is complicit in the action," Foster said.

In their talk, "Way Beyond the Bird-Bee Binary: Why Diversity Can Be an Uncomfortable Topic, Who Needs to Start the Conversation, and How to Do It Right," K. "KC" Cunningham, ATI Specialty Alloys & Components, described how divisions in the workplace can exist in a variety of ways, from race and identity issues to blue-collar versus white-collar issues. Being active in ATI's workplace diversity council, KC discussed how to foster inclusion among diverse co-workers and confided their personal struggles of having a non-traditional gender identity. A workplace diversity council may help bridge the divide by organizing events and activities that encourage dialogue and discussions between different groups. "You never know where someone is coming from until you talk about it," KC said, adding that family units need to commit to having tough conversations as well, by applying faith and love in each other and "coming from a place of humility."

Carol Handwerker, Purdue University, and Melissa Reeves (who presented in place of her colleague Shaik Jeelani), Tuskegee University, rounded out the session with an exploration of a successful collaborative fellowship program between Purdue University and Tuskegee University in their talk, "Building Sustainable Partnerships between Historically Black Colleges and Universities (HBCUs) and Majority, Research-Intensive Universities." Handwerker and Reeves described Sustainable Electronics, an action-based graduate program funded by an NSF Integrative Graduate Education and Research Traineeship (IGERT) grant. The collaboration included students from Purdue University, a major research university, and Tuskegee University, an HBCU, along with learning experiences with the Indian Institute of Management in Udaipur, India, and the International Electronics Manufacturing Initiative (iNEMI) electronics industry consortium.

The presentation explored what makes a lasting collaboration that grows beyond one grant cycle and showed that success is achieved with an emphasis on the people, common goals of the programs and universities, and a mutual respect between the partners. "This collaboration has been one of the most gratifying things I have ever done, where I formed relationships with new colleagues and was able to apply our talents above and beyond the call of duty," Handwerker said.

Carol Handwerker, Purdue University, presents "Building Sustainable Partnerships between Historically Black Colleges and Universities (HBCUs) and Majority, Research-Intensive Universities," on Monday, September 30, during MS&T19.

Decatur Foster (left), Portland State University, and K. Cunningham (right), ATI Specialty Alloys & Components, both participated in the Activating Allies: Navigating the Intersectional Landscape of Diversity & Inclusion—Abolishing the "Other"—How Intersectionality Challenges Our Current Approaches to Inclusion of People of Minority Identity session.

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LEARN FROM THE PAST FOR A SAFER TOMORROW:

A Preview of Safety Congress 2020

Roland Moreau

Roland Moreau

New applications of data and technologies are increasing profitability and productivity while making safer workplaces. Across industries, innovators are mitigating risks and ultimately saving lives by putting new practices in place, such as the use of structured management systems to improve processes, and automation and robots to remove workers from dangerous situations. To join the conversation, I hope you plan to attend the inaugural Congress on Safety in Engineering and Industry 2020 (Safety Congress 2020) that is set for June 21–24, 2020, in Philadelphia, Pennsylvania.

Safety Congress 2020 is the first combined effort of eight professional societies and the National Academies to collaborate on safety successes and challenges, with representatives from each of these organizations actively serving on the program committee to plan the event. The United Engineering Foundation also has provided tremendous support to ensure its success.

Speakers are recognized experts representing the cross-section of disciplines of the partnering societies. Commonalities among all sectors present a basis for our keynote topics and plenary sessions: The Importance of Safety and Value of Networking across Sectors; The Value Proposition for Safety; Executing an Effective Risk Management Program; The Role of Technology & Innovation in Improving Safety Performance; and Leading the Future of Safety by Learning from the Past.

The keynote and plenary sessions will introduce concepts and provide context for the breakout sessions, where attendees will explore safety issues in depth. Through collaboration and discussions, we will lay the groundwork to put new best practices in place, as well as to effectively avoid previous challenges that should be left in the past.

CROSS-SECTOR COLLABORATION

The combined efforts of the following organizations will provide attendees with unique networking and learning experiences.

Sponsoring Societies:

AIME American Institute of Mining, Metallurgical, and Petroleum Engineers
AIST Association for Iron & Steel Technology
SME Society for Mining, Metallurgy & Exploration
SPE International Society of Petroleum Engineers
TMS The Minerals, Metals & Materials Society

Co-Sponsoring Societies:

AIChE The Global Home of Chemical Engineers
ASCE American Society of Civil Engineers
ASME Setting the Standard
The National Academies of SCIENCES ENGINEERING MEDICINE

Safety Congress 2020 is made possible with generous support from the United Engineering Foundation.

Why Safety, Why Now

For many years, regulators have required reporting of major incident data, and many industry associations have had various systems for collecting and sharing data related to major incidents. Given that all industries are subject to a certain level of regulatory-required safety incident reporting, a wealth of information is available stemming from non-reportable events, such as near misses, stop-work situations, and low-probability/high-consequence events.

Many companies have good internal systems for capturing and analyzing these data, but few opportunities have been pursued to share their knowledge based on the perception that the challenges faced by each industry are unique. Most practices in safety and risk management are not proprietary, and so they may be readily shared.

Successful approaches can be applied to different industry settings to improve safety overall. All industries, for example, implement practices for personnel and process safety, risk assessment and management, and the use of management systems and data analysis to guide decision making. It is also important to prepare university students prior to entering the workforce. Both academics and practitioners will bring their perspectives to bear at Safety Congress 2020.

This event will showcase safety management successes, address challenges, and provide networking opportunities to share experiences. The cross-sector audience creates a new environment for discussing case studies and identifying areas for collaboration on safety initiatives that fall outside the participants' normal spheres of influence.

Anticipated Highlights

Prominent speakers will share their perspectives, including a speaker from the National Safety Council's Campbell Institute, key regulator representatives from the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration (MSHA), and university faculty.

Given NASA's expertise to ensure safety in all aspects of space flight, our opening keynote address will be delivered by former astronaut Jim Wetherbee, retired, U.S. Navy. Wetherbee has commanded five spaceflight missions and offers insights into dangerous businesses. He is the author of *Controlling Risk—In A Dangerous World*.

Chris Hart will deliver the dinner keynote address. He is a former member and chair of the National Transportation Safety Board (NTSB), chair of the Washington Metrorail Safety Commission, and founder of Hart Solutions LLC. Hart was instrumental in establishing the Airline Safety Reporting System (ASRS).

The breakout session on Safety Through Engineering Design will explore safety in the development and application of new technology and will be moderated by Robert Sims, a senior engineering fellow at Becht Engineering. The session's panelists include Gene Feigel, vice president of risk analysis at Hartford Steam Boiler Inspection and Insurance Company; Ken Balkey, retired director of Westinghouse Electric Company's Nuclear Engineering Program; John Gambatese, professor of civil and construction engineering at Oregon State University; Mihai Diaconeasa, assistant professor of nuclear engineering at North Carolina State University; and Mohammad Pourgal-Mohamad, senior staff engineer at Johnson Controls Inc.

Other breakout sessions—such as Leadership Development; Integration of Safety in Regulatory Frameworks; Incident Investigation; Interfacing Workers and Machinery in an Industrial Environment; The Role of More Effective Data Management; Risk Identification and Tolerance; and more—are detailed in the Program section of the congress website at www.safetycongress.org.

Make Your Plans

Can you think of an industry where safety is not considered a high priority? I believe that a challenge for most industries and companies may be how to effectively learn from the past. So, I am hoping that this event will allow participants to equally share successes and challenges with the objective of everyone collaborating and partnering to make the work environment safer, including at the university level. Start making plans to join this conversation by visiting www.safetycongress.org for details. The new year is a time for commitments, and few are more worthwhile than one to safety.

Roland Moreau is the program chair of Safety Congress 2020, a trustee on the board of the United Engineering Foundation, and retired safety, health, and environment manager in the Upstream Research, Gas & Power Marketing and Upstream Ventures business units at ExxonMobil. Moreau was also the 2018 president of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) and former board director for the Society of Petroleum Engineers.

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Gaining Global Perspective at EUROMAT 2019

A TMS/FEMS International Scholar Report

Jennifer L.W. Carter

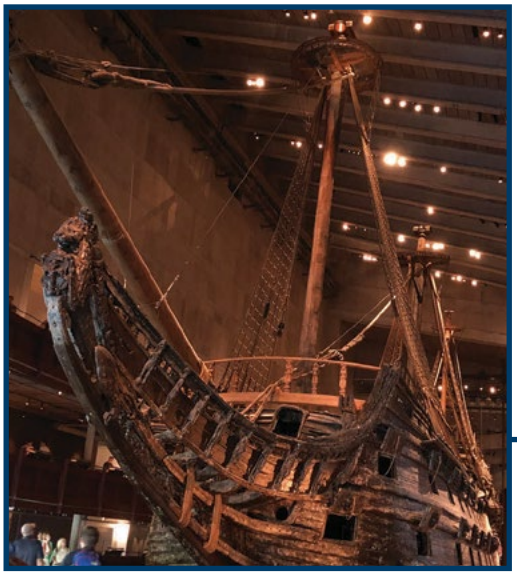
Jennifer Carter, 2019 TMS/FEMS Young Leaders International Scholar, stands at the City Center the day before EUROMAT 2019 technical sessions begin, admiring murals depicting Swedish scenes of life.

It was an honor to be selected by TMS as the 2019 TMS/Federation of European Materials Societies (FEMS) Young Leaders International Scholar. The TMS Foundation provided financial support for me to participate in the European Congress and Exhibition on Advanced Materials and Processes (EUROMAT 2019), held September 1–5, 2019, in Stockholm, Sweden. This biennial event brings together scientists and engineers from around Europe (and beyond) to discuss the research and developments in the materials community. This year's plenary talks focused on the materials research that will lead to more sustainable societies: battery technologies, high-strength steels, and bio-inspired robotics. The talks and discussions left me with hope and optimism that if we work in international teams it is possible to solve our sustainability challenges even when the U.S. is reducing its focus on the topic (16% drop in U.S. Department of Energy funding for the fiscal year 2020).[1]

This opportunity provided me a global perspective on our field that I had not appreciated from attending TMS annual meetings. Though we pride ourselves on being an international organization (in 2018, 39% of our membership was non-U.S.),[2] I was taken aback by my feelings of being a minority outsider. I have been an active volunteer with TMS since 2006, I understand how the Society works, and I have gotten used to feeling like a member of a larger community. My participation in EUROMAT activities reminded me that at the next conference I should reach out and say hello to someone new every day, and not live in my own bubble of influence. The experience reminded me that the surprise meetings in the hallway during breaks really are an opportunity to discuss mutual interests and build new collaborations.

I gave two talks at EUROMAT focused on the application of data science to integrate novel approaches to explore the physics of microstructural evolution with the goal to inform the design of processing routes of metals for extreme environments. My contributed talk presented an algorithm for quantifying nanoscale precipitates in superalloy 718 using high-resolution SEM imaging.[3] My invited talk discussed the validity of assumptions from models gleaned from smaller datasets by expanding these models to the larger alloy design space of 9–12 wt% Cr steels needed for advanced ultra-supercritical (A-USC) power plants. This work was an international effort relying on the cultivation and exploration of a database from Japan and the National Energy Technology Laboratory (NETL), and the application of creep models from the United Kingdom and China.[4] Both talks were well-received and spurred interesting conversations on how to choose the appropriate data analytic tool (i.e., conventional big-data statistics or artificial intelligence) for studying a particular scientific/engineering question.

During my time at EUROMAT, I also participated in the scheduled lunchtime discussions on issues surrounding gender inclusion in the fields of materials science. I had always wondered if our European counterparts had it "better," as universal healthcare and paid paternity leave can make it seem like a "greener pasture" for gender equality. The discussions left me with the feeling that the issues surrounding the leaky pipeline and inclusion of gender minorities at all levels of the profession are a universal issue. I left proud of the work that TMS and the Diversity Committee have done to enable an inclusive environment at TMS annual meetings. TMS and FEMS are not going to single-handedly change pervasive issues that cause women and minorities to leave the professions, but we can continue to enact change and policies that promote an inclusive society. I am proud to be a member of TMS and will continue to volunteer to promote the Society's strategic goals. **(Editor's note: For more details on the TMS strategic goals, visit www.tms.org/StrategicGoals.)**



This 17th century Vasa ship, which Carter saw during EUROMAT's conference dinner at the Vasa Museum, is preserved with polyethylene glycol to replace the extracted water from the wooden timbers. It is kept in a climate-controlled room possible of maintaining constant temperature and humidity and has hundreds of visitors each day.

Carter (left) and her husband, Robert (right), spent an afternoon at Drottningholm Palace, an exquisite example of separation of material form from function; all the facades in the palace were painted to look like marble, but were really wood and plaster replicates.

Of course, no travel to a new city would be complete without taking the time to explore local culture and history. I find that international travel always reminds me that the U.S. experiment in democracy has been short on a global political scale. In Stockholm, the history that I experienced was ripe with opportunities to explore how the materials of our world have shaped our existence. The EUROMAT conference dinner was held at the Vasa Museum, which houses the world's best-preserved 17th century ship. It sank on its maiden voyage because shipbuilders had not worked out the mechanics of stability for a double-decker sailing vessel. The development of materials and processing techniques to dry out and preserve this wooden vessel were fascinating, while the missing metal and textile components (like all historical preservation projects) reminded me that without human intervention the infrastructure developed today will not survive tomorrow.

We also took a ferry ride to Drottningholm Palace, one of the private residences of the Swedish royal family. Though French architecture was the style in the 1600s for royal residences, the Swedish royal court was not as rich as the French court. Therefore, they faked the opulence of the French architecture and style by painting the walls and banisters in the great hall to look like marble. It was a beautiful example of stage magic to set the mood and an example of materials selection to separate form from function.

Endnotes

1. "FY20 Budget Request: DOE Office of Science" (American Institute of Physics, 2019), https://www.aip.org/fyi/2019/fy20-budget-request-doe-office-science. Accessed 10 September 2019.
2. "Establishing Aspirations: The 2018 TMS Annual Report," *JOM*, 71, 3759, (2019). https://doi.org/10.1007/s11837-019-03818-9
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Jennifer L.W. Carter is an assistant professor in the Department of Materials Science and Engineering at Case Western Reserve University. She is also the recipient of the 2014 Structural Materials Division Young Leaders Professional Development Award.

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JOM themagazine

TMS meeting headlines

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

Other Meetings of Note

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

Offshore Technology Conference (OTC 2020)
May 4–7, 2020
Houston, Texas, USA

The 11th International Conference on Molten Slags, Fluxes and Salts (Molten 2020)
May 25–29, 2020
Seoul, South Korea

The 5th International Congress on 3D Materials Science (3DMS 2020)
June 28–July 1, 2020
Washington, D.C., USA

The 12th International Conference and Workshop on Numerical Simulation of 3D Sheet Metal Forming Processes (NUMISHEET 2020)
July 19–24, 2020
Toronto, Ontario, Canada

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

12th International Conference on Magnesium Alloys and their Applications (Mg 2021)
June 15–18, 2021
Montreal, Quebec, Canada

Materials in Nuclear Energy Systems (MiNES 2021)
September 19–23, 2021
Pittsburgh, Pennsylvania, USA

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
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www.tms.org/TMS2020

- John Mason of Solar Turbines Incorporated will present "Leveraging Materials Innovation to Drive Industrial Gas Turbine Performance and Secure a Sustainable Future" at the All-Conference Plenary on Monday, February 24.
- Global speakers from Canada, New Zealand, Norway, and the U.S. will discuss the next generation of technical talent at the Light Metals Keynote session.
- Attendees in most registration classes will receive free online access to eleven proceedings volumes.

Congress on
SAFETY 2020
in Engineering and Industry

June 21–24, 2020
Philadelphia Marriott Downtown
Philadelphia, Pennsylvania, USA
Discount Registration Deadline: May 11, 2020
www.SafetyCongress.org

- Former NASA astronaut and U.S. Navy captain Jim Wetherbee will deliver the opening keynote, "Controlling Risk in a Dangerous World."
- Speakers from Boeing, GE, IBM, NASA, the National Institute of Standards and Technology, and more will discuss safety's value proposition, risk management, innovation, and lessons learned in plenary talks each day followed by breakout sessions with other experts.
- Stay at the Philadelphia Marriott Downtown for convenient access to congress activities and sessions. Book by May 29, 2020, for the best rates.

ICTP 2020

July 26–31, 2020
The Ohio State University
Columbus, Ohio, USA
Discount Registration Deadline: June 15, 2020
www.tms.org/ICTP2020

- The 13th International Conference on the Technology of Plasticity (ICTP 2020) brings together colleagues across industry, academia, and government to discuss all aspects of metal forming science and technology.
- Eight keynote speakers will present their latest improvements and innovations covering the focal points of global issues, simulation, materials, and innovation. Learn more about the ICTP 2020 keynote session, as well as honorary symposia planned for this conference, on the Technical Program page of the website.

MS&T20
MATERIALS SCIENCE & TECHNOLOGY

October 4–8, 2020
David L. Lawrence Convention Center
Pittsburgh, Pennsylvania, USA
Abstract Submission Deadline: March 15, 2020
www.matscitech.org/MST20

- Materials Science & Technology 2020 (MS&T20) offers an impactful, cross-disciplinary showcase for your latest work and invaluable opportunities to network with colleagues. Be a part of one of the most extensive MS&T technical programs yet. Submit your abstract to one of the approximately 100 symposia planned for MS&T20 by March 15, 2020.
- Stay in the loop on MS&T20—sign up to receive e-mail updates on technical programming, registration, professional development courses, and other details at www.matscitech.org/MST20.

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JOM themagazine Classifieds

Whether you are seeking a new job opportunity or needing to fill an open position, the *JOM* Job Board provides companies, academic institutions, and other organizations with a valuable resource to post and search for job openings. For $125 per column inch, your ad can be posted, searched, and viewed by thousands of qualified candidates. Questions on placing a *JOM* classified advertisement?

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Opportunities for Recognition: TMS Awards Program Seeks Nominees

Help us to recognize excellence at all career levels and in all technical areas of minerals, metals, and materials science and engineering. Nominations for TMS Society and Division awards are due **April 1, 2020**. Awardees will be recognized at the TMS 2021 Annual Meeting & Exhibition.

Learn which awards are accepting nominations at www.tms.org/Awards

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call for papers

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

July 2020
Manuscript Deadline: February 1, 2020

Topic: Characterization of Amorphous Materials

Scope: Characterization of amorphous materials is quite challenging as compared to their crystalline counterpart. In this respect, this topic will include but is not limited to characterization of amorphous solids and possibly liquids using advanced analytical techniques such as electron microscopy, x-ray radiation, thermal analyses, spectroscopy, atom probe tomography, etc. Particular emphasis will be paid to less known characterization techniques used for amorphous materials such as fluctuation electron microscopy/x-ray scattering.
Editors: Yunus Eren Kalay, Rajiv Soman, and Zhiwei Peng
Sponsor: Materials Characterization Committee

Topic: Machine Learning Applications in Advanced Manufacturing Processes

Scope: Machine learning holds tremendous promise for revolutionizing modern manufacturing, from conventional operations to new advanced manufacturing processes, such as additive manufacturing. This special topic focuses on reducing waste, energy usage and carbon emissions, and spurring innovation in materials development and production. Advances in digital manufacturing, process control, predictive maintenance, and automation can be realized by integration of data analytics and validated models to ensure product quality, optimize operations, enhance productivity, and improve efficiency.
Editors: Donna Guillen, Judy Schneider, and Srikanth Patala
Sponsors: Energy Committee, Additive Manufacturing Committee, and Computational Materials Science and Engineering Committee

Topic: Recycling Silicon and Silicon Compounds

Scope: Silicon and silicon compound recycling is needed for a cleaner and greener environment. These materials can be reused in the manufacturing of solar cells and panels and other industries such as electronic industries. The scope of this special topic is concerned with recycling of all types of silicon, silicon products, and silicon compounds including silicon wafers, silicon poly chunk, IC grade, ingots, IC flakes, etc.
Editor: Shadia Ikhmayies
Sponsor: Recycling and Environmental Technologies Committee

Topic: Thermodynamic Modeling of Sustainable Non-Ferrous Metals Production

Scope: Conventional metallurgical processes were developed when complexity of resources and environmental impacts were not issues. Today, these issues need to be addressed through designing more efficient processes that enable a sustainable future. Papers covering experimental investigations, thermodynamic modeling, metallurgical process optimization, resource efficiency and environmental issues, particularly those pertaining to non-ferrous metallurgical processes, are invited. Manuscripts intended for a broad readership and review papers are especially encouraged.
Editors: Fiseha Tesfaye, Allie Anderson, and Mingming Zhang
Sponsors: Process Technology and Modeling Committee and Recycling and Environmental Technologies Committee

August 2020
Manuscript Deadline: March 1, 2020

Topic: Additive Manufacturing for Energy Applications (By Invitation Only)

Scope: This invited topic will feature manuscripts based on experimental and computational approaches in the following topic areas

- Processing-microstructure-property relationship of AM fabricated materials for structural components in energy sectors
- In-situ sensor development and in-situ processing and characterization
- Advances in AM design methodologies, new material designs and AM techniques

- Modeling and simulations for design of high-performance AM fabricated materials
- Qualification approaches
- Economic advantages: Case studies

Only papers presented at the Additive Manufacturing for Energy Applications II symposium at the TMS 2020 Annual Meeting & Exhibition will be considered for this topic.
Editor: Isabella van Rooyen
Sponsors: Additive Manufacturing Committee and Nuclear Materials Committee

Topic: Additive Manufacturing: Beyond the Beam Technology (By Invitation Only)

Scope: This invited topic will explore the print process and post-print processing variables of non-beam solid-state print technologies, which determine properties, application performance, and economics and enable component functionality. These processes include but are not limited to: binder jetting, material extrusion, filament processing, nano-inkjet printing and sintering.
Editors: Paul Prichard, Peeyush Nandwana, Matt Dunstan, James Paramore, and Kathy Lu
Sponsors: Powder Materials Committee and Additive Manufacturing Committee

Topic: Advanced Processing and Additive Manufacturing of Functional Magnetic Materials

Scope: Papers are invited on advanced processing and advanced manufacturing of functional materials with particular emphasis on magnetic materials. In particular, papers addressing permanent magnets, magnetocaloric materials, soft magnets, magnetic shape memory alloys, and multiferroics are welcome. Additive approaches to similar classes of functional materials are invited as well.
Editors: Scott McCall and Ikenna Nlebedim
Sponsor: Magnetic Materials Committee

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.
Editor: Vilupanur Ravi
Sponsor: Corrosion and Environmental Effects Committee

Topic: Metal Matrix Composites: Analysis, Modeling, Observations and Interpretations (By Invitation Only)

Scope: This invitation-only topic will present papers from the symposium Metal Matrix Composites: Analysis, Modeling, Observations and Interpretations, at the TMS 2020 Annual Meeting & Exhibition. The goal of this special topic is to publish papers representing developments in the analysis, modeling, and observations of metal matrix composites.
Editors: T.S. Srivatsan and W.C. Harrigan Jr.
Sponsors: Composite Materials Committee and Mechanical Behavior of Materials Committee

Topic: Metastable Phases and Phase Equilibria (By Invitation Only)

Scope: Invited authors will provide original research submissions on next-generation alloys enabled by the design and control of metastable phases. In these alloys, outstanding properties are achieved through a combination of carefully tailored chemical composition and thermal processing. Examples include metastable austenite in TRIP, TWIP and Q&P steels, beta-stabilized titanium alloys, gamma double prime precipitates in nickel superalloys, high entropy alloys, and spinodal decomposition during aging of aluminum alloys.
Editors: Gregory Thompson, Raj Banerjee, Eric Lass, and Bij-Na Kim
Sponsors: Phase Transformations Committee and Additive Manufacturing Committee

September 2020
Manuscript Deadline: April 1, 2020

Topic: Aluminum: Recycling and Carbon / Environmental Footprint

Scope: This topic covers recycling of aluminum (and its alloys), as well as mitigating the carbon footprint and/or environmental ramifications of both primary and secondary aluminum production.
Editors: David S. Wong and Anne Kvithyld
Sponsors: Aluminum Committee and Recycling and Environmental Technologies Committee

Topic: High Temperature Processing of Complex Ores (By Invitation Only)

Scope: Invited papers only will be published in this topic covering pyrometallurgical processes developed to recover metals from complex ores. The term complex refers to multi-metal sulfide resources, which often present inclusions and intricate structural or alteration patterns. Also included are orebodies such as multi-metal oxide ores that complicate processing due to the diversity of minor elements they contain. This topic will present a state-of-the-art picture of the high-temperature processing of complex ore, from historical to best available technologies.
Editors: Leili Tafaghodi, Camille Fleuriault, and Joseph Grogan
Sponsor: Pyrometallurgy Committee

Topic: Materials Research in Reduced Gravity

Scope: Reduced-gravity experiments can isolate phenomena otherwise obscured in ground-based experiments, leading to new discoveries that can improve materials and processes. Ground-based facilities for reduced-gravity experiments include drop tubes and towers that provide seconds of reduced gravity, aircraft that provide tens of seconds, and suborbital rockets that provide hundreds of seconds. Manuscripts are solicited in all areas of materials research employing reduced gravity, including crystal growth, containerless processing, materials processing and properties, and experimental facilities for materials research.
Editors: Douglas M. Matson, Robert W. Hyers, Michael Sansoucie, Jonghyun Lee, and Shaun McFadden
Sponsors: Process Technology and Modeling Committee and Solidification Committee

Call for Nominations
THE BRIMACOMBE PRIZE

The (CDN) $20,000 Brimacombe Prize will be awarded in 2020 for outstanding accomplishments in materials process engineering. The award is being presented in memory of **Dr. J. Keith Brimacombe**, an innovative giant in this field during the 20th century. Individuals or a team from academia, industry, or government may be nominated by an individual or institution. There are no age restrictions with respect to the nominee(s), and the prize is international.

Previous winners of the Brimacombe Prize include:

2010: Seshadri Setharaman, *Royal Institute of Technology, Stockholm, Sweden*

2012: Jonathan Dantzig, *University of Illinois, Urbana, USA*

2014: Michel Rappaz, *École Polytechnique Fédérale De Lausanne, Switzerland*

2016: Robertus Boom, *Delft University of Technology, The Netherlands*

2018: John Grandfield, *Grandfield Technolgy, Victoria, Australia*

Selection Criteria

The prize will be awarded for a single or sustained contribution to materials process engineering deemed outstanding. The work should demonstrate a high degree of creativity, imagination and engineering/scientific depth. Evidence of significant scientific or industrial impact will be an important measure of eligibility for the award. The following characteristics, which are well known of Dr. J. Keith Brimacombe, form an important set of criteria for the prize:

(1) Research Excellence and the Creation of New Insight

- Examines questions of practical importance and has impact relating them to real processes.
- Applies the best scientific methodology and academic rigor to his/her work.
- Pioneers, applies and integrates all of the research tools at our disposal to generate new knowledge that contributes to the "big picture."
- Disseminates research results to freely share important insights through widely published papers, patents and short courses.

(2) A World Ambassador

- A technical communicator who travels to any part of the world to teach university scholars, operators, technology and management groups in industry and universities.
- An international leader who associates with and influences other international leaders.
- A statesman who respects others, leads by example and sees the potential in the person regardless of origin or status.
- A teacher and friend.

(3) An Innovator and Visionary for a Better Global Society

- Demonstrates by his/her own work and leadership that science and technology are linked to the betterment of modern society and has significantly demonstrated successes in science and technology based on his/her innovation and shared knowledge.
- Goes beyond traditional boundaries in the discipline, whether academic, operational or management in materials processing; articulates and succeeds in technology transfer involving many complex issues: funding, politics, philosophical aspects, decision making and real engineering issues.
- Makes distinguished contributions to the knowledge of metallurgical processes, and with vision and determination, communicates this for a better world, sometimes against "conventional wisdom."
- Recognizes the importance of the role of professional societies on the national and international scene, and integrates technical contributions with leadership and vision to share knowledge and advance technology through professional societies as a vanguard to spreading new knowledge and "breaking down walls."

Further information is posted at http://brimacombecourse.org/prize.html.

Nomination Procedure

Nominations should include the individual's current curriculum vitae and summary describing the following:

- Nominee's achievements and contributions and how they relate to the selection criteria.
- Significance or impact of the achievement(s) in the field.
- Role of each individual in a team effort.

The nomination should also include names and addresses of five people who could provide an assessment of the nominee's eligibility for the award. Also include telephone, fax number and e-mail address for the references. Nominations will remain effective for three successive competitions. The selection committee may seek input from references other than the list provided by the nominee.

Deadline for Receiving Nominations is January 31, 2020.

Send nomination package to:
Prof. B.G. Thomas
Dept. of Mechanical Engineering
Colorado School of Mines
1610 Illinois St.,
Golden, CO USA 80401
or email to
bgthomas@mines.edu

The winner(s) will be announced in the summer of 2020.

Donors

The Brimacombe Prize is funded through an endowment of the Brimacombe Foundation. Contributions from donors are gratefully acknowledged.

Contributions may be sent to:

Brimacombe Foundation, c/o University of British Columbia, Materials Engineering Dept., 309-6350 Stores Rd., Vancouver, BC, Canada V6T 1Z4

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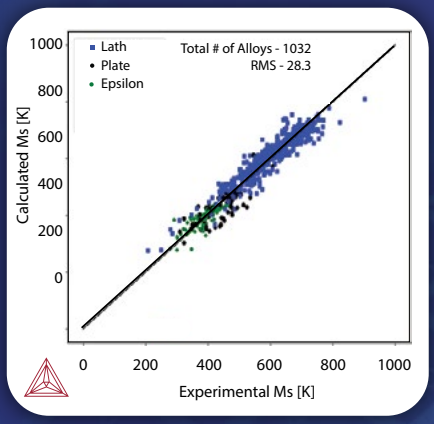
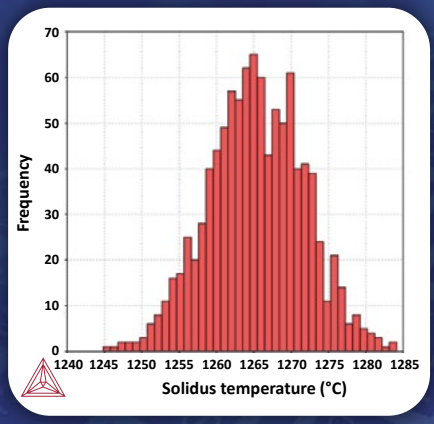


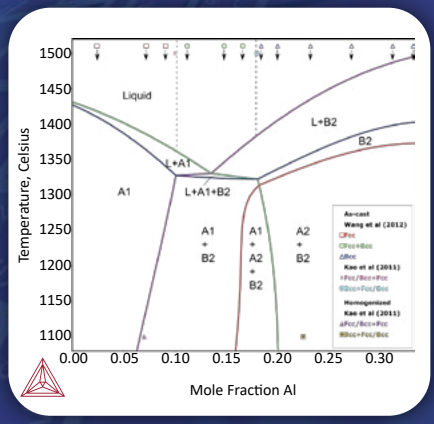
Comparison of calculated and experimental Ms temperatures for a wide range of steels

Nickel



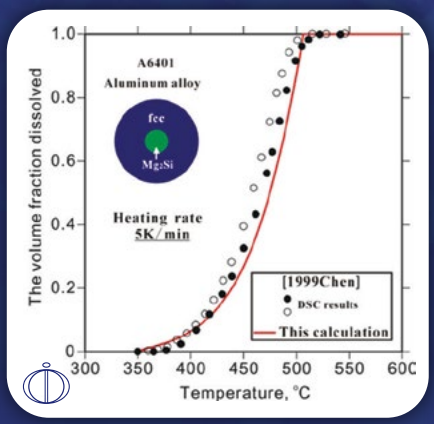
Variation in solidus temperature over 1000 compositions within alloy 718 specification

High Entropy Alloys



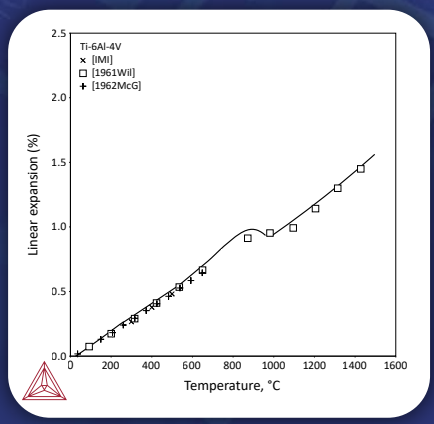
Calculated phase diagram along the composition line of CoCrFeNi-Al

Al Alloys



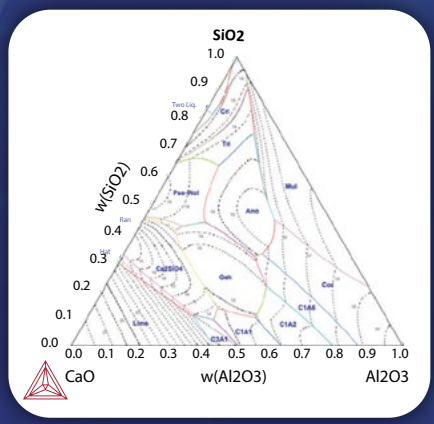
Dissolution of Mg2Si precipitate in Alloy A6401

Ti and TiAl Alloys



Linear expansion vs Temperature for Ti-6Al-4V

Oxides



Ternary liquidus projection in oxide systems

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