JOM

OCTOBER 2021
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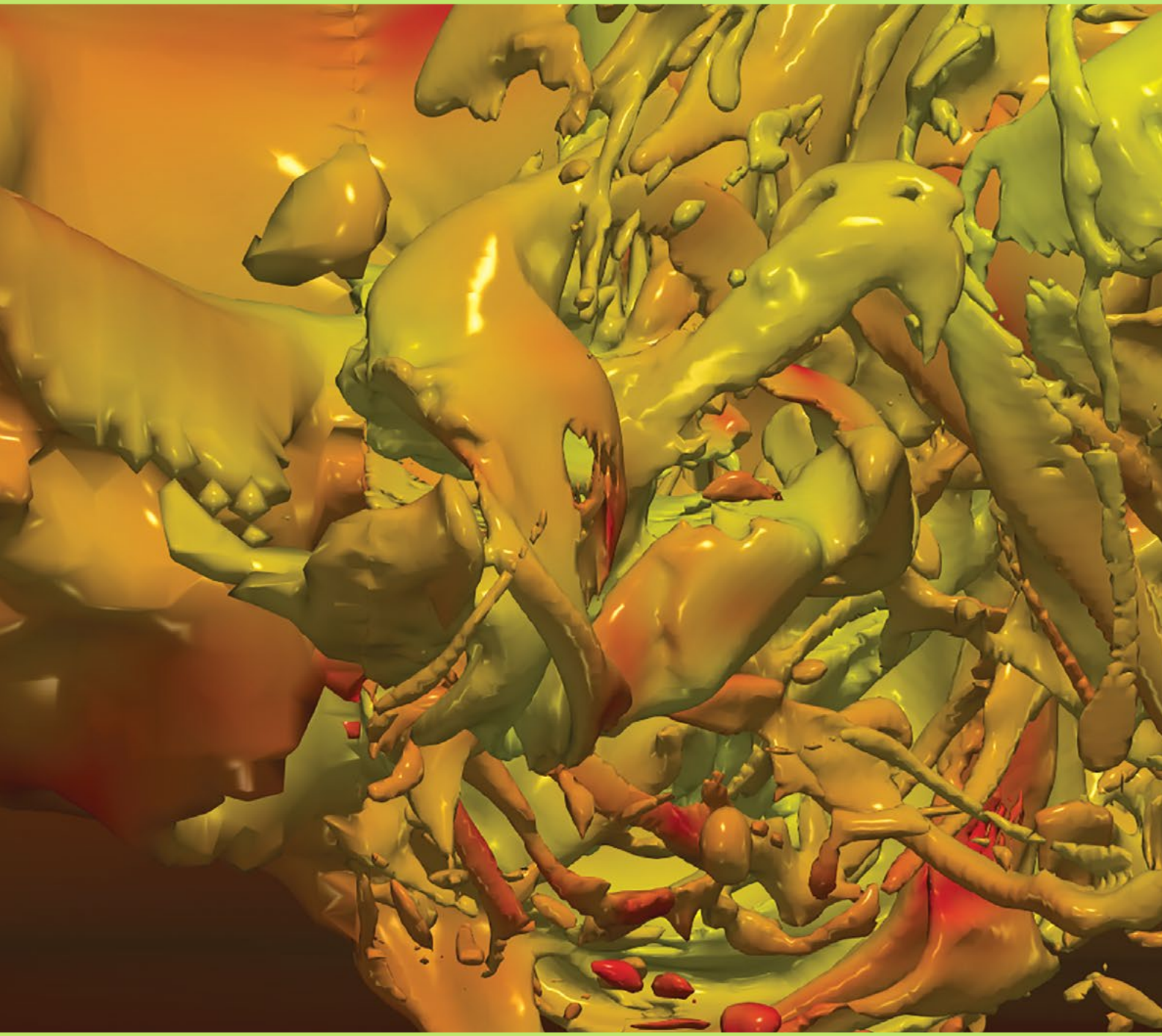
An official publication of The Minerals, Metals & Materials Society

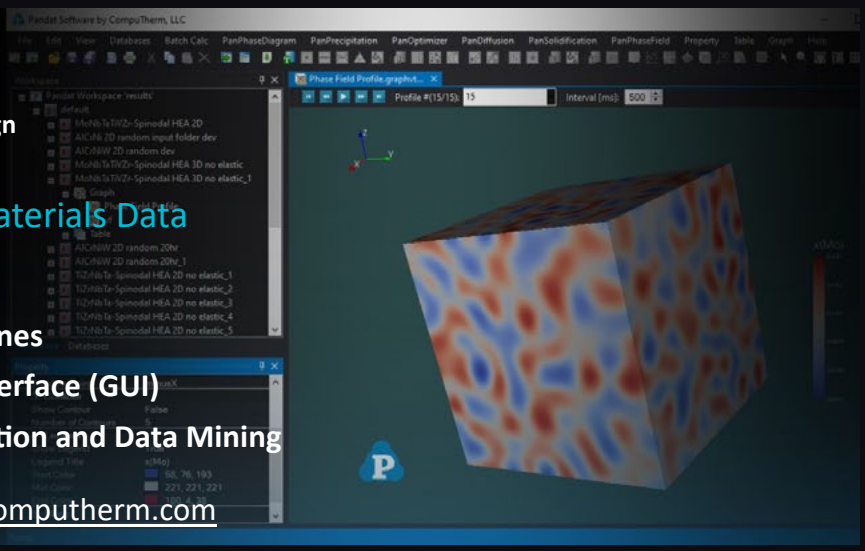


STAY CONNECTED: Preview a New Member Benefit with Ellen Cerreta

TMS Springer

Pandat Software

An Integrated Modeling Platform for Materials Design



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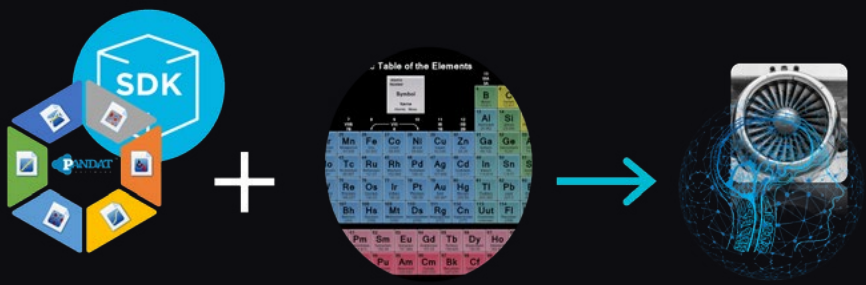

Pandat Software + **PanDatabases** → **ICME & MGI Applications**

Al – based alloys
Co – based alloys
Cu – based alloys
Fe – based alloys
Mg – based alloys
Ni – based alloys
Ti – based alloys
TiAl – based alloys
Refractory alloys
High-entropy alloys
More…

Pandat Software Modules

Pandat Software adopts modular design and enables users to easily switch between modules and perform various types of simulations in the same workspace.

PanPhaseDiagram

- stable and meta-stable diagrams
- property contour diagrams
- thermodynamic properties
- chemical driving force

PanPrecipitation

- concurrent nucle-ation, growth and coarsening
- particle size and size distribution
- multi-phase co-precipitation

PanDiffusion

- diffusion couple
- homogenization
- carburization and decarburization
- particle dissolu-tion

PanSolidification

- solidification path
- back-diffusion in the solid
- dendrite arm coarsening
- micro-segregation

PanPhaseField

- direct coupling with CALPHAD
- feasible for multi-component alloys
- open architecture for user's model plugin

JOM

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TMS Springer

About the Cover

In "Toward Multiscale Model Development for Multiphase Flow: Direct Numerical Simulation of Dispersed Phases and Multiscale Interfaces in a Gas-Stirred Ladle" Qiang Li and Petrus Christiaan Pistorius investigated the dispersing phases – gas bubbles and slag droplets – and interface profiles are directly visualized by the DPR-DNS-VoF method. The cover image shows slag droplet generation. The view is radially from the center of the vessel to the edge of the slag eye.

October 2021 Guest Editors

Additive Manufacturing: Functionally Graded Alloys
Additive Manufacturing Committee
Somayeh Pasebani, Oregon State University

Computational Modeling in Pyrometallurgy
Pyrometallurgy Committee
Quinn Reynolds, Mintek
M Akbar Rhamdhani, Swinburne University of Technology

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.

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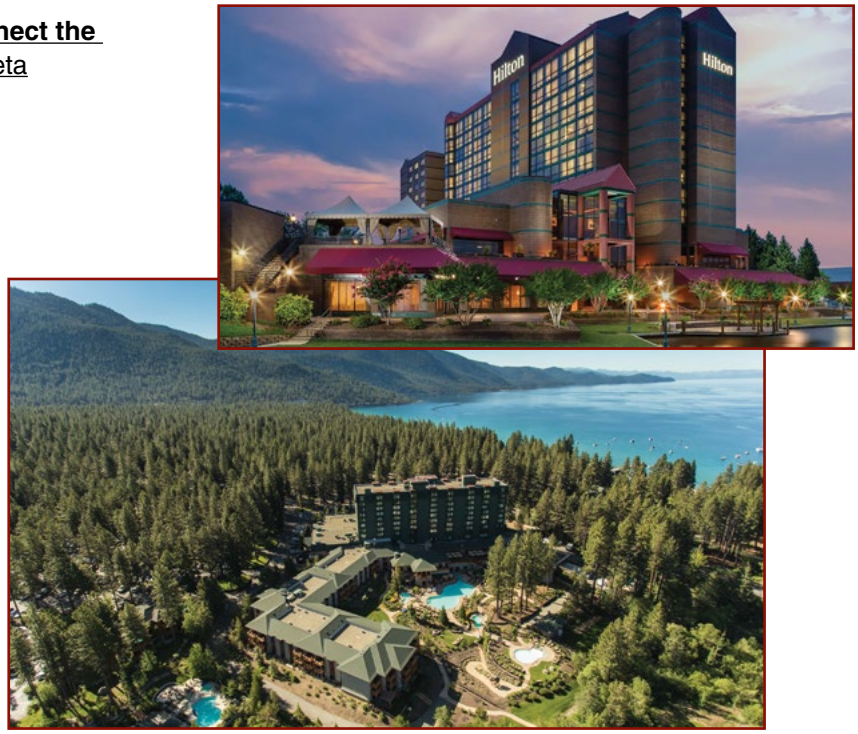
JOM: THE MAGAZINE



JOM: THE JOURNAL

Additive Manufacturing: Functionally Graded Alloys

Computational Modeling in Pyrometallurgy

Technical Articles

Correction

STAY CONNECTED TO YOUR TMS COMMUNITY:

TMS
The Minerals, Metals & Materials Society

RENEW YOUR MEMBERSHIP TODAY FOR 2022

Renew your TMS membership through December 2022 to:

- Maintain access to the technical information and online learning you need to succeed
- Stay active on a TMS technical or functional committee or join a new one
- Register for the TMS 2022 Annual Meeting & Exhibition at the discounted member rate

Continue to grow your network and share your knowledge with TMS members around the world -- renew today!

NEW FOR 2022

Beginning in January, every TMS member will also receive a print copy of *JOM*: *The Magazine* in their mailbox. This publication will include news from your colleagues, the industry, and the Society. You'll also receive continued access to *JOM* technical articles by logging in to the TMS website at **www.tms.org/Journals**.

Renew Today at members.tms.org

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in the final analysis

JOM
Volume 73
Number 10
October 2021

"Every book you pick up has its own lesson or lessons, and quite often the bad books have more to teach than the good ones."

—Stephen King

James J. Robinson
Executive Director
@JJRofTMS

I'm an avid reader, so I've read a lot of books, good and bad. That includes 20 or so Stephen King titles since 1976. If you've ever walked past an airport newsstand, you know that King's 70-ish titles generally fall within the broad category of horror fiction. Scary stuff, but after a year and a half of COVID-19, many of our definitions of what is scary have changed. If the pandemic was a book, it would be a tragically bad one—mishandled beginning, chaotic midsection, and indeterminate and clumsy ending. Yet, within that dreadful book would be many lessons for apt pupils. For example, I have learned that . . .

. . . Science is a life saver: Literally. Yes, this is not a new lesson, but it is one that we cannot repeat enough. All hail to a science community that mustered a remarkable and remarkably effective response to an unprecedented challenge. There were great successes against minor missteps—lightning-fast responses and superior efficacy in confronting a dangerous and unduly politicized global health problem. Wow.

. . . Flexibility is everything: In "To a Mouse," Scottish poet Robert Burns enduringly wrote, "The best laid schemes o' mice an' men | Gang aft a-gley." Every "a-gley" or "awry" moment provided a rapidly shifting landscape that demanded a willingness to quickly abandon plans that were months or years in the making, the ability to make critical decisions in nanoseconds, and a reservoir of patience to do the same again and again and again.

. . . We live in a brave new "Zoom" world: In the "before times," we knew intellectually that we had the capability to meet virtually, but few of us felt comfortable doing more than dialing-in for faceless conference calls. People affixed stickies, tape, or other obfuscators on those little camera lenses built into our laptops and tablets—just in case some ne'er-do-well would hack in and see us with hair uncombed or something less flattering. Getting a group of people to show themselves on Zoom, Teams, Webex, etc. was much resisted. No more. Now, large groups camera- and screen-share multiple times per day, getting work done at a distance while maintaining a new form of human connectivity. I like it!

. . . Conferences with virtual components are here to stay: While we all hunger to convene in person once more, we have also learned that virtual events can work. They can be clunky and detached, but we keep getting better as conference organizers and attendees with each successive meeting. Going forward, some meetings might elect to be all virtual all of the time. More likely, the future of conferences is a blended experience of in-person and virtual elements. Like so much since February 2020, the landscape continues to evolve.

. . . My crystal ball is rubbish: An executive director is a common nonprofit designation for a chief executive officer. People often expect CEOs to be visionary and have a special prescience about the opportunities of the moment and what the future holds. So, I've been asked more times than Stephen King has thumbed a spacebar, "When do you think things will get back to normal?" My every answer has been resoundingly wrong: A few weeks? No. A few months? Nope. A year? Nada. Undeterred, I am optimistic that TMS will hold in-person meetings in Fall 2021, will have a full events calendar with somewhat curtailed in-person participation in 2022, and will thrive in the post-pandemic "new normal" in 2023. Why not?

Let's also learn from a common King theme: Ordinary people can overcome dreadful challenges. Not all people survive, and no one is unscathed, but evil things can be defeated. We will endure the pandemic as we accept the challenges, adapt to the circumstances, act smartly, show kindness, and refuse to give up. I can craft no better lesson plan.

"If the pandemic was a book, it would be a tragically bad one—mishandled beginning, chaotic midsection, and indeterminate and clumsy ending."

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Call for White Papers Announced for National Academies Survey; TMS Member Appointed to Women of Color in Engineering Collaborative

member news

Share the good news about your professional accomplishments! Contact Kaitlin Calva, JOM Magazine Managing Editor, at kcalva@tms.org. Please note that only news submitted by current TMS members will be considered.

Submit Your White Paper for BPS Decadal Survey

The National Academies of Sciences, Engineering, and Medicine has announced a formal call for white papers to contribute to the Decadal Survey on Biological and Physical Sciences (BPS) Research in Space 2023–2032 (BPS2023).

The project will aid NASA in defining BPS research to advance knowledge in the field, meeting exploration mission needs, both human and robotic, and providing terrestrial benefits. This study will review current and emerging knowledge and will yield strategy and vision recommendations for a decade of science at the front of BPS research in space.

The success of BPS2023 is dependent on information and contributions from a broad range of disciplines and research communities. Input is sought from within and beyond the current space sciences community, as knowledge and techniques in all BPS-associated fields can enable discovery and advancements.

White papers are welcome in one or several disciples associated with BPS. They should identify research areas, concepts, methods, tools, techniques, and new ideas to advance knowledge in at least one of the following areas: the effects of the spaceflight environment on biological and biophysical systems and processes; the effects of the spaceflight environment, including gravitational effects, on physical systems and processes; and gravitational and other space environment effects on physical and biological processes involved in the functioning of space exploration technologies.

Both topical and research campaign white papers are being sought and should address how the proposed science can or must be done in space with intended value to human exploration, to humans on Earth, and/or benefits from analysis in a reduced gravity environment.

Topical white papers are due by Sunday, October 31, 2021, and research campaign white papers are due by Thursday, December 23, 2021. Further information and submission format and instructions can be found at www.nas.edu/microgravity.

TMS Members Invited to Contribute to Data Collection Project

The O*NET Data Collection Program, sponsored by the U.S. Department of Labor, has requested the assistance of TMS members to accurately describe the materials science and engineering professions. O*NET is a free resource which compiles occupational data for job seekers, employers, veterans, students, and more. Participating in this survey can help keep the information about these professions up to date and accurate, both for yourself and your fellow colleagues.

From those who respond, a random sample will be invited to answer a set of questionnaires. Those who are selected and agree to contribute will receive $40.00 in cash and a certificate of appreciation from the U.S. Department of Labor.

The organization is currently seeking the input of expert materials engineers/scientists for the O*NET database. You are considered an occupation expert if you meet the following criteria:

- You have at least five years of experience with the occupation. This time can include supervising, teaching, or training, if you have at least one year working as a materials engineer/scientist during your career.
- You are currently active in the occupation (practicing, supervising, teaching, and/or training) and based in the U.S.

If you are eligible and wish to participate, contact Jim Rose, RTI International, at jrose@onet.rti.org or 919-926-6584 with your name, address, daytime phone number, e-mail address, and that you heard about this opportunity through TMS.

Michele Manuel Named TMS Representative to WCEC

TMS member Michele Manuel has been appointed to the Women of Color in Engineering Collaborative (WCEC). The WCEC's creation is supported by the National Science Foundation (NSF) grant, NSF INCLUDES, received by the Society of Women Engineers (SWE) in collaboration with the National Society of Black Engineers (NSBE) and the Society of Hispanic Professional Engineers (SHPE).

With the aid of this grant, the WCEC will be formed by the SWE, NSBE, and SHPE as they focus on professional associations with memberships that include women engineers of color. The WCEC will then expand to incorporate higher education, industry, government, and other organizations that share the common goal of increasing representation and equity of women engineers of color. The WCEC aims to utilize its resources, and those of its partner organizations, to advocate for systemic changes while decreasing barriers women engineers of color face.

Manuel, department chair and professor, Department of Materials Science and Engineering, University of Florida, has been a member of TMS since 2001. She has served on several TMS committees and as Content Development & Dissemination Director on the TMS Board of Directors from 2017 to 2020. Manuel was a recipient of the 2021 Brimacombe Medal, a 2014 Early Career Faculty Fellow Award, the 2014 Young Leaders TMS/Japan Institute of Metals and Materials International Scholar Award, and a 2009 TMS Light Metals Division (LMD) Young Leaders Professional Development Award.

Michele Manuel

In Memoriam

Italo "Al" Servi

Andrew "Andy" Spencer

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

Italo "Al" Servi, a TMS member since 1948, passed away in January 2021 at the age of 98. Servi received a degree in industrial chemistry from the Università degli Studi di Milano in 1946. In 1947, he immigrated to the United States from Italy to study at the Massachusetts Institute of Technology (MIT) and received a master's degree and a Ph.D. in metallurgy, graduating with his Ph.D. in 1950. Servi's successful career was largely focused on applied research. He served on several TMS and AIME committees throughout his life, including the Membership Development Committee, the Public & Government Affairs Committee, and the AIME Board of Trustees, and authored several papers published in *JOM*.

Andrew "Andy" Spencer passed away in February 2021 at the age of 99. Spencer joined TMS in 1957, the same year that the Metallurgical Society (TMS) became a constituent society of AIME. He studied at the Edison Institute of Engineering at Greenfield Village and Wayne State University, from which he earned a B.S. in metallurgical engineering in 1947. Spencer served in the Merchant Marine, Coast Guard, and Navy in World War II.

Chester Spencer, professor emeritus in the Materials Science and Engineering Department at Virginia Polytechnical Institute and State University (Virginia Tech), passed away in January 2021 at the age of 96. Spencer served in World War II and was awarded the Bronze Star and other medals for his service. After returning from the war, he received bachelor's and master's degrees in engineering from the University of Kansas and later received his Ph.D. in materials science from the University of Wisconsin-Madison. He joined TMS in 1948, while it was still a division of AIME. After receiving his Ph.D., Spencer accepted a position as a faculty member at Cornell University where he continued his research. He then worked at AVCO, where he oversaw the development of the heat shield for the Apollo re-entry vehicle for NASA. Spencer also served as the vice president of research for Kennecott Copper Corporation and as executive director of the National Materials Advisory Board, part of the National Academy of Sciences before returning to his academic roots at Virginia Tech.

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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.

4JET Expands U.S. Presence

Alsdorf, Germany: The 4JET Group, supplier of laser systems to the photovoltaic and tire industry, opened a new location in Atlanta, Georgia, USA, with plans to establish a headquarters for sales, application testing, and service for the growing number of customers in North America. The site will house demo systems for laser cleaning and tire marking. The demo center will be expanded to include other products. Spare parts for the most important product lines will be kept in stock to enable short response times.

Robot Developed for Nuclear Site

Cumbria, U.K.: Forth Engineering Ltd., a British robotic engineering firm, built a rescue robot to help with disaster recovery in hazardous industrial environments. Developed for the Sellafield nuclear site in Cumbria, U.K., the rescue robot is built on a compact excavator platform and fitted with robotics systems, wireless technology, specialist cameras, and lights. It can be fitted with tools to contain nuclear spillage and employ a grapple hook for moving obstructions. The rescue robot is the first of its kind at Sellafield to be operated remotely.

Eissmann Acquires KTSN Mexico

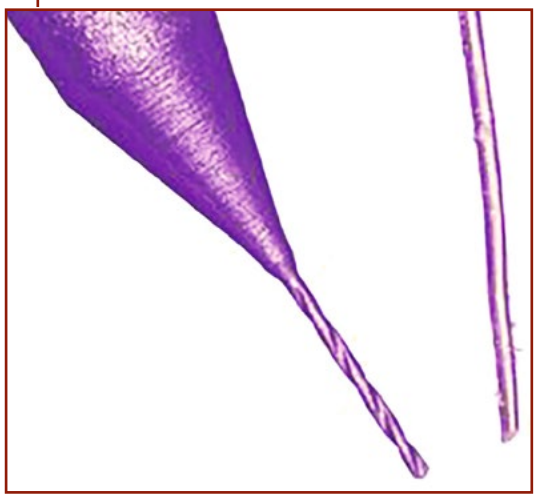
Bad Urach, Germany: Eissmann Group Automotive completed its global acquisition of Minda KTSN Plastic Solutions with the agreement to takeover Minda KTSN Plastic Solutions Mexico. Eissmann acquired Minda KTSN Plastic Solutions GmbH & Co. KG in Germany and Poland in March 2021. The Mexican site in Querétaro has around 130 employees and is in the automotive center, northwest of Mexico City, near factories of international car manufacturers. KTSN is a well-known automotive supplier in the fields of injection molding and kinematics technologies.

Hilditch West Upgraded

Adelaide, Australia: Maximus Resources Ltd. intersected encouraging nickel sulfide assay results from its maiden reverse circulation (RC) drill program at the Hilditch West target in Western Australia. The company's six-hole, 624-metrer RC campaign successfully intersected shallow, highly anomalous nickel-copper-cobalt and scandium across all three drill sections. The drilling program upgraded Hilditch West as a polymetallic target with significant mineralization encountered in four of the six holes drilled in both oxidized and sulfide material. The drill sections cover 500 meters of strike along the extensive alteration domain at the Hilditch West target which is 25 kilometers from BHP Group Ltd.'s Kambalda Nickel Operation.

Raffmetal Launches New Green Alloys

Brescia, Italy: Raffmetal now offers Silval, a new range of primary aluminum alloys from recycling with performances equal to primary aluminum alloys produced from bauxite. The company's plant in Odolo applies the best technologies for processing, treating, and sorting aluminum scrap to separate the raw material from impurities and organic parts, as well as select it based on the specific chemical analysis. The scrap goes through advanced melting processes. Thanks to continuous casting technology, Raffmetal ensures the production of high-quality alloys with a low carbon footprint, guaranteeing total control of the entire production process.



Weingarten, Germany: GCT GmbH, a global leader in diamond-coated micro-tools, announced the first successful diamond-coating of a 0.05 mm drill with its own GCT-multilayer layer. Many processing applications are now possible in electronics and ceramics. The picture shows the coated tool (left) compared to a human hair (right) and the impressing dimensions of the tool. (Photo credit: GCT)

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A New Member Benefit to Connect the Community in 2022

Ellen Cerreta

Ellen Cerreta

"Whether you prefer to interact virtually, through our publications, or in person, you'll find ways to connect with your larger professional community through your membership in TMS."

Despite 2021 being another challenging year with limited international travel and fewer traditional in-person events, our TMS family found effective ways to continue to stand together, even as we had to stay apart. We've connected through free webinars and successful online conferences. We've shared our work through journals and other publications. We've gathered at virtual committee meetings to keep our Society's vital work moving forward.

Now, as we look ahead to 2022, we are introducing a new, but also familiar, way of keeping in touch. Beginning in January, every TMS member will receive a print copy of *JOM: The Magazine* in their mailbox. I know what you're thinking. "But the issues are too big." Let me explain. *JOM: The Magazine* is the front portion of the publication that you're reading right now—the color pages that include news from your colleagues, the industry, and the Society. This portion of the publication is what you'll receive in the mail. And the technical articles that make *JOM* such a high value? *Those* will still be free to TMS members and easily accessible from Springer by logging in to the TMS website at www.tms.org/JOM.

Of course, as a TMS member, you always have options. If you'd still like to receive a print copy of the *JOM* publication of record, which encompasses both *JOM: The Magazine* and the peer-reviewed technical articles, you can purchase that as a subscription during the membership dues renewal process. You can also opt out of the print *JOM: The Magazine* mailing by updating your profile at members.tms.org and continue to access TMS member news and features completely online.

Renew your membership for 2022 so you don't miss an issue of the redesigned *JOM: The Magazine*.

While we hope that keeping up with your TMS colleagues in *JOM: The Magazine* each month will help you to feel closer to your community, we're optimistic that seeing these colleagues *in person* will also be a part of your 2022 membership experience. We are gearing up for a full return to an in-person TMS 2022 Annual Meeting & Exhibition (TMS2022), February 27–March 3, in Anaheim, California. More than 4,000 abstracts have been submitted for TMS2022, indicating a strong interest in coming together next year. You can view all our upcoming event plans at www.tms.org/Meetings.

Whether you prefer to interact virtually, through our publications, or in person, you'll find ways to connect with your larger professional community through your membership in TMS.

Our 2022 membership renewal program is now in full swing. Stay connected to your TMS community through 2022 by renewing your membership at members.tms.org.

Make Your Plans Now!

Don't Forget:
TMS members receive discounted rates on the TMS Annual Meeting & Exhibition. Renew your membership today to ensure you don't miss out on this member benefit.

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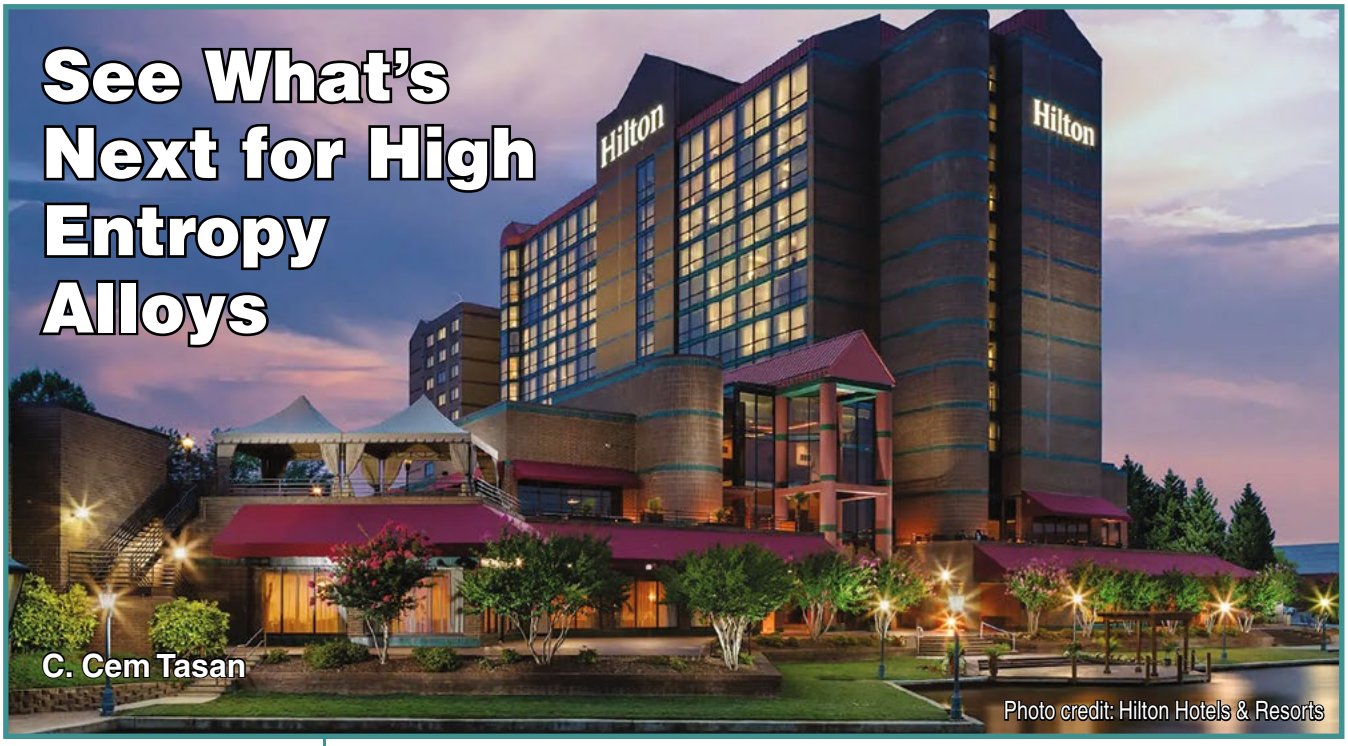
https://doi.org/10.1007/s11837-021-04859-9

See What's Next for High Entropy Alloys



C. Cem Tasan

Congress Background

The COVID-19 pandemic may have slowed down almost every aspect of our lives, but not by much for the research of high entropy alloys (HEA). Enabled by the enormous compositional space it covers, the field is growing at a mind-blowing pace, as can be seen from the thousands of publications in the last two years alone. On an almost weekly basis we witness the introduction of new alloys with promising property combinations. Moreover, new insights are provided regarding the thermodynamics and kinetics of microstructure development, and how it governs the properties, through the use of advanced experimental methods. These investigations altogether help develop an improved understanding of structure-property relationships in HEAs and the underlying physical mechanisms that are involved.

To explore these latest discoveries and to discuss future pathways, the world's leading scientists, engineers, and business leaders, as well as students and postdocs interested in the science and engineering of high-performance alloys, will convene in Charlotte, North Carolina, on December 5–8, 2021, for the 2nd World Congress on High Entropy Alloys (HEA 2021).

HEA 2021 will be a cross-disciplinary technical forum designed to share the latest research advances in single-phase and multi-phase metallic, intermetallic, and ceramic high entropy materials for functional or structural applications. Building on the inaugural congress held in 2019 in Seattle, Washington, HEA 2021

will feature highly focused technical talks on topics that include, but are not limited to, fundamental theory of alloy design, computational modeling and simulation, properties, processing, and applications of high entropy alloys.

A full technical program will feature plenary talks, invited speakers, more than 100 contributed presentations, and more than 90 posters to capture the advancements in research, which have accelerated since the meeting last convened.

Program Headlines: Exploring High Entropy Alloys

Representing strong and distinctive voices in the high entropy alloys field, there are three plenary speakers who will provide their insights on design, mechanistic understanding, and recyclability of HEAs: **Amy Clarke**, Colorado School of Mines, USA; **Maryam Ghazisaeidi**, The Ohio State University, USA; and **Elsa Olivetti**, Massachusetts Institute of Technology, USA.

The technical program will include the following invited speakers:

- **Raj Banerjee,** University of North Texas, USA
- **Matthew Barnett**, Deakin University, Australia
- **Nick Birbilis,** The Australian National University, Australia
- **Andrew Detor**, GE Research, USA
- **Kathy Flores**, Washington University in St. Louis, USA
- **Amy Gandy**, University of Sheffield, U.K.
- **Dan Gianola**, University of California, Santa Barbara, USA
- **Murakami Hideyuki**, National Institute for Materials Science, Japan
- **Zhiming Li**, Central South University and Max-Planck-Institut für Eisenforschung, China
- **Anna Manzoni**, Bundesanstalt für Materialforschung und -prüfung, Germany
- **Francesco Maresca**, École Polytechnique Fédérale de Lausanne, Netherlands
- **Andrew Minor**, University of California, Berkeley, USA
- **Dan Miracle**, Air Force Research Laboratory, USA
- **B.S. Murty**, Indian Institute of Technology Madras, India
- **Hyunseok Oh**, Massachusetts Institute of Technology, USA
- **Noah Philips**, ATI, USA
- **Ying Yang**, Oak Ridge National Laboratory, USA

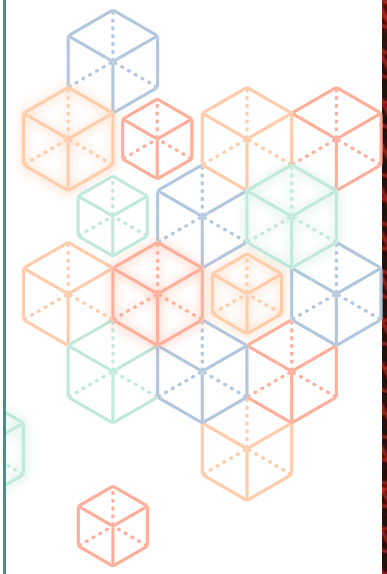
Find more details and the latest updates on the congress technical program at www.tms.org/HEA2021.

Make Plans to Join the HEA Community

Please join the second iteration of the World Congress on High Entropy Alloys to not only witness these exciting presentations from across the globe, but also to be a part of the discussions that shape the future of our community, and that hopefully enable the widespread application and adoption of these materials. Networking and social events are planned for attendees to spark such conversations and collaborations on this vibrant technology. Please note that attendees must register to participate in HEA 2021. Registration for the congress is currently open. To register, visit www.tms.org/HEA2021.

Your health and safety is a priority. TMS continually monitors the COVID-19 situation and the latest guidance on health and safety protocols. As a part of registration, we will be asking attendees to confirm that they are not feeling sick and have not been in contact with others who may have COVID-19. We also ask attendees to work with us to follow all federal, state, local, venue, and CDC guidelines, and we will keep you informed as to how those guidelines pertain to HEA 2021. We appreciate your cooperation in these matters.

C. Cem Tasan is the Thomas B. King Associate Professor of Metallurgy at the Massachusetts Institute of Technology and is chair of the HEA 2021 organizing committee.



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Lake Tahoe Welcomes the ICME Community

Will Joost

Will Joost

Introduction

The sixth World Congress on Integrated Computational Materials Engineering (ICME 2021) will be held November 14–18, 2021, at the Hyatt Regency Lake Tahoe in Incline Village, Nevada, USA. Although the world has changed since the last meeting in 2019, the materials science and engineering field continues to pursue a bold vision for materials discovery, design, development, and manufacturing through integrated computational materials engineering (ICME). ICME 2021 is where our community will convene to review progress toward this vision and lay the groundwork for the next two years.

Background of the Congress

The congress originally developed out of the need to establish and shape the pathway for ICME in the materials science and engineering field, following the landmark ICME report by the National Academies in 2008. This year's event marks one decade since the first ICME congress met in 2011. Each meeting has yielded an outstanding collection of technical talks combined with rich opportunities for networking and technical exchange.

Attendees share the latest knowledge and advances in the discipline at the congress, which has become known as a hub of interaction among ICME practitioners including software developers, process engineers, and researchers from across industry, government, and academia. Thanks to a singular focus on ICME, the congress is uniquely positioned to benefit attendees from across this broad range.

This is the only congress dedicated to bringing together the ICME community from across nations, disciplines, and organizations to focus on integration priorities and gaps that need to be addressed in order to advance the field.

Highlights of ICME 2021

Many attendees look forward to seeing colleagues face-to-face and meeting new contacts for the first time in a long time. This iteration of the ICME congress will host in-person networking opportunities, including a welcome reception, poster reception, and banquet dinner, all with pandemic precautions. TMS is working in partnership with the Hyatt Regency Lake Tahoe to comply with guidance from the Centers for Disease Control and Prevention and state and local authorities.

A robust technical program is planned. The five-day schedule features a combination of plenary presentations, contributed talks and posters, workshops on computational tools, and networking.

In addition to plenary and invited speakers, the program offers approximately 200 contributed talks and posters.

A sampling of confirmed plenary presentations at press time follows, with the latest additions to the program being posted on the meeting website:

- "DAMASK: Experiences from 10 Years of ICME Software Development for Physics-based ICME"
  Martin Diehl, KU Leuven
- "An ICME Approach to Development of a Low-Cost Magnesium Sheet Component for Automotive Applications"
  Bita Ghaffari, Ford Motor Company
- "Virtual Testing of Structural Composites: A Multiscale Perspective"
  Carlos González, IMDEA Materials Institute and Technical University of Madrid
- "ICME for High Strength Metal Alloys: Current Status and Future Challenges"
  Louis Hector, GM Global Technical Center
- "Hybrid Twin: Combining Physics- and Data-based Models in a Consistent Digital Thread Spanning the AM Process Chain"
  Mustafa Megahed, ESI Group
- "To Machine Learning… and Beyond: The Use of Machine Learning to Understand and Predict Advanced Material Behavior in the ICME Framework"
  Andrea Rovinelli, Argonne National Laboratory
- "Computational Design of Lithium-ion Batteries Using Multi-scale Models and Machine Learning"
  Kandler Smith, National Renewable Energy Laboratory
- "ICME of Additively Manufactured Metals: New Computational Tools and the Central Role of Materials Data"
  Peter Voorhees, Northwestern University
- "Titanium Alloy and Process Design: Gaining Insights through Multi-scale Computation"
  Rui Yang, Institute of Metal Research

First ICME Industry Award Confirmed for ICME 2021

Louis Hector

TMS is proud to announce the inaugural recipient of its ICME Industry Implementation Award, sponsored by the TMS Materials Processing & Manufacturing Division (MPMD). TMS member **Louis Hector**, technical fellow at GM Global Technical Center, will accept the award on behalf of the team at **United States Automotive Materials Partnership LLC** (USAMP) at ICME 2021 this November. As a part of the award, Hector will give a presentation during the congress plenary session.

This new award recognizes the significant achievements that industry has made to implement integrated computational materials engineering (ICME) methods into a manufacturing process and/or design of a new material. "In 2012, we started with a vision where new multiphase Gen 3 steels could be developed and then applied as replacement materials for existing materials with an ICME approach. The ICME results were to provide a framework for new materials development and application through close integration of different methods spanning relevant length scales," Hector said. This vision was awarded a grant from the U.S. Department of Energy in 2012 for a project entitled, "ICME Approach to Development of Lightweight 3GAHSS Vehicle Assembly," with work led by Hector and spanning from 2013 to 2017.

Hector elaborated on the work, saying: "We believe that the Gen 3 steel ICME project was the first to incorporate a forming test to validate the performance of the predicted materials in a stamping process. The other aspect was the significant opportunities to teach and train graduate students and postdocs."

"It is with great appreciation and humility that we accept the MPMD ICME award," Hector stated, in a final note of gratitude. "TMS is presently the only professional society to which I belong. It has provided a wonderful home for someone like me from an industrial R&D environment where both fundamental and applied materials science and engineering are emphasized."

The next ICME Industry Implementation Award will be given out in two years at the next ICME World Congress. Applications should be submitted to awards@tms.org by April 1, 2022, for consideration. Visit www.tms.org/Awards for award criteria and details on how to apply.

"It is time to reflect on the progress that has been made since the National Academies report defined ICME as a discipline and to discuss the opportunities and challenges that lie ahead."

Find additional details on the Technical Program page of the congress website at www.tms.org/ICME2021.

New Workshops on Computational Tools

Three parallel tutorial sessions will take place Wednesday afternoon prior to the banquet dinner. These workshops are designed to provide hands-on training and equip attendees with new skills that they can begin to utilize as soon as they return from the congress. Each workshop will describe the fundamental principles and practical execution of an open-source computational toolset with direct utility for ICME. The workshops are included as part of the registration fee and are within the standard conference schedule—no added cost or extended travel is required.

Expert instructors will teach the topics, including **Mohammadreza Yaghoobi**, University of Michigan, teaching PRISMS-Plasticity (crystal plasticity finite element); **Raymundo Arroyave**, Texas A&M University, introducing Bayesian Optimization; and **Steve Plimpton**, Sandia National Laboratories, instructing on LAMMPS (large-scale atomic/molecular massively parallel simulator).

In the first session, Yaghoobi will provide an overview and give tactical instruction on PRISMS-Plasticity, a modular open-source software for parallel 3D crystal plasticity finite element (CPFE). A learning objective will be connecting PRISMS-Plasticity to the common pre-processors to read-in different experimental/synthetic microstructures and post-processors for generating different outputs, such as stress-strain, slip activity, and pole figures. Some advanced features will be discussed, such as user-defined constitutive model, modeling voids, and fatigue analysis.

David Montiel, also from the University of Michigan, will teach the second part of the session on PRISMS-PF (phase field), which is an open-source, general purpose framework for high-performance phase field modeling. Attendees will gain an overview of the features and capabilities and receive a demonstration on how to install the framework, run applications, and analyze the results from simulations.

The second session on Bayesian Optimization will begin with an overview by Arroyave. Concluding the session, **Brent Vela**, Texas A&M University, will cover the application of model reification and fusion as an optimization approach using the BAREFOOT framework.

Plimpton's session, titled "Using the LAMMPS Molecular Dynamics Package for Materials Modeling," will provide an overview of basic and advanced features of LAMMPS for materials modeling. Participants will learn how to write and edit LAMMPS input scripts, run simulations, and plot and visualize results, as well as how to apply this new knowledge to their own material models or integrate it as part of a workflow.

Conclusion

Last, but not least, one aspect of ICME 2021 that cannot be ignored is the stunning location on the north shore of Lake Tahoe, Nevada. The congress venue offers not only classy amenities of a waterfront resort, such as a spa and fine dining, but also beautiful views of the immense freshwater lake and the Sierra Nevada mountains.

ICME 2021 will build on the momentum of the first five ICME congresses in 2011, 2013, 2015, 2017, and 2019. It is time to reflect on the progress that has been made since the National Academies report defined ICME as a discipline and to discuss the opportunities and challenges that lie ahead. Attendees will join vigorous discussions, inspiring workshops, and powerful speakers with fellow engineers, scientists, and educators. ICME 2021 is positioned to be a meeting of great impact.

Will Joost is the ICME 2021 conference chair and has been a TMS member since 2010.

JOM themagazine

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JOM themagazine

TMS meeting headlines

TMS is committed to your safety during the pandemic. Meeting dates and locations are current as of August 5, 2021. For the most recent updates on TMS-sponsored events, visit www.tms.org/Meetings.

Other Meetings of Note

Congress on Safety in Engineering and Industry 2021 (Safety Congress 2021)
November 1–3, 2021
Fort Worth, Texas, USA

Materials in Nuclear Energy Systems (MiNES 2021)
New Dates!
November 8–12, 2021
Pittsburgh, Pennsylvania, USA

TMS Materials Innovation Briefing: Focus on Pittsburgh
November 10, 2021
Cranberry Township, Pennsylvania, USA

Offshore Technology Conference (OTC Asia 2022)
March 22–25, 2022
Kuala Lumpur, Malaysia

World Congress on Artificial Intelligence in Materials and Manufacturing (AIM 2022)
April 3–6, 2022
Pittsburgh, Pennsylvania, USA

8th International Conference on Solid - Solid Phase Transformations in Inorganic Materials (PTM2022)
June 27–July 1, 2022
Xi'an, China

Liquid Metal Processing & Casting Conference (LMPC 2022)
September 18–21, 2022
Philadelphia, Pennsylvania, USA

TMS ICME MANUFACTURING DESIGN MATERIALS

November 14–18, 2021
Lake Tahoe, Nevada, USA
Register Now!
www.tms.org/ICME2021

- The 6th World Congress on Integrated Computational Materials Engineering (ICME 2021) convenes leading researchers and practitioners to share the latest knowledge and advances in the discipline.
- A robust technical program is planned. The five-day schedule features a combination of plenary presentations, contributed talks and posters, and networking events.
- Three parallel tutorial sessions on new computational tools will take place Wednesday afternoon. Visit the congress website to learn more about the technical program and register.

2nd WORLD CONGRESS ON HIGH ENTROPY ALLOYS HEA 2021

December 5–8, 2021
Charlotte, North Carolina, USA
Discount Registration Deadline: October 22, 2021
www.tms.org/HEA2021

- The 2nd World Congress on High Entropy Alloys (HEA 2021) is a cross-disciplinary technical forum designed to share the latest research advances in single-phase and multi-phase metallic, intermetallic, and ceramic high entropy materials for functional or structural applications.
- The plenary speakers are *Amy Clarke*, Colorado School of Mines; *Maryam Ghazisaeidi*, The Ohio State University; and *Elsa Olivetti*, Massachusetts Institute of Technology. Visit the HEA 2021 website for more details on invited speakers and technical topics.

CELEBRATION AIME-TMS 150th TMS 2022 Annual Meeting & Exhibition SINCE 1871

February 27–March 3, 2022
Anaheim, California, USA
Last Chance for Poster Abstracts!
www.tms.org/TMS2022

- If you missed the abstract submission deadline but would still like to see your work represented at the conference, submit an abstract for the TMS 2022 Annual Meeting & Exhibition (TMS2022) Late News Poster Session by November 4, 2021.
- Visit the TMS2022 website for information on submitting your poster abstract, planning your travel, and applying for a travel visa.

AM BENCH 2022 | ADDITIVE MANUFACTURING BENCHMARKS

August 15–18, 2022
Bethesda, Maryland, USA
Submit an Abstract by January 7, 2022
www.tms.org/AMBench2022

- The Additive Manufacturing Benchmarks (AM-Bench) Conference is the home for presenting the findings and results associated with a continuing series of controlled benchmark tests from the AM-Bench committee. AM-Bench 2022 will build on the successful model of the 2018 meeting.
- Separate from the benchmark tests, the conference will also include technical sessions with a focus on additive manufacturing (AM) modeling, measurement, and characterization.
- Technical areas to be covered include: Quantitative Measurements and Characterization; End-user Modeling Needs; AM Benchmark Needs and Directions; Qualification and Certification of AM Components; and other related areas.

JOM, Vol. 73, No. 10, 2021
https://doi.org/10.1007/s11837-021-04862-0

call for papers

***JOM* is seeking contributions on the following topics for 2022. For the full Editorial Calendar, along with author instructions, visit www.tms.org/EditorialCalendar.**

April 2022

Manuscript Deadline: November 1, 2021

Topic: Computational Design of Alloys for Energy Technologies

Scope: This special topic covers design, development, and lifetime modeling of materials for extreme operating conditions in energy technologies. Advanced materials that resist elevated temperatures, corrosive environments, and a range of static and dynamic stresses are needed to improve the efficiency and reduce the environmental impact of energy technologies. Articles will cover the use of computational modeling using techniques including machine learning and experiments to close the design loop and accelerate materials discovery and advanced manufacturing.
Editors: Ram Devanathan, Jeff Hawk, and Laurent Capolungo
Sponsor: ICME Committee

Topic: Computational Modeling of Metallurgical Furnaces

Scope: Computational modeling continues to play an increasingly important role for evaluating and improving metallurgical furnace design and operation. Metallurgical furnaces typically involve complex transport phenomena, multi-phase chemical reactions and phase transformations, which make modeling efforts challenging. This special topic invites original research on high-fidelity simulations of industrial metallurgical furnaces. Papers that address gas, liquid, and solid phase interactions are encouraged.
Editors: Alexandra Anderson, Fiseha Tesfaye, Chukwunwike Iloeje, and Stuart Nicol
Sponsors: Process Technology and Modeling Committee and Pyrometallurgy Committee

Topic: Energy Efficiency and Low Carbon Footprint in Metals Processing

Scope: Metal production technologies are carbon and energy intensive, but it can be argued that the bulk of carbon footprint of metal processes comes from energy sources and reductants. In this case, decarbonizing is closely intertwined with energy consumption of processes. This special topic covers energy efficiency in relation to decarbonization of metal production. Manuscripts should address energy efficiency, carbon capture, and reducing the carbon footprint of metals processing, as well as life cycle assessment.
Editors: Joseph Hamuyuni, Fiseha Tesfaye, Chukwunwike Iloeje, and Alexandra Anderson
Sponsors: Energy Committee, Recycling and Environmental Technologies Committee, and Process Technology and Modeling Committee

Topic: Phenomena and Scales Influencing Alloy Solidification Microstructures

Scope: This topic focuses on numerical predictions and experimental observations of the coupling/interaction of processes that occur across varying length and time scales simultaneously during solidification. Examples include microstructure simulations to characterize macroscopic properties such as permeability or experiments, such as bulk stirring that influences solidification.
Editor: Andrew Kao
Sponsor: Solidification Committee

May 2022

Manuscript Deadline: December 1, 2021

Topic: Advances in Characterization of Functional Composite Materials

Scope: Papers are invited on the latest developments and applications of functional composite materials with advanced engineering uses, from initial conception to obsolescence. Of particular interest are original papers and reviews focusing on characterization and non-destructive evaluation of metal-matrix composites, ceramic-matrix composites, polymer-matrix composites, and coatings at the nano- and microscales.
Editors: Zhiwei Peng, Rajiv Soman, Yunus Eren Kalay, and Ramasis Goswami
Sponsor: Materials Characterization Committee

Topic: Progress on Recovery of Critical Raw Materials

Scope: For a sustainable economy, many countries have published their Critical Raw Materials (CRM) list. Over time, extensive research and developmental activities have led to the emergence of new methods and engineering processes for the recovery of CRM from mineral ores or tailings, extractive waste, and metallurgy slags. Authors are welcome to contribute manuscripts on the recovery of CRM from various feeds, ranged from ore to metallurgical slag, using hydrometallurgical and electrometallurgical extraction processes.
Editors: Hong Peng and Kerstin Forsberg
Sponsors: Hydrometallurgy and Electrometallurgy Committee and Recycling and Environmental Technologies Committee

Topic: Sustainable Composite Materials

Scope: This special topic covers composite materials that are derived from renewable sources and/or can be used in renewable energy-based applications such as wind and solar energy, among others. Fundamental and applied research in this area is welcome. This call invites scientists from diverse groups such as early career, graduate students, academics, industry, and national labs to submit their research.
Editors: Simona Hunyadi Murph and Surojit Gupta
Sponsors: Composite Materials Committee and Energy Conversion and Storage Committee

June 2022

Manuscript Deadline: January 1, 2022

Topic: 30 Years of Oliver-Pharr: Then, Now and the Future of Nanoindentation

Scope: The 1992 seminal publication by W.C. Oliver and G.M. Pharr laid a cornerstone for the development of nanoindentation as reference technique for nanomechanical characterization. The "Oliver-Pharr" method has enabled numerous transformative research efforts in a wide range of fields spanning materials science, geology, biology, and medicine. This special topic is devoted to its amazing range of applications, as well as the current developments and future trends that it continues to inspire.
Editors: Verena Maier-Kiener, Benoit Merle, and Samantha Lawrence
Sponsor: Nanomechanical Materials Behavior Committee

Topic: Magnetic Materials for Multifunctional Applications

Scope: Papers are invited on magnetic materials which can be used for multifunctional applications in the power and energy sector (energy conversion, energy storage, power generation, etc.). Fundamental and applied research in this area with an emphasis in novel processing, and the interplay between composition-processing-structure-microstructure-property-performance is welcome. Peer-reviewed manuscripts based on original research, literature review, and scientific viewpoint will be considered for publication. This call targets scientists/researchers from diverse groups such as early career professionals, graduate students, academics, industry, and national labs to submit their research.
Editors: Surojit Gupta, Radhika Barua, Manoj Mahapatra, and Lan Li
Sponsor: Energy Conversion and Storage Committee

Topic: Magnetic Structure Characterization over Multiple Length Scales

Scope: Magnetic structures form over multiple length scales. Characterization of magnetic structures over multiple length scales plays an essential role in advancing the understanding of structure-property-processing relationships of magnetic materials. This topic covers various complementary characterization techniques that help illuminate the magnetic phenomena from atomic-scale spin configurations to nano-scale structures to meso-scale domains in magnetic materials.
Editor: Yongmei Jin
Sponsor: Magnetic Materials Committee

Topic: New Frontiers in Physical Metallurgy of Steels

Scope: This topic seeks articles focusing on physical metallurgy of steels with novel alloying concepts including increased levels of elements such as Mn, Al, and Si. Novel microstructure concepts and processing strategies to manufacture high performance steels are encouraged. Research articles highlighting recent advances in experimental and modeling studies for multi-phase steel microstructure such as TRIP/TWIP effect and interface precipitation, as well as their industrial applications, are recommended.
Editors: Amit Behera and Ana Araujo
Sponsor: Steels Committee

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CELEBRATION
AIME–TMS 150th
TMS 2022
Annual Meeting & Exhibition
SINCE 1871

EXHIBIT DATES:
MONDAY, FEBRUARY 28, TO WEDNESDAY MARCH 2




Celebrate the return of the in-person exhibit, the continuation of the TMS-AIME 150th Anniversary Year, and the excitement of the 2022 TMS Bladesmithing Competition with a booth at the TMS 2022 Annual Meeting Exhibition or an event sponsorship.

EXHIBIT

Reserve your booth in the TMS2022 Exhibit Hall to connect with minerals, metals, and materials scientists and engineers from around the world. The event will draw more than 3,000 attendees to Anaheim, California, an accessible location for travelers.

With special events like poster sessions, networking receptions, and the 2022 TMS Bladesmithing Competition taking place in the TMS2022 Exhibit Hall, your booth will be at the center of a dynamic networking hub.

Reserve your exhibit space at:
www.tms.org/TMS2022/Exhibit

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Can't be with us in person this year? Make sure your company retains a strong presence at TMS2022 with a sponsorship. You can sponsor:

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- Electronic communications like the TMS2022 App or the TMS2022 daily newsletter
- And much more!

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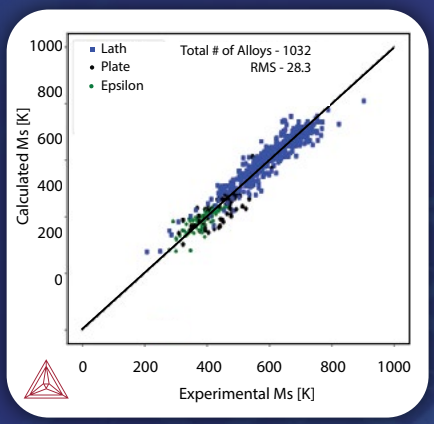
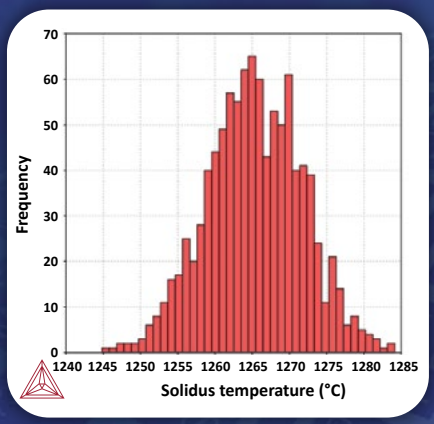


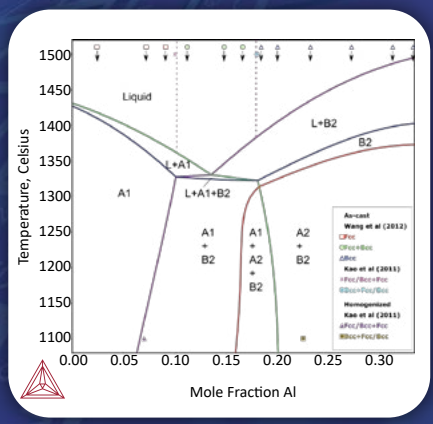
Comparison of calculated and experimental Ms temperatures for a wide range of steels

Nickel



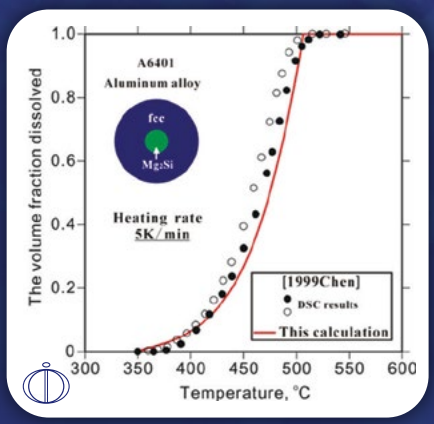
Variation in solidus temperature over 1000 compositions within alloy 718 specification

High Entropy Alloys



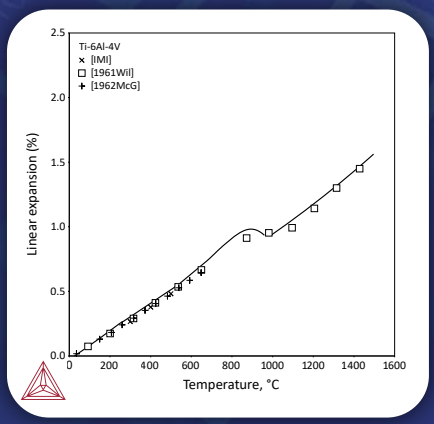
Calculated phase diagram along the composition line of CoCrFeNi-Al

Al Alloys



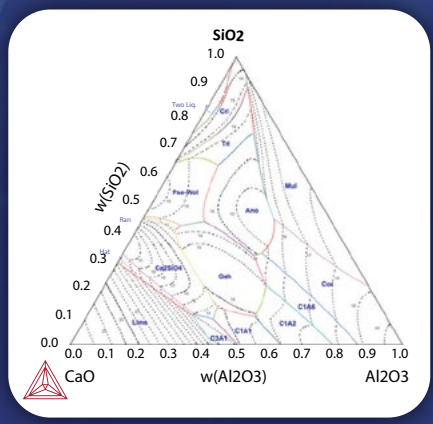
Dissolution of Mg2Si precipitate in Alloy A6401

Ti and TiAl Alloys



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

Oxides



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