

JOM THE MAGAZINE

JANUARY 2023

www.tms.org/JOM

News and insights about TMS, its members, and the professions it serves

CELEBRATING A REMARKABLE METAL

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ABOUT THE COVER



A GTF Advantage engine configuration is prepared for testing at Pratt & Whitney's West Palm Beach, Florida, facility. This month's *JOM: The Magazine* cover feature focuses on superalloys—the metal that helps make jet engine technology possible—with a preview of the upcoming TMS Superalloy 718 & Derivatives conference and a glimpse at other TMS initiatives that support the superalloys technical community. (Photo Credit: © 2022 Raytheon Technologies Corporation, Pratt & Whitney Division. Reproduced with permission.)



Access Technical Journal Articles

TMS members receive free electronic access to the full library of TMS journals, including *JOM: The Journal* are available on the Springer website. TMS members should log in at www.tms.org/Journals to ensure free access.

About *JOM: The Magazine*:

This print publication is excerpted from the publication of record, *JOM*, which includes both *The Magazine* and *The Journal* sections. *JOM: The Magazine* includes news and insights about TMS, its members, and the professions it serves. To access the publication of record, visit www.tms.org/JOM.

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. Learn more at www.tms.org.

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TABLE OF CONTENTS

JOM Volume 75
Number 1
January 2023

FEATURES

- 10:** Celebrating a Most Remarkable Metal:
Lynne Robinson
- 16:** Anticipating the Wave: TMS Study Examines
Potential of Artificial Intelligence:
Elizabeth Holm
- 20:** TMS Programming and Events Shine at
MS&T22: Kelly Zappas
- 25:** Magnesium and Castles: The Travel Diary of a
TMS/JIM International Scholar: Victoria Miller
- 27:** Meet Megan Burrill, Competitive Swimmer:
Kelly Zappas
- 30:** TMS Asian/Pacific Islander (API) Working
Group Seeks to Raise Awareness:
Dong (Lilly) Liu



23

DEPARTMENTS

- 3:** In the Final Analysis: James J. Robinson
- 4:** JOM Technical Topics
- 5:** JOM Machine Learning Showcase Topic:
Submit Your Manuscript by May 1, 2023:
Michael Groeber and Victoria Miller
- 6:** TMS Member News
- 32:** In Case You Missed It:
Business News from the Field
- 33:** TMS Meeting Headlines



28

SPECIAL INSERT

TMS2023 Pre-Show Report



16



13

IN THE FINAL ANALYSIS

"I think the printed magazine's mission is to curate all of these things that might be of the reader's interest and put it into the perfect format that you don't need to plug in and charge; in fact, you don't need to do anything with it except enjoy it."

—Maria Pardo de Santayana, Editor-in-Chief, *Marie Claire* (as reported by "Mr. Magazine")

One of the many Stephen Spielberg films that I enjoy is *Minority Report*. Thoughtful, polished, and action-packed, the film was released 21 years ago in 2002 and is set 31 years from now in 2054. When the film was being made, I recall much discussion about how Spielberg convened a panel of futurists to advise the filmmaking team on what technologies might be part of daily living 50 years hence. Watching *Minority Report* today, we already have much of the envisioned future tech, including biometrics, autonomous vehicles, drones, and personalized advertising. Less prescient by the futurists: In a crowd scene, a man drops his briefcase; it springs open, spilling out papers and magazines. Forget the world of 2054 or even 2023: Briefcases and print magazines are quaint and rare sights in today's Gorilla Glass society.

When it comes to publishing periodicals, the gradual phase out of printing is ongoing and inevitable. For reasons both professional and personal, that makes me wistful. My feelings aside, e-content delivery is just too convenient, too searchable, too immediate, too aggregated, and too scrollable to resist. What we miss, however, is the sheer tactility of paper in hand. A magazine invites you to study the cover, thumb its pages, and allow your eyes to linger on an intriguing headline, article, or image. Time was that every manner of periodical cascaded from newsstands; now, they are selective boutique experiences where one enjoys not only the content but also the physicality of the manner in which that content is presented.

Within TMS, we are very attuned to the present and future of periodical publishing. We must be as TMS publishes six journals. From that portfolio, every article from every issue of every periodical is available to every TMS member via SpringerLink at no extra cost. Our member journal, *JOM*, is the oldest member of the TMS periodical family and is especially robust, comprising two elements: "The Magazine" (news and features) and "The Journal" (technical articles). I think of *JOM* as the personality of TMS.

Time was that we mailed gratis every complete issue of *JOM* to every TMS member who would have it. Today, we print and mail only "The Magazine" as a member benefit. We started this practice in 2022, delivering 10 issues of "The Magazine" to member mailboxes. Feedback was good, but we continue to fine tune our model because the publishing world is evolving at dizzying speed. Based on lessons learned in 2022, we are making the following adjustments for 2023:

- The number of "The Magazine" issues printed and mailed to members in 2023 will be reduced to eight. Why? Inflation, up-trending paper costs, increases in mailing expense—all things that fall under the umbrella of practical business reality. Plus, we have a better idea to deploy. . . .
- In the four months when a print issue is not distributed, online-only "The Magazine" content will be published on SpringerLink. In this way, there will be fresh "The Magazine" content during all twelve months of 2023. Our editorial team believes that this format will deliver a better overall experience for readers by consolidating smaller issues and providing an opportunity for articles to be published online that couldn't otherwise be part of the print issues, because of space limitations, missed deadlines, or some other reason.

The collective goal is to assure that TMS members can depend on an excellent reading experience when presented with *JOM* regardless of delivery platform. Oh yes, speaking of excellent reading experiences, I will once again write 12 installments of In the Final Analysis rather than the 10 in 2022. So, if you are a ITFA completist, you'll have to lean into SpringerLink for four installments. We get stats on such things, so please do some clicking and keep my ego intact!

Volume 75

Number 1

January 2023



James J. Robinson
Executive Director

 @JJRofTMS

"Time was that we mailed gratis every complete issue of JOM to every TMS member who would have it. Today, we print and mail only "The Magazine" as a member benefit."

JOM TECHNICAL TOPICS

JOM
THE MAGAZINE

JOM: The Journal includes peer-reviewed technical articles covering the full range of minerals, metals, and materials. TMS members receive free electronic access to the full library of TMS journals, including *JOM*. For the full Editorial Calendar, visit www.tms.org/EditorialCalendar.

Review the technical topics included in the current issue of *JOM: The Journal* here, and then go to www.tms.org/JOM to log in access technical journal articles on the Springer website.

// JANUARY 2023

Advances in Surface Engineering

Scope: This special topic aims to capture recent advances in processing, characterization, simulation/modeling, and applications related to surface engineering of materials. Coatings, surface alloying, gradient structures, nano-crystallization, and inhibitors have been applied to tailor the surfaces for improved corrosion and wear resistance. Areas of interest for this topic include surface protection from wear and corrosion, surface characterization techniques, surface alloying, and nano-structured surfaces.

Editors: Tushar Borkar, Cleveland State University; Arif Mubarak, PPG Industries; and Bharat Jasthi, South Dakota School of Mines and Technology

Sponsor: Surface Engineering Committee

Liquid Metal Processing of Al- and Mg-based Composite Materials

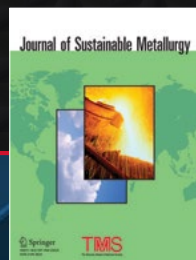
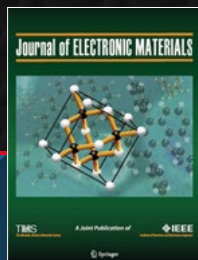
Scope: Liquid-phase manufacturing and processing of composite materials is a scalable yet challenging technological route. Papers in this topic will focus on the advanced technological solutions that tackle the main challenges, i.e., agglomeration, inhomogeneity, and poor bonding of reinforcement; as well as on the development of new compositions, process modelling, and advanced characterization of Al- and Mg-based composites.

Editor: Dmitry Eskin, Brunel University London

Sponsor: Aluminum Committee

READ ALL SIX TMS JOURNALS

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www.tms.org/Journals

JOM MACHINE LEARNING SHOWCASE TOPIC:

Submit Your Manuscript by May 1, 2023

Michael Groeber and Victoria Miller

The *JOM* editorial team is pleased to announce that a call for manuscripts is now open for a new Machine Learning Showcase Series.

Traditionally, *JOM* special topics are organized by TMS technical committee volunteers. This series was planned to supplement the excellent work our committees are doing by exploring three specific areas of machine learning: additive manufacturing, materials development, and deformation processes. The topics will include a combination of invited and unsolicited manuscripts, so participation by our *JOM* audience is encouraged.

// ABOUT THIS TOPIC

Machine learning (ML) and artificial intelligence (AI) have become the focus of many research efforts across numerous scientific fields. As a result, there has been a rapid growth in the development and application of exciting new tools, with some beginning to percolate through the materials science and engineering fields. The field of materials science and engineering offers some interesting new problems for AI/ML to potentially impact, though there are challenges to application. Common AI/ML problems, such as image classification, have been shown to be directly applicable to the materials field. More recently, AI/ML methods have been applied to materials development, process design and control, and reduced order model development. In this series of special topics, we hope to both demonstrate what is currently possible and inspire new users of AI/ML techniques.

Machine Learning: Additive Manufacturing

This topic covers the use of ML and AI for the advancements of additive manufacturing (AM) processes. Specific topics of interest include approaches/tools for (1) developing new alloys tailored to AM, (2) analyzing/utilizing in-process

monitoring data, (3) designing novel processing strategies, (4) predicting component performance, and (5) qualifying components.

Guest Editor: Michael Groeber

Machine Learning: Materials Development

The use of ML and AI for the development of new materials, material combinations, and microstructures is the focus of this topic. Specific areas of interest include new approaches or tools for (1) targeted design and optimization of alloy compositions, (2) microstructural engineering during processing, and (3) hierarchical or architected materials.

Guest Editor: Victoria Miller

Machine Learning: Deformation Processes

The application of ML and/or AI methods to the development of novel applications in the area of deformation processes will be examined in this topic. Specific areas of interest include approaches/tools for (1) predicting microstructures that result from deformation pathways, (2) numerical design of thermomechanical processes, and (3) in-process control methods.

Guest Editor: Michael Groeber

How to Submit

To submit to any of these topics, first, prepare your manuscript according to the *JOM* Instructions for Authors found at www.tms.org/jom. Then, submit your manuscript through Editorial Manager at www.editorialmanager.com/JOMJ. All manuscripts will be reviewed by two qualified, objective experts in the field. When that process is complete you will receive a decision on your submission. Manuscripts will be published online as they are accepted and will appear in *JOM* issues beginning in October 2023. The deadline for manuscript submissions is May 1, 2023.



About the JOM Associate Editors

Michael Groeber is an associate professor, Mechanical and Aerospace Engineering, at The Ohio State University. He is a member of the following TMS committees: Additive Manufacturing; Advanced Characterization, Testing, & Simulation; Integrated Computational Materials Engineering (ICME); and Materials Innovation. His technical interests encompass additive manufacturing, 3D materials science, ICME, and data analytics.

Victoria Miller is an assistant professor, Materials Science and Engineering, at the University of Florida. She is a member of the TMS Magnesium Committee, and is the Light Metals Division Representative to the TMS Membership, Diversity & Development Committee and the TMS Program Committee. Her technical interests are recrystallization, magnesium alloys, and recovery.

TMS MEMBER NEWS

Share the Good News!

Contact Lynne Robinson, Department Head, Marketing and Communications, at lrobinson@tms.org, to share your professional accomplishments. Please note that only news submitted by current TMS members will be considered.

TMS Foundation Expands Family Care Grants, Young Leader Awards



Two popular TMS Foundation-funded programs will receive a boost over the next two years,

thanks to the Foundation's generous donors. The TMS Foundation Board of Trustees recently approved an expansion to the following programs in 2023 and 2024:

Family Care Grant Program: Designed to help individuals who are incurring extra family care expenses as a result of attending the TMS Annual Meeting & Exhibition, these grants assist attendees with expenses related to childcare, eldercare, care of a family member with disabilities, or personal assistance needed at the meeting due to a disability. Beginning with the TMS 2023 Annual Meeting & Exhibition (TMS2023), the TMS Foundation will expand the program to fund a total of 30 grants per year (up from 20 grants currently). Grants of up to \$500 per household are available to registered meeting attendees. Learn how to apply for a grant for TMS2023 at www.tms.org/TMS2023.

Young Leaders Professional Development Award:

For more than 25 years, the TMS Young Leaders Professional Development Award has helped early career professionals develop valuable professional skills and connections. Currently, two individuals are selected from each of the five TMS technical divisions to receive a development award each year. Beginning with the 2024 awards cycle, this number will expand to three individuals from each technical division, for a total of 15 early career professionals benefitting from this program each year. Applications for the 2024 TMS Young Leaders Professional Development awards are due August 15, 2023. Visit awards.tms.org for details on how to apply.

Doubling the number of available awards offered by these two programs has been the focus of the TMS Foundation's fundraising efforts since 2021. This initial expansion marks the halfway point to these goals. A third goal is to re-establish the TMS Presidential Scholarship. To find out more about the TMS Foundation or to make an online contribution, visit www.TMSFoundation.org.

TMS2024 Symposium Proposals Due January 31

Beginning with the TMS 2024 Annual Meeting & Exhibition (TMS2024), the TMS Program Committee has developed a new timeline for proposing TMS Annual Meeting symposia. Symposium proposals will now be due January 31 of the preceding year—approximately two months earlier than previous years' deadlines. For TMS2024, the following timeline has been established:

- Organizers submit symposium proposals by **January 31, 2023**

- Program Committee reviews proposals through **February 28, 2023**
 - Feedback provided to symposium organizers by **March 7, 2023**
 - Technical committee review and sponsorship at TMS2023 through **March 23, 2023**
 - Call for abstracts opens by **mid-April 2023**
- Symposium proposals can be submitted through the Programming section of the TMS2024 website at www.tms.org/TMS2024.

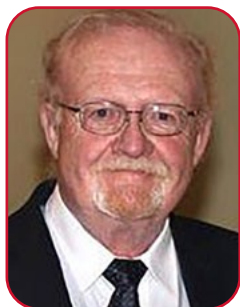
TMS Committee Name Changes

The TMS Board of Directors approved the renaming of the Membership & Student Development Committee and the related director position to the Membership Diversity & Development Committee and Membership Diversity & Development Director, respectively, at its August 2022 meeting. Also approved is the renaming of the Young Professionals Committee to the Emerging Professionals Committee.

2023 TMS Meeting of the Membership and Open Board of Directors Meeting

The Minerals, Metals & Materials Society, Inc. (TMS), in accordance with its bylaws (Article II, Section 2.6, and Article III, Section 3.7) will hold its 2023 Annual Meeting of the Membership with Open Board of Directors Meeting, on Thursday, March 23, 2023, at 8 a.m. (PT) at the San Diego Hilton Bayfront, during the TMS 2023 Annual Meeting & Exhibition in San Diego, California.

A Tribute to Richard Hoagland



Richard (Dick) G. Hoagland passed away September 29, 2022, at the age of 81. He was a TMS member since 1981 and a 2010 TMS Fellow.

He was born in Denver, Colorado and received his BS in metallurgical engineering from Colorado School of Mines in 1962. He worked as a research scientist at Battelle Northwest Lab from 1962 to 1969. While working at Battelle, he received his MS degree in materials science from Washington State University (WSU), and then moved to The Ohio State University where he earned his PhD in metallurgical engineering in 1973, advised by John P. Hirth.

After his PhD, he worked as a principal research scientist at Battelle Institute until 1979, when he transitioned to academia, first at Vanderbilt University and then at The Ohio State University. In 1987, he became professor of materials engineering at WSU, where he served as chair of the materials engineering program, Westinghouse Distinguished Professor in Materials Science, and the director of the Center for Materials Science. He was recognized as a Senior Scientific Fellow by Pacific Northwest National Laboratory (PNNL) in 1989. In 1999, he became professor emeritus at WSU and spent a year at Los Alamos National Laboratory (LANL) as the prestigious Bernd T. Matthias Scholar in LANL's Center for Materials Science. From 2000 to 2003, he consulted for LANL and for PNNL and in 2003, he moved to LANL as a senior staff scientist. He retired in 2009 and worked as a lab associate at LANL until he passed away. His career in metallurgy/materials science spanned 60 years and served three sectors: industrial research and development, academia, and national laboratories.

Dr. Hoagland made seminal contributions in both experimental and computational materials research. He was involved in the development of an ASTM method to measure plane-strain crack-arrest fracture toughness to evaluate the safety of nuclear reactor pressure vessels. He was the first to employ flexible

boundary conditions (FLEX II) in atomistic models of defects that enabled significant improvement in computational speed and accuracy, as early as 1970. He also championed developments in atomistic modeling of fracture, hydrogen embrittlement and toughening mechanisms in ceramics. At LANL, he was a principal leader in the atomistic modeling of deformation mechanisms in nanolayered materials, and made important discoveries about the complex atomic structures of interphase boundaries in metals. This work provided the basis for atomic-scale defect interactions involved in the fabrication of ultra-high-strength, radiation-damage tolerant metallic composites.

Throughout his career, he mentored a diverse group of doctoral and postdoctoral students and early and mid-career scientists who are now tenured faculty in academia or staff scientists at national laboratories. He was an inspirational mentor who motivated young scientists to deliver their best. He was known for asking probing questions, explaining difficult scientific concepts with ease and humor, and developing lifelong friendships with scientific colleagues. He enjoyed fishing in the rivers and lakes of the American West, astronomy, painting, and cooking. His love of cooking and science produced creative outcomes, including a "nano-layered salmon" dish for a reception at his residence in Santa Fe, New Mexico, in which he arranged arrays of capers to replicate the atomic structure of an interphase boundary.

Dr. Hoagland received numerous honors and awards for his outstanding research accomplishments and became the first LANL scientist to be honored with the rank of Fellow in three materials science professional societies: ASM International, TMS, and the Materials Research Society. He is survived by his spouse Cheryl, a son, a daughter, and four grandchildren.

--Contributed by A. Misra, P.M. Anderson & J.P. Hirth on behalf of Dick Hoagland's colleagues at TMS.
Acknowledgements to C. Hoagland, M.J. Demkowicz, S.J. Fensin, N.A. Mara, S.A. Maloy, S.G. Srivilliputhur, B.P. Uberuaga, J. Wang and others for reviewing and editing this tribute.

In Memorium

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

| | | | | |
|--------------------|-------------------|-------------------|--------------------|------------------|
| Clyde Adams | C. Cochran | John Forst | Ralph McAlister | Richard Reddy |
| Jagdish Agarwal | Hans Conrad | William Harms | Arthur J. McEvily | George Robinson |
| Frank Aplan | Francois D'heurle | Richard Hunnicutt | Carl McHargue | Joseph Sevic |
| Richard Bauer | Thomas W. Eagar | David Krashes | Wilfred Nagel | David B. Snow |
| Jack S. Brett | Edwin Eiswerth | Henry Kurtz | Michael Nevitt | Paul Spencer |
| Lynwood Burkhalter | August Ferretti | David Levinson | Robert Peppers | William Stauffer |
| Ye Chou | George Fischer | Charles Licht | Harold P. Rajcevic | |

New AIME Oral Histories Spotlight TMS Members



Rodney R. "Rod" Boyer



Raymond Decker



Peter Liaw



Donald R. Sadoway

The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) has released new videos as part of their Oral History project. This project strives to support part of the Institute's mission, by preserving and promoting the achievements in the fields and sharing prominent members' stories with future generations.

Four new TMS members' histories have been added to the existing collection:

- **Rodney R. "Rod" Boyer**, Retired, RBTi Consulting
Title: *Rodney R. (Rod) Boyer: The Ti Guy*
- **Raymond Decker**, Chief Technology Officer, Thixomat/nanoMAG, LLC, and Adjunct Professor, University of Michigan
Title: *Raymond Decker: A Life Full of Serendipity and Discovery*

- **Peter Liaw**, Endowed Ivan Racheff Chair of Excellence, Department of Materials Science and Engineering, University of Tennessee
Title: *Peter Liaw: Success in Academia Through Devotion and Dedication*
- **Donald R. Sadoway**, Professor of Materials Chemistry, Massachusetts Institute of Technology
Title: *Donald Sadoway: Pursuing Service with a Passion to Change the World*

Visit the AIME Oral Histories web page at <https://aimehq.org/what-we-do/oral-histories> to learn the story of your profession in the words of those who have lived it. Check the AIME Oral Histories page regularly for announcements when new TMS member interviews are available, or to submit a candidate for AIME's Oral History capture.

TMS Award Recipients Honored at TMS2023 in March

TMS will honor its society- and division-level award recipients at the 2023 TMS-AIME Awards Ceremony & Reception on Wednesday, March 22, as part of the TMS 2023 Annual Meeting & Exhibition (TMS2023) in San Diego, California. Award recipients, their guests, and TMS2023 registrants are all invited to attend the ceremony, which will feature award presentations from both TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), of which

TMS is a member society. A ticketed reception will be held prior to the ceremony; TMS2023 attendees can purchase tickets for this reception for \$25 each through the TMS2023 registration form.

For a preview of the 2023 TMS Award recipients, visit the TMS Honors and Awards website at awards.tms.org and select Current Award Recipients from the menu. The last day to register for TMS2023 at the discounted early registration rate is January 31, 2023.

Professional Societies Honor TMS Members

Congratulations to the following TMS members who were recently honored at awards events held by various materials professional societies.



The American Ceramic Society (ACerS)

Presented at the ACerS Annual Awards Banquet held in conjunction with Materials Science & Technology 2022 (MS&T22) on October 10, 2022 in Pittsburgh, Pennsylvania, USA.

2022 Fellow

Janet Callahan, Michigan Technological University
TMS member since 1992

Shen Dillon, University of California, Irvine
TMS member since 2010

Yanwen Zhang, Oak Ridge National Laboratory
TMS member since 2011

Richard M. Fulrath Award, American Industrial
Tobias Schaedler, HRL Laboratories, LLC
TMS member since 2006



ASM International

Presented at the ASM Awards Dinner, September 13, 2022, in New Orleans, Louisiana, USA, in conjunction with IMAT22.

2022 Fellow

Nick Birbilis, The Australian National University
TMS member since 2004

Carelyn E. Campbell, National Institute of Standards and Technology
TMS member since 1988

Qing Chen, Thermo-Calc Software AB
TMS member since 2008

Nikhil Gupta, New York University
TMS member since 1997

Hideyuki Kanematsu, National Institute of Technology (KOSEN)
TMS member since 1993

Jian Luo, University of California, San Diego
TMS member since 2005

Paul K. Mason, Thermo-Calc Software, Inc.
TMS member since 2001

Douglas M. Matson, Tufts University
TMS member since 1996

Todd A. Palmer, Pennsylvania State University
TMS member since 1992

Timothy J. Rupert, University of California, Irvine
TMS member since 2007

Adrian S. Sabau, Oak Ridge National Laboratory
TMS member since 1999

Narasi Sridhar, MC Consult, LLC
TMS member since 2020

Michael D. Uchic, Air Force Research Laboratory
TMS member since 1999

Jian Wang, University of Nebraska-Lincoln
TMS member since 2000

Cyril L. Williams, US Army Research Laboratory
TMS member since 2011

Gold Medal Award

Glenn S. Daehn, The Ohio State University
TMS member since 1987

Albert Sauveur Achievement Award

Mark F. Horstemeyer, Liberty University
TMS member since 1998

J. Willard Gibbs Phase Equilibria Award

Kallarackel T. Jacob, Indian Institute of Science
TMS member since 1978

Albert Easton White Distinguished Teacher Award

John J. Lewandowski,
Case Western Reserve University
TMS member since 1984

Bronze Medal Award

Abdallah Elsayed, University of Guelph
TMS member since 2007

Bradley Stoughton Award for Young Teachers

Ashwin Shahani, University of Michigan
TMS member since 2011



The Metallurgy and Materials Society (MetSoc) of the Canadian Institute of Mining, Metallurgy and Petroleum

Presented at the MetSoc Annual Awards Banquet on August 23, 2022, Montreal, Quebec, Canada in conjunction with the Conference of Metallurgists 2022.

MetSoc Airey Award

Tony Warner, Worley
TMS member since 1988

MetSoc Award for Research Excellence

Mihaiela M. Isac, McGill University
TMS member since 2009

MetSoc Brimacombe Award

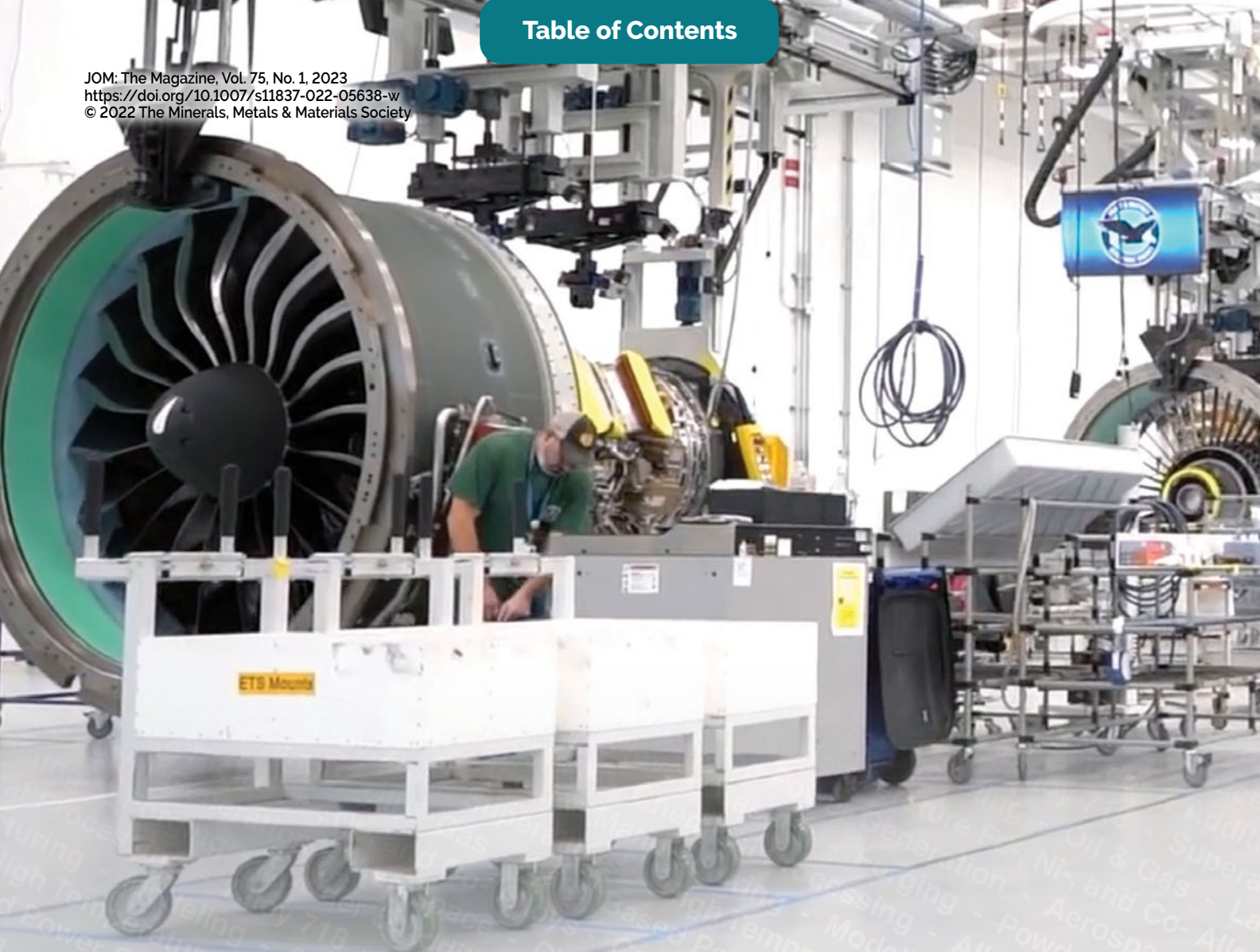
Leili Tafaghodi, McMaster University
TMS member since 2009

Pyrometallurgy Best Paper Award

Sam Marcuson
TMS member since 1992

Light Metals Best Paper Award

Ian W. Donaldson
TMS member since 1984



CELEBRATING A MOST REMARKABLE METAL

Lynne Robinson



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Superalloys have made many of the signature technologies of the modern age possible. Suited for the most punishing operating conditions, this iron, cobalt or nickel-based alloy system can be pushed to the highest fraction of its melting point and also operate effectively at cryogenic temperatures, all the while offering superior corrosion and oxidation resistance. Because of these remarkable properties, superalloys have enabled us to connect the world through jet travel, probe the possibilities of space, explore energy sources deep beneath the earth and sea, and ensure the energy generation necessary to sustain our way of life.¹

TMS has long supported the superalloys technical community in its mission to improve the performance and production of these metals in the face of evolving service conditions and economic challenges. The next milestone on this journey is the 10th International Symposium on Superalloy 718 & Derivatives (Superalloy 718 & Derivatives 2023).

REGISTER TODAY!

SUPERALLOY 718
and Derivatives

Superalloys 718 and Derivatives 2023

May 14-17, 2023

Sheraton Pittsburgh Hotel at Station Square
Pittsburgh, Pennsylvania

Discount Deadline: April 3, 2023

www.tms.org/Superalloy718-2023

BUILDING ON A LEGACY OF EXCELLENCE



Joel Andersson

"The conference has a legacy of a high standard research within the field and covers a broad range of manufacturing processes of structural components of high importance to aerospace as well as the energy sector," noted Joel Andersson, organizing committee chair for Superalloys 718 & Derivatives 2023. "It's also very well-balanced in academic and industrially oriented research, with a very friendly and welcoming atmosphere."

Andersson speaks from experience to the legacy and impact of this conference, crediting its "welcoming atmosphere" coupled with high-quality technical content as factors in his own career development. "My first conference was Superalloys 718, 635, 706 & Derivatives in 2005, chaired by E.A. Loria," he said. "It was a great experience for me as a young grad student to meet all the important people in the world in relation to superalloys. I still remember the kindness and impressive knowledge Dr. Loria possessed and gladly shared."

"During the conference I joined TMS and have been a member ever since," Andersson continued. "After the 2005 conference, I started my Ph.D. studies at Chalmers University of Technology, and in collaboration with Volvo Aero Corporation (GKN Aerospace Sweden), pursued research in welding and weldability testing of precipitation hardening Ni- and Ni-Fe- based superalloys—an area which is still very close to my heart and where I nowadays supervise several Ph.D. students on my own."

Joel Andersson (right) with E.A. Loria at the first conference that Andersson attended—Superalloys 718, 635, 706 & Derivatives in 2005, chaired by Loria.



David Furrer

DAVID FURRER, SUPERALLOYS 718 & DERIVATIVES 2023 KEYNOTE SPEAKER

David Furrer is Senior Fellow Discipline Lead at Pratt & Whitney. In the following interview, he previews his keynote talk, "Application of Computational Materials and Process Modeling to Current and Future Aero-engine Component Development and Validation," which he is slated to deliver at Superalloys 718 & Derivatives 2023.



Integrated computational materials engineering (ICME) is a relatively new discipline that is growing in its adoption. What have been some of the key milestones in its evolution so far, particularly as it relates to superalloys?



Actually, ICME is not new. It has been around for decades in various forms and fashion. The identification of the utility and value of formally linking materials and process models to other engineering discipline workflows (e.g., design, structures, manufacturing, quality, etc.) has made the formalized concept of ICME more visible. I feel that a number of critical technologies have now matured sufficiently and are being individually adopted to allow for ICME to effectively be more fully deployed. These enabling technologies include enhancements in physics-based understanding of materials mechanisms (physics-based models), advanced characterization methods that are supporting physics-based model development and validation, new software and computational methods for efficient simulation and prediction capabilities, and focus and advancement of materials and process data management and analytics (AI/ML).

Today, Andersson is a professor of Materials Science, Head of the Division of Welding Technology and Director of Production Technology at University West in Trollhättan Sweden. As a way of giving back for the professional experiences that shaped him, he joined the Superalloys 718 and Derivatives organizing committee in 2014 and has been committed to this conference's development ever since. "It feels great to work and learn from all these knowledgeable people on the committee," he said. "I try my best to contribute to the high standard that this conference holds as its reputation."

Reflecting on how topic areas have changed since his first conference, Andersson said, "In 2005, there was a tremendous amount of research on 718Plus which made a strong impression on me. The focus on 718Plus then gradually shifted to Haynes 282 by the conference in 2010. Now, in the last few iterations, there has been a shift in process focus, particularly with regards to additive manufacturing."

Powder and Additive Manufacturing once again figures in the list of technical topics to be explored at Superalloys 718 & Derivatives 2023 meeting. In addition, industry-focused topics, such as Aerospace, Land-Based Power Generation, and Oil and Gas, are joined by topics such as Modeling and Data Analytics that examine emerging tools and techniques.

"There are also some very interesting papers within my own favorite area of welding and welding-based additive manufacturing which I very much look forward to listening and learning more from," said Andersson.

As with past conferences, all papers presented undergo rigorous peer review, with all speakers required to submit full manuscripts for the proceedings.

SUPERALLOY 718 and Derivatives

CONTRIBUTE TO BREAKING NEWS

A call for breaking news abstracts will open for Superalloys 718 & Derivatives 2023 on January 18 and close on March 31, 2023. If you missed the opportunity to contribute a paper, this is your chance to share your insights at this prestigious meeting, sponsored by the TMS Structural Materials Division and High-Temperature Materials Committee.

Visit www.tms.org/Superalloy718-2023 for details and to submit your abstract.



What are some of the current challenges to ICME's growth and deployment?



Industrially practical (fast, accurate, and cost effective) software tools are an important part of deployment and adoption of ICME-type technologies and capabilities.

This is readily occurring at all the existing software companies who have traditionally supported other engineering disciplines with finite element (FE), computational fluid dynamics (CFD), and other methods. Materials and process specific software tools are also continuing to advance in capability and functionality, including thermodynamic and kinetics modeling tools, as well as continuum process modeling packages.

Two major hurdles exist for continued implementation of ICME. Workflows that can link modeling tools and associated simulation prediction are ad hoc as best, and largely left to individual organizations to manage with no standards. Additionally, deterministic treatment of ICME will provide answers to only so many questions (a huge number, by the way), but to provide the ultimate benefit from ICME tools there is a need for full linkage between material, process, and product design in a probabilistic manner.

Statistical material science and engineering must be more completely adopted. Average grain size and other microstructural features and processing parameters do not provide sufficient information to fully answer the questions asked of the materials community by our other engineering discipline counterparts, leaving the requirement for huge amounts of testing, empirical design systems, and complex qualification/certification processes. This challenge is being overcome with tools and methods such as statistically equivalent representative volume elements (SERVEs) tools and frameworks.

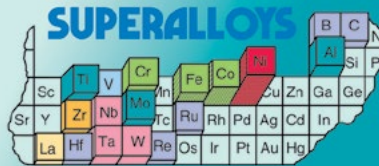
Additional conference highlights include two keynotes. Melissa Martinez, Vice President, Product & Process Technology, ATI Metals, U.S. will present a historical overview in "Meeting the Challenges of the Future by Understanding Our Past" What the future may hold is the focus of the keynote talk delivered by David Furrer, Senior Fellow Discipline Lead, Materials and Propulsion Technology, Pratt & Whitney, U.S. **(Editor's Note:** The question-and-answer interview with Furrer as part of this article offers a preview of his keynote topic.)

"I'm looking forward to listening to our keynote speakers—They span an impressive breath of experience and knowledge from superalloy production aspects to end user perspectives," commented Andersson.



Chantal Sudbrack

Chantal Sudbrack, conference co-chair, has been involved with organizing Superalloys 718 & Derivatives since its 2018 installment, when she was recruited to the organizing committee because of her symposium organizing experience and involvement with the TMS High Temperature Alloys Committee and her own research into Alloy 718. Currently a research engineer with the U.S. Department of Energy National Energy Technology Laboratory (NETL) and principal investigator for NETL's advanced materials development and advanced turbines programs, Sudbrack points to the sister conference of Superalloys 718 & Derivatives, as a formative early career experience.



EXPLORE THE SUPERALLOYS PROCEEDINGS ARCHIVE

The Superalloys Conference Proceedings Archive offers a searchable, online collection of more than 1,000 technical articles that document the history of these important materials, starting with the 1968 International Symposium on the Structural Stability in Superalloys. The archive is free to all users through the support of the International Symposium on Superalloys Subcommittee. To access the archive, visit www.tms.org, navigate to the Publications tab, and select Superalloys Proceedings Archive under the Proceedings and Other Resources heading.



In the abstract for your talk, you note that materials modeling is starting to be applied to emerging supply chain processes. Could you provide a brief, high-level overview of this development and its potential impact?



Metal additive manufacturing (AM), though actually an old process and concept, has seen a significant resurgence through enabling technologies such as advanced energy sources, automation, sensors, controls, etc. Modeling and simulation methods are being applied to AM in a significant way. The "emergence" of AM as a production manufacturing process is enabling the potential for a "clean sheet" approach to how components and associated processes should be designed, controlled and qualified/certified. Computational modeling is guiding the development of successful, robust build strategies for complex geometry components and highly alloyed materials. Additionally, process parameter sensitivities on a configuration-by-configuration basis can be assessed and "smart" quality control and certification test plans can be established. Computational modeling is enabling the viability of the highly flexible additive manufacturing process.



You also note in your abstract that computational modeling and simulation is being extended to component qualification and certification. Could you briefly comment on this development, its current prevalence, and its potential impact?



Modeling and simulation tools can provide critical information regarding component location-specific microstructure and mechanical properties (or residual stresses, etc.), which can be used to assess regions of interest for testing and validation. Such up-front analysis can also guide engineers in the identification of critical to quality (CTQ) processing parameters that must be controlled individually or in combination ("stacked" tolerances) to ensure reliable capability of meeting engineering design intent. Enhanced understanding of manufacturing controls and spatial distribution of properties and associated uncertainties throughout component volumes by the means of modeling tools provide a roadmap for efficient, rapid qualification and certification plans. Through-process modeling and data management and analytics will provide a digital thread (fingerprint) that defines a component at both a part number and serial number basis that will be used to support and justify focused qualification and certification plans.

"As a graduate student, I was aware of the prestige of the International Symposium on Superalloys and I was thrilled to prepare a poster on my Ph.D. research for the Superalloys 2004 conference," she said.

Both TMS-affiliated superalloys conferences offer a high standard of technical programming, Sudbrack noted, but still feels that a key reason to participate is "socializing and networking with seasoned and emerging professionals and key experts in the field."

And another reason?

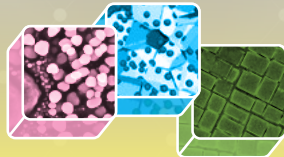
"Because superalloys are awesome!"

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CALL FOR ABSTRACTS OPEN | SUBMISSION DEADLINE: JULY 31, 2023

SUPERALLOYS 2024



Held every four years as the sister conference to Superalloys 718 & Derivatives, the International Symposium on Superalloys is the destination event for the full spectrum of the superalloys community. The call for abstracts is now open for the 15th iteration as the conference returns to Seven Springs Mountain Resort in Champion, Pennsylvania, after being compelled to hold the last symposium virtually due to the global pandemic.

In addition to the traditional focus areas of alloy development, processing, mechanical behavior, coatings, and environmental effects, the symposium invites papers from academia, supply chain, and product-user members of the superalloy community that highlight technologies contributing to improved manufacturability, affordability, life prediction, and performance of superalloys. The symposium is sponsored by the TMS Structural Materials Division and the High-Temperature Alloys Committee.

Visit www.tms.org/Superalloys2024 to submit an abstract by July 31, 2023 to be considered for inclusion in the technical program.



What is the main takeaway that you would like attendees to leave with after hearing your talk?



I would like attendees to understand that computational modeling capabilities are continuing to advance, and that they should be actively working to apply or further integrate such tools in their daily engineering, manufacturing, and quality functions. I feel the materials community can and should represent materials in a more statistical manner, which will also aid in understanding the full extent of material, process, and product capabilities.



Is there anything else you would like to add?



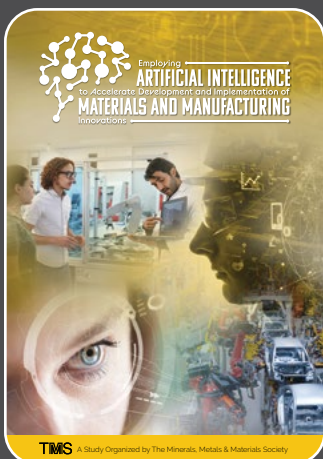
I feel materials and process modeling, and materials informatics will allow for the materials science and engineering discipline to continue to integrate with other disciplines for holistic product design and realization. Modeling will also provide a path for more efficient, cost-effective and capable products that can rapidly evolve through introduction and acceptance of new materials, manufacturing processes, configurational designs and other technologies.

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ANTICIPATING THE WAVE:

TMS Study Examines Potential of Artificial Intelligence

Elizabeth Holm



Artificial intelligence offers unprecedented opportunities in materials science and manufacturing. The latest TMS science and technology accelerator study charts a course.

DOWNLOAD YOUR FREE COPY!

Employing Artificial Intelligence to Accelerate Development and Implementation of Materials and Manufacturing Innovations is available to all for free download. Access your copy today at www.tms.org/Studies.

Artificial intelligence (AI) has the potential to revolutionize how materials and materials-related manufacturing research, development, and innovations are accomplished, and to significantly accelerate their pace, as well. Materials professionals with an interest in AI will find *Employing Artificial Intelligence to Accelerate Development and Implementation of Materials and Manufacturing Innovations* worth reading. Published in April 2022 on behalf of the Office of Naval Research and the National Institute of Science and Technology, it is the result of a 13-month study that began in April 2021. I served as chair of the 11-person lead study team, which was made up of internationally known subject matter experts from various materials, manufacturing, and AI-related backgrounds who represented academia,

national laboratories, and industry. Together, we completed eight virtual workshops, a series of online meetings, as well as homework assignments.

The lead study team delivered its initial recommendations to a small satellite team, who took a deep dive into a selection of target areas and met to develop those areas further. In the final stages, an independent review team of experts offered feedback on a draft of the final report. The outcome represents a consensus of the community of experts in this area.

The report's goal is to address a wide range of issues surrounding the deployment of AI in the development and implementation of materials and manufacturing. As a TMS accelerator report, it is meant to help the community bring this promising new technology to materials practice.



ABOUT THE AUTHOR

Elizabeth Holm is a professor and Department Chair of Materials Science and Engineering at the University of Michigan. She served as the 2013 TMS President, is a 2019 TMS Fellow, and was most recently honored with the 2022 AIME Honorary Membership Award and 2022 TMS Structural Materials Division Distinguished Scientist/Engineer Award, in addition to her numerous other awards and honors. She is currently the President-Elect of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME).

MEET THE STUDY TEAM - Thank you to all the following volunteers for their service.

Lead Expert Study Team

- Elizabeth A. Holm,
Study Chair, *University of Michigan*
- Surya Kalidindi,
Georgia Institute of Technology
- Adam Kopper,
Mercury Marine
- Kenneth A. Loparo,
Case Western Reserve University
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Massachusetts Institute of Technology
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Carnegie Mellon University
- Francesca Tavazza,
National Institute of Standards and Technology
- Christopher Wolverton,
Northwestern University

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- Henry Kvinge,
Pacific Northwest National Laboratory
- Renata Rawlings-Goss,
Georgia Institute of Technology
- Alok Sutradhar,
The Ohio State University

VALUE PROPOSITION

Interest in AI is growing in society, from our campuses to our news headlines. We have to understand how materials science and engineering (MSE) can intersect with AI to bring benefits across the materials community. From the start, the report presents an overarching value proposition for using AI in support of innovations, as shown in Table 1.

Table 1. Summary of the value proposition of utilizing AI in materials and manufacturing environments (right column) grouped by thematic implementation area (left column).

| Thematic Area | Value Proposition |
|---|--|
| Resource Optimization & Automation Greater efficiency and effectiveness of research and development efforts | Autonomous research <ul style="list-style-type: none"> Guides and accelerates autonomous experimentation and computational modeling efforts Directs which experiments are most effective to run |
| | Greater resource efficiency Automates "routine" tasks and improves time allocation of human researchers |
| | Better product quality Improves product quality and yield (e.g., via defect detection) |
| | Augmented decision-making AI-driven analytics enable faster and cheaper decision-making with greater precision |
| Pattern Analysis & Prediction Identification of data trends, and property-chemistry-structure correlations | Rapid materials discovery High-dimensional synthesis mapping enables rapid exploration of design spaces |
| | Extraction of novel science Enables discovery of new scientific principles unseen by humans |
| | Faster materials qualification Accelerates efforts to qualify new materials, processes, or components (e.g., via deep learning of multi-modal data) |
| | Accelerated delivery of new materials and processes Accelerates the implementation of new and innovative materials systems and manufacturing process methodologies |
| | Integration of diverse or disparate information sets e.g., multiscale, multi-fidelity experimental and simulation data sets |
| Greater Research Accessibility Increased accessibility of materials research through online platforms, open-source tools, data, and more effective modes of teaching and learning | Equitable use and access Brings together underserved communities by providing K-12 schools and universities (e.g., Minority Institutions (MIs) and Historically Black Colleges and Universities (HBCUs)) with affordable and accessible equipment and training resources for all communities |
| | Inclusive engagement <ul style="list-style-type: none"> Attracts students and professionals of all types AI has a lower cost of entry (e.g., compared with traditional manufacturing technologies) for small businesses, including women- and minority-owned businesses |
| | Diversity of ideas Enables connections across disciplines and areas of expertise |

To build the value proposition, the lead study team identified the key application areas and domains that hold great promise for the application of AI in materials and manufacturing. These include materials discovery and design; predictive maintenance and condition monitoring; materials characterization, imaging, and quality assessments; autonomous experimentation and decision-making; support for designing/selecting experiments; synchrotron beamline experimental data acquisition; anomaly detection in manufacturing processes; additive manufacturing process optimization and control; hybrid manufacturing, novel planning, and set-up.

**YOU MIGHT ALSO BE INTERESTED IN . . .
ARTIFICIAL INTELLIGENCE IN MATERIALS SCIENCE AND ENGINEERING.**

TMS (ONLINE COURSES

Online Course: April 3-5, 2023 Register today to build on the knowledge and skills you need to accelerate processes, reduce costs, and innovate products through AI. Visit www.tms.org/AICourse2023 to Register.

For each of the areas and domains, the “Gaps, Barriers, and R&D Enablers” chapter presents a succinct outline of impediments to deployment, as summarized in Table 2.

Table 2. Summary of the key challenge areas currently limiting the integration of AI into materials and manufacturing environments (left column) as well as the specific gaps and barriers which need to be addressed (right column)

| Key Challenge Area | | Gaps/Barriers |
|--------------------|--|---|
| A | Need for greater flexibility, reliability, and trustworthiness of AI algorithms | Limited interpretability, uncertainty quantification (UQ), and trust in AI predictions |
| | | Need for algorithms that adapt to varying levels of complexity, as related to small, heterogenous, multimodal, and/or incomplete datasets |
| | | Need for artificial intelligence/machine learning (AI/ML) models to integrate physical mechanisms and expert knowledge |
| B | Experiments that are difficult to automate or make autonomous | Robot-friendly hardware and software interfaces are required for autonomous experimentation |
| | | Most characterization tools use proprietary data formats |
| C | Lack of large-scale investments in AI for materials and materials processing/manufacturing innovations | Dedicated, sustainable, large-scale investments are required |
| | | Materials research funding typically does not support AI-related components of materials research |
| | | Funding opportunities typically separate AI from materials discovery and development |
| D | Lack of AI-related data infrastructure and best practices for capitalizing on such data | Revising existing manufacturing operations to capitalize on data collection to support AI methods is difficult |
| | | Data needs to be collected in a format that is conducive to sharing and interoperability |
| | | Lack of incentives for manufacturers to share data |

RECOMMENDATIONS AND ACTION PLANS

At the heart of the report, you will find eight recommended priority action plans with detailed tasks. Importantly, the report includes discussions on how to implement the recommendations. These discussions are relevant to all sectors and aim to foster a tight link between industry, government, and academia. A section of the report called “AI Resources Associated with Industry” is specifically called out. We want to make sure industry is integral to the collaboration.

Diversity, equity, and inclusion opportunities are also addressed here. MSE has not been a diverse community historically but, looking forward, the budding new field of AI has the potential to include individuals and communities who have not traditionally been represented in MSE. We want to be proactive to ensure we make this new branch of materials science extend to everyone.

OUTCOMES

TMS has completed science and technology accelerator studies in the past, with reports being available to freely download at www.tms.org/studies. Built on this template, the AI report will help develop new initiatives, such as webinars, short courses, specialty conferences, workshops, consortia, and additional studies. It also will enable the coordination of groups with complimentary interests.

Follow-up activities will further stimulate the impact of this science and technology accelerator report to continue moving the needle on leveraging the great potential of AI in materials and manufacturing innovations. TMS will continue to monitor and support the study and its related initiatives.

LONG-TERM VISION

AI pervades surprising areas of daily life and it is quickly extending to MSE. The lead study team perceives that in 10 years there will be a substantial sea change in the implementation of AI-based methods, such as machine-learning, data science, and computer vision. AI-based tools will become commonplace in MSE, from the classroom to the factory floor.

AI has immense potential not just *in* materials science but *specifically* in materials science. I encourage you all to download the report and spend time reviewing the recommendations and action plans. *Employing Artificial Intelligence to Accelerate Development and Implementation of Materials and Manufacturing Innovations* is an accessible and timely tool designed to help our community to fully understand and realize this potential.

Editor’s Note: This article is based on a presentation that Elizabeth Holm gave at the inaugural World Congress on Artificial Intelligence in Materials and Manufacturing on April 5, 2022.



Technical Meeting and Exhibition

MS&T22
MATERIALS SCIENCE & TECHNOLOGY

TMS PROGRAMMING AND EVENTS SHINE AT MS&T22

Kelly Zappas

More than 3,000 scientists, engineers, and students gathered in Pittsburgh, Pennsylvania, October 9-12, for the multidisciplinary Materials Science & Technology 2022 (MS&T22) technical meeting and exhibition, making it the best attended meeting in the conference series since MS&T18, held in Columbus, Ohio.

A reinvigorated exhibit and strong technical programming from four materials-related societies bolstered the overall event, while professional development programs and an inspiring plenary presentation were just a few of the high points for TMS members.

Read on for details about the highlights from MS&T22 and view more photos from the event at www.flickr.com/photos/tmsevents.

Technical Program Highlights

As in previous years, MS&T22 featured technical programming by TMS, the American Ceramic Society (ACerS), and the Association for Iron & Steel Technology (AIST). The Society for Biomaterials also joined MS&T22 as a co-sponsor and presented three symposia as part of the conference's technical program.

In total, more than 1,500 technical presentations were delivered at MS&T22 at more than 80 symposia in 15 technical tracks. TMS technical committees organized 28 of those symposia in areas of interest to TMS members and presented them as part of the TMS Fall Meeting within the larger MS&T22 program.

Many thanks to John Carpenter, Los Alamos National Laboratory, and Eric Lass, University of Tennessee, Knoxville, who served as the TMS representatives on the MS&T22 Program Coordinating Committee.

Solving Energy Issues with Technology

Iver Anderson admitted that the lecture he delivered at the **MS&T22 Plenary Session** on October 11 wasn't his usual technical talk. His presentation, "Materials Research on Clean Energy: For the Sake of our Grandchildren," was the TMS/ASM Distinguished Lectureship in Materials and Society. It began with a discussion of the causes and effects of climate change, laying the case for action among his fellow materials scientists and engineers, and then shared some of the energy-related solutions he and his colleagues at the U.S. Department of Energy (DOE) have been developing. Anderson is senior metallurgist, Division of Materials Sciences and Engineering, at DOE's Ames Laboratory, and adjunct professor, Materials Science and Engineering Department, Iowa State University.

"We've come up 1.1°C above where we were at the start of the industrial revolution," Anderson said. "And, the experts are saying we surely will reach 2 °C. It all depends on how fast we can go after that upper atmosphere problem."

He's referring to the greenhouse gases in the upper atmosphere that trap heat and warm the planet, intensifying events like wildfires, floods, and hurricanes. While some climate-change activists aren't very optimistic about technology being able to solve these problems, Anderson is.

"I think we can do a lot," he said. "And we need to be working on all of the issues that will help to blunt or reverse these negative effects to bring us to a much more stable environment."

First, he talked about grid

interconnections, which allow power to be shared across the country. "It's incredibly important to tie together the country," he said, explaining how this allows access to both wind- and solar-generated electricity, as well as to additional baseload sources, like nuclear power, that can be used when wind and solar are low.

"High-voltage direct-current (HVDC) power lines can be a very practical way to move power with far less losses over long distances and these kind of HVDC links have been established for a long time from the Pacific Northwest, where there's a tremendous amount of hydroelectric power, down into California," he said.

At Ames, Anderson and his colleagues have been working on an aluminum calcium composite conductor that can be used to strengthen HVDC power lines.

"Essentially there are thin filaments of calcium that are in an aluminum matrix, and these run the length of the wire," he said. "You have the pure aluminum running down the length, and the calcium is a reinforcement filament. The longer you stretch it, the better reinforcement filament it is."

A second advance that Anderson discussed addresses concerns related to increasing the use of nuclear power as a carbon-free energy source so that it can provide baseload power to supplement wind and solar. "That's really important to take some of the pressure off of grid-scale battery generation, if you also add to the baseload and you're not putting carbon into the atmosphere," he said.

But, Anderson notes, there is public



Top: Iver Anderson represents TMS at the MS&T22 Plenary Session. **Bottom:** TMS member Matthias Militzer delivers the AIST talk at the MS&T22 Plenary Session.

resistance to the idea of nuclear power, as many people fear a failure like the one that happened at the Fukushima Daiichi reactor in 2011, when steam oxidation of a cladding cap that was on fuel rods led to a breach and caused the plant to shut down. Anderson spoke of an alternative that his team is developing with collaborators at Pacific Northwest National Laboratory and North Carolina State for fuel cladding and other parts of the reactor that need to have high resistance to radiation damage.

"At this point, there's funding to go after a lot of these problems," he said. From increasing the use of renewable energy, to replacing retired coal-fired power plants with small modular reactors, to advances that bring nuclear fusion closer, Anderson noted that there is a lot that can be done. And there is a lot that members of the science and engineering community can do, as well.

"One strong thing you can do is volunteer to present a talk like this one," he said, noting that he has given similar talks to different organizations in the city of Ames. "We need to have that public outreach to get our population energized as much as we can be energized as professionals."

Anderson represented TMS as one of three plenary speakers at MS&T22. He was joined at the plenary session by Sanjay Mathur, University of Cologne, Germany, who represented ACerS with the presentation, "Ceramic Particles for Precision Drug Delivery" and Matthias Miltzer, University of British Columbia, who represented AIST with his presentation "Interface-based Design – A New Frontier for Microstructure Engineering of High-Performance Steels." Miltzer is also a TMS member and has been active on the TMS Steels Committee.

Honoring Carolyn Hansson

Resisting Degradation from the Environment was the subject of a special symposium at MS&T22 honoring Carolyn M. Hansson, professor emerita, University of Waterloo. Hansson celebrated her 80th birthday in 2021, and this symposium honored her research and pioneering experiences as a woman in science, technology, engineering, and math (STEM). The symposium consisted of two sessions of talks followed by a poster session on Monday, October 11.

A highlight of this event was a Fireside Chat—held in front of a virtual roaring fire—where Joey Kish, McMaster University, and Ashley Paz y Puente, University of Cincinnati, talked with Hansson about the decisions she made



Carolyn Hansson looks back on her career in a fireside chat.

A New Exhibit Concept



More than 100 exhibitors participated in MS&T22, making it one of the busiest show floors since MS&T14 (also held in Pittsburgh). For 2022, MS&T joined forces with Event Partners, a U.K.-based commercial exhibition firm, to expand the MS&T Exhibit Hall, in part by including two co-located events: **The Advanced Materials Show USA** and **The Nanotechnology Show**.

For the first time, MS&T opened the exhibit hall for anyone to attend, with no charge for exhibit-only registrants. As a result, more than 1,000 individuals came to the David L. Lawrence Convention Center in Pittsburgh just to attend the exhibit.

and the challenges she faced throughout her career.

When Hansson began her metallurgy studies at the Royal School of Mines at Imperial College, London, in 1959, she discovered that she was the only girl there. In fact, she was the first girl there. After a rocky start—the boys didn't know how to talk to her and she didn't know how to talk to them, she said—she settled in and began to have a good time.

One day, the head of the department called her into his office to let her know she was having too much of a good time and her marks weren't what they should be. He had just been to a meeting of department chairs of all the metallurgy departments in the United Kingdom, and his was the only department that had a woman in it. He had just been telling them what a benefit it was to have a woman in the department. "He said to me, 'If you don't pass, there won't be another girl admitted to a metallurgy college for many years,'" Hansson recalled.

She heard something similar at her first job, where she was told that they would hire her and, if it worked out, maybe they would consider hiring other women. In both situations, she decided that she needed to work hard to make sure that

other women would have a chance after her.

Throughout her career, she found that being a woman in engineering could be both a benefit and a drawback. "The pendulum swings," she said. "One minute you couldn't get a job because you're a woman, the next you get one because you're a woman. I don't want to be offered a job because I'm a woman but because I'm a person."

When you're the first at something—as she was often the first woman in her class and in her workplaces—she said it feels like you have to be perfect.

"How do you maintain excellence?" an audience member asked. Her answer? "You don't have to be excellent, just be good. Accept your failures and talk about them. Don't be afraid of it."

Looking back, the interviewers asked, would she have changed anything about her career? "If I went back to 18, I'd still say yes to metallurgy. I find it fun. I'm always amazed by nature."

The symposium was sponsored by the TMS Corrosion and Environmental Effects Committee and the TMS Steels Committee.

(From the top): Kester Clarke, Elizabeth Holm, and Jeffrey Fergus deliver talks at the Elizabeth Judson Memorial Symposium.



Exploring Education Techniques

On Monday, October 11, the TMS Accreditation Committee and the TMS Education Committee sponsored **Curricular Innovations and Continuous Improvement of Academic Programs (and Satisfying ABET along the Way): The Elizabeth Judson Memorial Symposium**. The one-day symposium featured talks from 11 speakers, as well as two panel discussions.

The first half of the day focused on curricular advances and accreditation, with the afternoon session examining what should be taught and how to teach it. Topics ranged from how to prepare students to work on diverse teams and strengthen communication skills to introducing students to sustainability topics, machine learning, and data science. Abstracts are now being accepted for the 2023 Judson symposium and a second TMS-sponsored education symposium, the TMS/ACerS Emerging Faculty Symposium, planned as part of the TMS Fall Meeting 2023 at MS&T23.

Professional Development Events

TMS offered two different types of professional development events at MS&T22, one focusing on technical skills and one on professional skills.

On Sunday, October 9, TMS offered its popular

Additive Manufacturing Materials and Processes Workshop

a half-day learning event that is regularly offered in conjunction with the TMS Annual Meeting and MS&T. Approximately 25 people participated in the course, led by Sneha P. Narra, Carnegie Mellon University.

For those who missed the MS&T installment, another session of the workshop is planned for the TMS 2023 Annual Meeting & Exhibition (TMS2023) on Sunday, March 19, in San Diego, California. The TMS2023 workshop will be led by Joy Gockel, Colorado School of Mines; Kirk Rogers, The Barnes Group Advisors; and

Scott Thompson, Kansas State University.

On Monday, October 10, the TMS Professional Development Committee sponsored a new event for students, early-career professionals, and anyone with an interest in honing their professional skills. More than 20 individuals participated in the **Improve Your Networking Skills Workshop by TMS**, which

was a unique blend of instruction and practical application led by Emily Kinser of 3M. Kinser also serves as Vice Chair of the TMS Professional Development Committee.

"We all hear the advice: 'Network!' But how?"

Kinser said. She offered the audience a number of practical tips on how to initiate a conversation, how to introduce yourself in a concise and memorable way, when to end a conversation, and how to follow up later with new contacts. She also

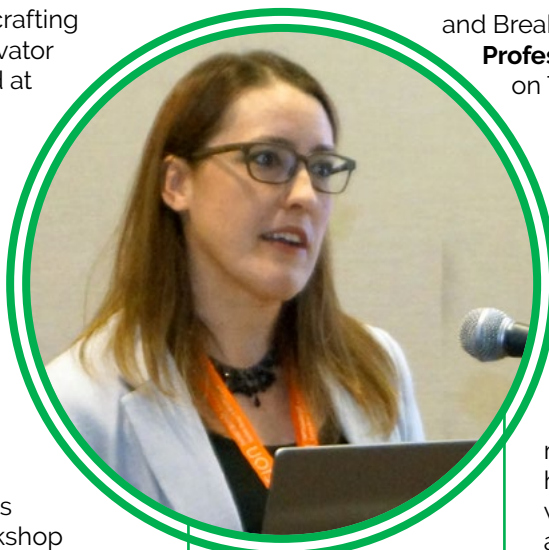


Participants practice their networking skills at a new MS&T workshop.

offered a series of tips on crafting a brief but memorable elevator speech that could be used at networking events.

After the presentation, participants spent some time putting these suggestions into action, introducing themselves and their work to their fellow participants.

This workshop was offered to all MS&T attendees as part of their registration fee. The TMS Professional Development Committee is planning another free workshop for attendees of the TMS 2023 Annual Meeting & Exhibition, this time focusing on communications skills. Visit the Professional Development section at www.tms.org/TMS2023 for more information.



Joy Gockel presents at the TMS Emerging Professionals Tutorial Luncheon and Lecture.

and Breaking Barriers," at the **TMS Emerging Professionals Tutorial Luncheon and Lecture** on Tuesday, October 11.

She began by providing the early-career professionals in attendance with an overview of additive manufacturing and its history, then delved into her own history. Gockel said that she started her education undecided—still uncertain whether she wanted to major in mechanical engineering or music education. Ultimately, she decided on engineering and progressed to the Ph.D. level, where she focused on additive manufacturing for her research. Once she had completed her doctoral degree, she worked in industry before returning to academia.

After describing her career path, she asked audience members to reflect on what they wanted their own careers to look like by identifying what they valued most.

"Seek out opportunities that allow you to accomplish the things that you value," she advised them. "If there's an opportunity

you want, go for it. If you go for it and you don't fail, you deserve it. You got it for a reason."

She pointed to additive manufacturing as an example of this idea. "Additive manufacturing started as art and science fiction," she said. "Because these innovators took risks—and many of the early ones failed—this technology was able to take hold."

Emerging Professionals Luncheon

Joy Gockel is an associate professor of Mechanical Engineering at Colorado School of Mines. She is also the vice-chair of TMS's interdisciplinary Additive Manufacturing Committee. Both of these roles informed her presentation, "Making Opportunities

TMS FALL 2023
@ MATERIALS SCIENCE & TECHNOLOGY



Visit www.tms.org/FallMeeting/TMSFall2023 to view a complete listing of TMS-sponsored symposia. You can also view the complete MS&T23 technical program—which includes symposia organized by TMS, the American Ceramic Society, and the Association for Iron & Steel Technology—at www.matscitech.org/MST23. Abstracts for all TMS Fall 2023 symposia and all other MS&T23 symposia are due April 3, 2023.

We hope to see you in October for the TMS Fall Meeting at MS&T23.

Submit Your Abstract by April 3

Materials Science & Technology 2023 (MS&T23) will be held October 1-5, 2023 in Columbus, Ohio. As part of the TMS Fall Meeting at MS&T23, TMS is sponsoring 24 symposia in 11 topic tracks:

- Additive Manufacturing
- Artificial Intelligence
- Ceramic and Glass Materials
- Education and Career Development
- Fundamentals and Characterization
- Iron and Steel (Ferrous Alloys)
- Lightweight Alloys
- Modeling
- Nuclear Energy
- Processing and Manufacturing
- Special Topics

Magnesium and Castles: *The Travel Diary of a TMS/JIM International Scholar*

Victoria Miller

Growing up, I never traveled much, so when I was selected as the 2022 TMS/JIM Young Leaders International Scholar I was honored, excited, and definitely a little nervous. It was a tremendous privilege to represent TMS at the 2022 Japan Institute of Metals and Materials (JIM) Fall Meeting, September 21-23, in Fukuoka, Japan.

Wednesday morning—twelve hours after landing at Fukuoka International Airport and only 24 hours after a typhoon passed—I found myself being introduced by Hideaki Yamamura at the conference opening ceremony, located at the Fukuoka Institute of Technology's campus. The conference itself was a well-organized whirlwind. It was the first in-person JIM meeting since the start of the pandemic, so the atmosphere was joyful as everyone saw old friends. To my pleasant surprise, I immediately found people who I already knew through my involvement in TMS,

As part of her experience as a TMS/JIM Young Leaders International Scholar, Victoria Miller toured the rebuilt Kumamoto Castle between technical visits.



Victoria (Tori) Miller (right) receives a certificate commemorating her award from Professor Yoko Mitari during the International Session.



Open a World of Opportunities: Give to the TMS Foundation

The TMS Foundation has given promising young scientists and engineers a chance to develop important scientific collaborations across global cultures since 2006 through the TMS Young Leaders International Scholar program. In cooperation with the Japan Institute of Metals and Materials (JIM) and the Federation of European Materials Societies (FEMS), the TMS Foundation has enabled early career professionals, selected by a competitive review of their accomplishments, to travel to the JIM and FEMS annual meetings to present scientific papers and participate in learning and networking activities.

Make a gift to the TMS Foundation today to ensure that this program and others continue to engage future generations of professionals in their scientific community. Scan the QR code provided or visit the TMS Foundation website at www.TMSFoundation.org to learn more and make an online contribution. For questions, contact TMS Foundation staff at TMSFoundation@tms.org



including Don Shih, Mingzhe Bian, Sae Matsunaga, and Tessa Davey.

The first day closed with the conference banquet, located in a beautiful venue on a peninsula. While the speeches were in Japanese, Professor Song-Zhu Kure-Chu from Nagoya Institute of Technology helped to translate for me. Afterward, conversation flitted from shape memory alloys to the best snacks to take home as souvenirs and back to microstructural engineering. The night ended with a fireworks show over the sea.

The second and third days of the conference featured the 1st International Session of the JIM Annual Meeting, organized by Professor Yoshihito Kawamura of Kumamoto University and chair of the International Academic Exchange Committee of JIM. These sessions highlighted research trends in various countries and included speakers from India, South Korea, Australia, China, and the United States. During this session, I gave a talk on my National Science Foundation CAREER-funded research on recrystallization in nickel-based superalloys. The talk was well-received and generated numerous questions about extending the research to other alloy systems. The session closed with an address by Takayoshi Nakano, president of JIM, on the importance of international collaboration and cooperation such as that facilitated by the Young Leaders International Scholar Award.

Friday morning, I took the train to the Chikushi Campus of Kyushu University where I visited the laboratories of Masatoshi Mitsuhashi and Hideharu Nakashima. Mitsuhashi and I spent over an hour

discussing our research, comparing techniques for microstructural characterization, and exchanging advice on sample preparation. I was thoroughly impressed by their characterization facilities.

Friday evening, the 1st International Session wrapped up with a banquet at a traditional Japanese restaurant for all the invited speakers. The food was incredible, but the real highlight was the conversation comparing food customs among all the represented countries. My hosts were tickled by my (mostly) proficient use of chopsticks. After the banquet, I took the shinkansen (bullet train) to Kumamoto in preparation for my visit to Kumamoto University and the Magnesium Research Center.

I am extremely grateful to Professor Yoshihito Kawamura and Mika Dyroff for coordinating my visit to Kumamoto. They even included some sightseeing in my itinerary! Saturday morning, I visited Kumamoto Castle and a nearby shrine. The castle had been destroyed in 2016 by an earthquake, but had been rebuilt as a historical museum.

Saturday afternoon, I visited the Magnesium Research Center (MRC) at Kumamoto University. Touring their facilities, I was excited and envious: they have equipment from nearly full-scale magnesium manufacturing to high-end nanoscale electron microscopy all in a single facility.

At the MRC, I gave a Special Institute for Light Metals International Seminar talk about my research in deformation twinning and recrystallization in magnesium alloys. The researchers at MRC were excited about the experimental and simulation methods we had used, and they challenged me to think about applying my methods to their alloys—opening the door for a potential collaboration.

All in all, my visit to Japan was a rewarding cultural and professional experience. I am grateful to the TMS Foundation and JIM for providing me with the opportunity. At every stage of my career TMS and the TMS Foundation have been there to both challenge me and give me unforgettable opportunities, like traveling to Japan for the first time. I can't wait to go back, and I can't wait to see what's next.



Associate Professor Masatoshi Mitsuhashi poses with a Titan transmission electron microscope at Kyushu University.

About the Author



Victoria (Tori) Miller is an assistant professor at the University of Florida. She is heavily involved in many TMS functional and technical committees and is currently serving as secretary of the Magnesium Committee. She was a recipient of the 2017 TMS Young Leaders Professional Development Award through the support of the TMS Foundation.

Meet Megan Burrill, Competitive Swimmer

Kelly Zappas

“Swimming is something that is non-negotiable in my life for my mental sanity and stress relief. There are so many things to keep track of while you're swimming that you really can't think of anything else.”

—Megan Burrill

Megan Burrill is a Ph.D. student at Northwestern University, a materials science graduate of the Illinois Institute of Technology (Illinois Tech), a TMS member through the Material Advantage program, and a former competitor in TMS Bladesmithing Competitions. Long before they started studying materials, however, Burrill discovered competitive swimming.

In second grade, Burrill joined the local swim team. Their mother—who had been a swimmer in high school—said they had to swim for one year so that they could learn to be confident and safe in the water. After one year, Burrill was hooked.

Growing up in a ski town, Burrill also skied and ran, but the other activities gradually dropped off, and, in their sophomore year of high school, they started swimming year-round.

“We got a new club coach that year, and he had a mathematical style of training that appealed to my way of thinking,” said Burrill. “He'd say, ‘Take your best 200-yard butterfly time, divide by four and then subtract two seconds. We're going to do 50 yards today, and I want you to hit that pace the entire practice.’ Having those goals in the back of your mind gives you something to focus on that's numerical.”



One of their favorite aspects of swimming is the connection between training and outcomes. “It's a sport where you can see results directly,” Burrill said. “You put in the work at practice, and then, at competitions, you have hard-cut numbers that show you if it made things better or worse. You can see how much daily habits pay off.”

It's a lesson that's carried over in their studies as well. “That's how I think about everything else now,” Burrill said. “When I need to get schoolwork done, I don't think, ‘I'm not motivated to do this assignment.’ I think ‘Here's the list of things I need to do for my classes.’ I go through and do them based on what's the most pressing and break it down into day-to-day steps to reach that final goal.”

Ultimately, it was swimming that led Burrill to Illinois Tech, where they graduated with co-terminal undergraduate and master's degrees in materials science and engineering in the spring of 2022. Having grown up in California, Burrill hadn't heard of the school until Illinois Tech's swim coach, who had heard of their speed in the 200-yard butterfly race, contacted them.

This article is part of an occasional feature series in which *JOM: The Magazine* shares stories about members and their hobbies, interests, and experiences outside of their TMS membership. To suggest a candidate for this feature, contact Kelly Zappas at kzappas@tms.org.

Burrill chose Illinois over other Division III schools that called partly because it had a materials science major and partly because it was a place where you could do undergraduate research. "I thought research could be something that interested me, but I wasn't necessarily sure, so I wanted to test it out as an undergrad before getting into grad school and deciding I didn't like it."

Bladesmithing

As a freshman at Illinois Tech, Burrill attended a club fair, looking for a club to join in their major that would help them get to know some other material science students at the school.

"I saw a table with a sword on it, so I had to stop. How do you not stop when you see a sword on the table?" Burrill said. The table belonged to a club for materials students, and that is how Burrill joined the school's Bladesmithing Club. "That was one of the major steps in getting into research and feeling confident about my major choice. It connected me with more senior students, who helped me find a small research project in the spring of freshman year. It really convinced me that first semester that I was in the right field."

In Burrill's freshman year, 2018–2019, the team made a kunai blade, a throwing knife associated with ninjas. They chose the kunai because, by its nature, it is a rough blade, not meant to be polished or decorative, and it met their requirements.

"We were limited by a few factors," Burrill said. "We were doing a cumulative roll bonding process to bond different types of steel together for that blade, so that meant the width of our billet was limited to the width of the drawing mill, and the length of the blade was limited by the length of our furnace. We also had a thickness constraint."

Because they were limited to these relatively small dimensions, the kunai seemed like a good option. Their team displayed the finished knife at the 2019 TMS Bladesmithing Competition, held at the TMS 2019 Annual Meeting & Exhibition in San Antonio, Texas.

The following year, the Illinois Tech team participated in the Bladesmithing Symposium held at the TMS 2020 Annual Meeting & Exhibition in San Diego, California. (The Bladesmithing Competition is held once every two years, with a research symposium held in alternating years.) By this time, Burrill had taken charge of the Bladesmithing Team and was beginning to look for a new material to work with.

"I didn't want to work with steel anymore," Burrill said. "I wanted a new material that was lower temperature and easier to either bond or cast in a billet. That makes life a lot easier."

The team threw some ideas around and decided on aluminum bronze, because both of those metals have a low melting temperature and the finished product is a pretty color when polished.

Commercial aluminum-bronze, Burrill said, is often used in pipe fittings and designed for high corrosion resistance. For a blade, you are more interested in high strength and high ductility properties.

"For the research project, we wanted to come up with an aluminum-bronze alloy that was better suited to a blade technology than to a pipe-fitting technology," Burrill said.

Megan Burrill (second from left) with the 2019 Illinois Tech Bladesmithing Team showing off their kunai throwing knife.



Megan Burrill (center) with the 2022 Bladesmithing Team (top). The Illinois Institute of Technology entry in the 2022 Bladesmithing Competition was an aluminum bronze khopesh (bottom).

During that research year, they experimented with different combinations that they could use to make a blade for the 2022 TMS Bladesmithing Competition. They realized that melting aluminum onto iron powder could cause an explosion in the furnace, so they abandoned that idea. Next, they tested out an alloy that was just aluminum and copper. Then, to add the iron content, they used stock aluminum bronze that had the iron pre-alloyed in so the reaction wouldn't be an issue.

"We found that the alloy with the most iron had the best strength and ductility," Burrill said. "Based off that, for the second blade, we bought a stock alloy and cast it down into the dimensions we wanted. We melted it, cast it in a billet, used the rolling mill to stretch the billet, and then forged it into the final curved shape."

The finished result was an aluminum bronze khopesh that was displayed as part of the Bladesmithing Competition at the TMS 2022 Annual Meeting & Exhibition in Anaheim, California. Burrill was the team captain for that entry, but by that time—their senior year of undergraduate studies—they had moved into a more administrative role: coordinating with professors to get lab space, making room reservations, overseeing the scientific process, and making sure the project was finished on time. Burrill, who was spending roughly 20 hours a week swimming and a lot of time preparing graduate school applications, was more than happy to let some of the other team members take over the bulk of the work of producing the blade.

In 2022, Burrill was awarded the TMS Materials Processing & Manufacturing Division Scholarship, a \$2,500 scholarship for undergraduate students in their sophomore or junior years, who are majoring in metallurgical and/or materials science and engineering. On receiving the award, they said, "TMS Bladesmithing ignited my love for materials science, and I sought every opportunity to learn more." Burrill also credited Bladesmithing with providing them the valuable experience of leading a research project and presenting the results at TMS2020.

Burrill never actually made it to the 2022 Bladesmithing Competition in Anaheim to see the final blade displayed because another important competition intervened.

Division III Swimming Finals

Two weeks after TMS2022, the Women's 2022 National Collegiate Athletic Association (NCAA) Division III National Swimming and Diving Championships took place in Indianapolis, Indiana, and Burrill had qualified for the 200-yard butterfly. Instead of traveling with the Bladesmithing team, Burrill stayed behind to train and prepare for the competition.

Qualifying for this national competition was impressive enough, but Burrill was only the second person from Illinois Tech to *ever* qualify for nationals. The first was a teammate who qualified but was unable to compete when the event was cancelled due to COVID-19. As a result, Burrill was the first person from the school who was able to travel to the venue for the competition.

"It was the biggest meet I've ever been to," Burrill said. Most of the other schools came with a whole team, but Burrill was solo.

They finished 23rd overall, but competing at the national level was an ideal ending to a successful varsity swimming career.



Megan Burrill (center) represents Illinois Institute of Technology at the Women's 2022 NCAA Division III National Swimming and Diving Championships.

What Comes Next

Now Burrill is a first-year Ph.D. student at Northwestern University, where they are researching hydrogen in energy and information sciences and are co-advised by professors Sossina Haile and James Rondinelli.

Their goal is ultimately to work with energy or energy-adjacent materials—either designing materials that allow us to better utilize green energy or designing materials that allow computers or other electronics to run with higher energy efficiencies. Burrill decided to pursue a Ph.D. because they knew they wanted to be in charge of research projects, leading and coming up with new ideas. No matter where their path ultimately leads, however, Burrill knows that swimming will still be a part of it.

Though not swimming competitively anymore, Burrill has joined Northwestern's swim club. It's much more casual than varsity swimming, they said, with three practices a week (all optional). Burrill also swims independently two mornings a week. But it keeps them in the water.

"Swimming is something that is non-negotiable in my life for my mental sanity and stress relief," Burrill said. "There are so many things to keep track of while you're swimming that you really can't think of anything else. I enjoy climbing, hiking, and that sort of thing, but I find that nothing else is quite the same. Swimming just gives me everything I need."

TMS Asian/Pacific Islander (API) Working Group Seeks to Raise Awareness

Dong (Lilly) Liu
Chair, TMS API Working Group

TMS

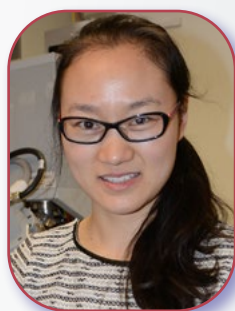
While API has a sizeable presence in the TMS community, they are underrepresented in leadership roles. This is similar to what is seen throughout the United States. Asian Americans comprise 13% of the American workforce, but only hold 6% of leadership positions. The discrepancy is even greater in the technology sector at 27% and 14%, respectively [1-3]. This disproportionate representation has often sidelined the voice of the API community—a situation that is particularly dangerous in our current times. Although anti-Asian hate is not a new phenomenon, crimes against Asian/Pacific Islander (API) communities rose considerably during the COVID-19 pandemic.

To address this issue and garner support for the API community, the TMS Diversity, Equity, and Inclusion (DEI) Committee established the API Working Group in 2022. The mission of the group is to raise awareness about micro- or macro-aggression against the API community, while providing a safe space for API

members to talk about their experiences, provide guidance, and share resources. The working group also encourages members of the API community to seek out leadership opportunities across all levels of the Society and provides a platform and open dialogue with other DEI working groups.

As its inaugural event, the working group will hold an API workshop and reception at the TMS 2023 Annual Meeting & Exhibition (TMS2023) on Tuesday, March 21, from 3:30 p.m. to 5:30 p.m. PT in San Diego, California. All TMS members who identify as API and API allies are welcome to attend. The workshop will feature world-renowned speakers sharing tips and advice on how to build a successful career and navigate the professional world as an API. There will also be opportunities for networking and providing suggestions for future events. The workshop and reception are free as part of TMS2023 registration, but to assist us in planning, we ask that you sign up ahead of time on the TMS2023 Registration Form.

Meet the API Working Group



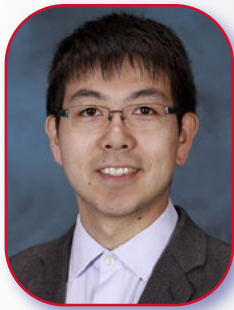
Dong (Lilly) Liu
University of Bristol

"I am a strong supporter of DEI as I believe it helps to generate better science and promotes positivity, productivity, mutual respect, and fairness. Establishing this working group is a positive step that will give the API community a voice and allow us to recommend TMS leadership opportunities to help them to succeed."



Yongqiang (Yong) Wang
Los Alamos National Laboratory

"Supporting DEI is important since I believe that while each of us may be from families with very diverse ethnic, cultural, or economic backgrounds, we all deserve respect and equal opportunities to fulfill our dreams. I am happy that the API Working Group will raise awareness at TMS and help to mitigate any potential unfair treatment."



Yue Fan
University of Michigan
"The pandemic has caused a lot of uncertainty in the world, and there is no moment more urgent than now that people from diverse backgrounds have a safe and supportive environment. By launching the API Working Group, TMS is playing a leading role and setting a high bar for other professional societies, and I am glad and proud to be part of it."



Eliana Fu
TRUMPF
"I have been incredibly concerned about the rise in anti-Asian hate crimes since the pandemic but also very proud about increased representation in the API community, particularly in STEM. I'm so proud that TMS has a place for our community so that we can increase awareness and representation."



Hojun Lim
Sandia National Laboratories
"This new initiative will help to raise awareness of recent hate crimes and discrimination against API groups. I am very excited to be a part of the WG and hope to contribute to the growth and development of API groups in the materials community."



Janelle P. Wharry
Purdue University
"Navigating a career path is challenging for everyone, especially for individuals facing discrimination and isolation based on their heritage or identity. Seeing TMS place value on inclusivity and equity for APIs makes me proud to contribute to this working group."



Amy Wat
Lawrence Livermore National Laboratory
"The creation of the API WG is critical to welcoming the API community within TMS and I am excited to pass forward the support I have received from this community to others."



Mengying Liu
Washington and Lee University
"Being minority and underrepresented person, I am always eager to contribute to DEI and the API community. I hope to bring up the awareness of the issues that APIs are facing to a broader audience in the TMS community and support their fairness and success in this field."



Assel Aitkaliyeva
University of Florida
"I am excited about the API Working Group and DEI efforts to help TMS be more inclusive. The pandemic has clearly shown us how isolated certain communities might feel and now that we are back to the 'new normal', I look forward to networking with API community and helping to address their concerns."



Maggie Chong
University of British Columbia (Student)
"I am pleased to be working with the team to help TMS become a welcoming space for all API students and professionals. I am particularly passionate about encouraging more women to enter this field."

References

1. Rhodes, Kirsten and Prabhakar, "Asian Americans: The 'Model Minority' Is Underrepresented in Leadership," *San Francisco Business Times*, May 26, 2021.
2. Tang, Christopher S., "Op-Ed: Why Successful Asian Americans Are Penalized at the Workplace," *Los Angeles Times*, May 6, 2021.
3. Chen, Brian X., "The Cost of Being an 'Interchangeable Asian,'" *The New York Times*, June 6, 2021.

In Case You Missed It:

BUSINESS NEWS FROM THE FIELD

Charlotte, North Carolina, USA:

Siemens is the inaugural customer of ExOne's InnoventPro™ metal 3D printer (Photo Left) and will use the 3D printer at its Charlotte Advanced Technology Collaboration Hub (CATCH) in Charlotte, North Carolina, to develop materials and processes before taking them to scale on the X1 160Pro™ extra-large metal 3D printer. (Photo Credit: ExOne)



Do you have business or industry news of interest to the minerals, metals, and materials community?

JOM
THE MAGAZINE

Submit your announcement or press release to Lynne Robinson, Department Head, Marketing and Communications, at lrobinson@tms.org.



Pittsburgh, Pennsylvania, USA: The Moonshot Museum (Photo Above) opened to the public in October 2022 with a focus on career readiness for the contemporary space industry. Launching a new model for collaboration between education-focused nonprofits and industry, Moonshot Museum enables visitors to experience simulated lunar missions designed to foster interest in pursuing space-related careers, including pathways in medicine, business, law, and policy. (Photo Credit: Astrobotic)

JFE Cuts Carbon Emissions

Tokyo, Japan: JFE Steel plans to spend 1 trillion yen on low-carbon technology over the next eight years to achieve its 2030 goal of cutting carbon dioxide (CO₂) emissions by 30% versus 2013 levels. That compares with Japan's overall 2030 target to cut CO₂ emissions by 46% from 2013 levels. JFE President Yoshihisa Kitano asked the government to help ensure JFE would get a premium on the sale of lower carbon steel to justify its investments.

New Software System Predicts Viability of HEA Material Combinations

Worcester, Massachusetts, USA: The Integrated Materials & Processes Design Group (IMPD Group) at Worcester Polytechnic Institute (WPI) have developed a software package called HEA_ML that predicts mechanical properties of high-entropy alloys (HEAs) in all composition ranges, including large and complex systems. Other software offerings have generally focused on the phase stability of new HEAs. HEA_ML predicts mechanical properties in any combination, and while it demonstrates data for the most popular Al-Co-Cr-Fe-Ni system, data can be expanded to address high-order systems, including 10 to 20 elements. Once possible compositions are identified, IMPD Group researchers can provide elevated-temperature, mechanical-property predictions for insights into how the mechanical property will perform under high temperature service conditions. In the automotive, aerospace, and military industries have begun using the software.

Bradda Receives Lithium Permit

Isle of Man, UK: Bradda Head Lithium Ltd, the North American-focused lithium development group, received permission to drill at Basin East Extension (BEE) in Arizona, adjacent to Basin East where Bradda has a 305 kt lithium carbonate equivalent JORC resource. Sonic drilling, will be used, which uses significantly less water than traditional core drilling, while yielding superior core recoveries for softer deposits like clay. Drilling results from BEE are expected to feed into a revised resource estimate on the Basin Project in early 2023. This will also form part of the resource for a preliminary economic assessment (PEA), due to start in 2023.

Plug and Amazon Sign Hydrogen Agreement

Latham, New York, USA: Plug Power Inc., a provider of turnkey hydrogen solutions, signed a hydrogen supply deal with Amazon to provide liquid green hydrogen starting in 2025 to help decarbonize Amazon's operations as part of its goal to be net-zero carbon by 2040. This deal is expected to help Plug achieve its 2025 \$3 billion revenue goal. Plug seeks to build an end-to-end green hydrogen ecosystem and provide integrated hydrogen solutions for its global customers.

TMS MEETING HEADLINES

Meeting dates and locations are current as of October 31, 2022. For the most recent updates on TMS-sponsored events, visit www.tms.org/Meetings.



TMS 2023 Annual Meeting & Exhibition (TMS2023)

March 19–23, 2023
San Diego,
California, USA

Discount Registration Deadline:

January 31, 2023

TMS2023 brings together more than 4,000 engineers, scientists, business leaders, and other professionals in the minerals, metals, and materials fields for a comprehensive, cross-disciplinary exchange of technical knowledge. Register today to join them!

www.tms.org/TMS2023



Superalloy 718 & Derivatives 2023

May 14–17, 2023
Pittsburgh,
Pennsylvania, USA

Discount Registration Deadline:

April 3, 2023

Superalloy 718 & Derivatives 2023 attendees gain networking opportunities across industries, forge new connections for future collaborations, and learn about the latest developments in alloy processes, applications, and modeling.

www.tms.org/Superalloy718-2023



7th World Congress on Integrated Computational Materials Engineering (ICME 2023)

May 21–25, 2023
Orlando, Florida, USA

Discount Registration Deadline:

April 7, 2023

ICME 2023 will benefit researchers, software developers, metallurgists, materials scientists and engineers, process engineers, senior scientists, chief technology officers, and a variety of others working in R&D. Attendees will gain insights on recent advances and discuss opportunities in the field.

www.tms.org/ICME2023



TMS Fall Meeting 2023 @ Materials Science & Technology (MS&T)

October 1–5, 2023
Columbus, Ohio, USA

Abstract Deadline:

April 3, 2023

TMS Fall 2023 presents robust programming, networking and social activities, and professional development events tailored to TMS member interests within the broader structure of the MS&T conference series, giving attendees an opportunity to experience both their TMS community and the resources of all the MS&T partnering societies.

www.tms.org/FallMeeting/TMSFall2023

Other Meetings of Note



3rd World Congress on High Entropy Alloys (HEA 2023)

November 12–15, 2023
Pittsburgh, Pennsylvania, USA
www.tms.org/HEA2023



TMS 2024 Annual Meeting & Exhibition (TMS2024)

March 3–7, 2024
Orlando, Florida, USA
www.tms.org/TMS2024



15th International Symposium on Superalloys (Superalloys 2024)

September 8–12, 2024
Champion, Pennsylvania, USA
www.tms.org/Superalloys2024

Offshore Technology Conference (OTC) 2023
May 1–4, 2023
Houston, Texas, USA
Co-sponsored by TMS

European Metallurgical Conference (EMC 2023)
June 11–14, 2023
Düsseldorf, Germany
Co-sponsored by TMS

OTC Brasil 2023
October 24–26, 2023
Rio de Janeiro, Brazil
Co-sponsored by TMS

Materials in Nuclear Energy Systems (MiNES 2023)
December 10–14, 2023
New Orleans, Louisiana, USA
Co-sponsored by TMS

THE WORLD COMES HERE.

TMS 2023

152nd Annual Meeting & Exhibition

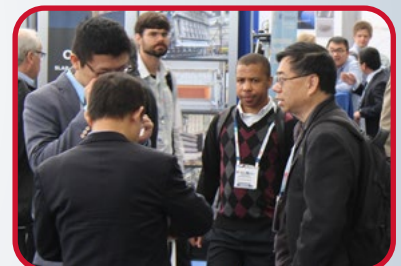
PRE-SHOW REPORT



MARCH 20-22, 2023

HALL G
SAN DIEGO CONVENTION CENTER,
SAN DIEGO, CALIFORNIA, USA

#TMSAnnualMeeting
www.tms.org/TMS2023



TMS2023 EXHIBITOR LIST

(AS OF DECEMBER 5, 2022)

| Company Name | Booth Number | Company Name | Booth Number |
|---|--------------|---|--------------|
| ABB, Inc. | 305 | Plastometrex Limited | 201 |
| Alemnis AG/Angstrom Scientific Inc. | 308 | Precimeter Inc. | 405 |
| Almex USA, Inc. | 409 | Quantum Design | 605 |
| Bruker Corporation | 513 and 514 | REL, Inc. | 202 |
| Cameca | 510 | RUMUL North America LLC..... | 501 |
| Carl Zeiss Microscopy, LLC..... | 602 | Sistem Teknik Industrial Furnaces Ltd | 414 |
| CompuTherm, LLC..... | 611 | STAS-SERMAS | 402 |
| EDAX | 606 | Synton Mdp AG..... | 610 |
| FemtoTools AG..... | 502 | TA Instruments | 607 |
| GLAMA..... | 401 | Tekna | 505 |
| Haarslev Industries Press Technology GmbH + Co KG..... | 507 | Tenova Inc..... | 310 |
| Hycast | 306 | TESCAN | 412 |
| KLA Corporation | 608 | Thermo Calc Software Inc..... | 301 |
| Light Metal Age..... | 410 | Thermo Fisher Scientific | 416 |
| Maschinenfabrik Gustav Eirich GmbH & Co KG..... | 508 | UES, Inc. | 204 |
| MTI Corporation..... | 609 | Wagstaff, Inc..... | 302 |

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EXHIBIT FLOORPLAN

(AS OF DECEMBER 5, 2022)

Poster Session

Hall G

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|------------|--------------------|--------------------|--------------------|--------------------|------------|
| 215 213 | 216 315 214 313 | 316 415 314 413 | 416 414 513 | 615 514 613 | 612 610 |
| 211 209 | 210 | 312 310 409 | 412 511 410 509 | 512 611 510 609 | 608 |
| 207 205 | 307 206 305 | 308 407 306 405 | 408 507 406 505 | 508 607 506 605 | 606 604 |
| 203 201 | 204 303 202 301 | 304 302 401 | 404 503 402 501 | 502 | 602 |

SPACE STILL AVAILABLE — BOOK AN EXHIBIT BOOTH

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THE WORLD COMES HERE.

TMS 2023

152nd Annual Meeting & Exhibition



MARCH 19–23, 2023 | SAN DIEGO, CALIFORNIA, USA
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REGISTER AND BOOK HOUSING TODAY: JOIN US FOR THE FULLY IN-PERSON TMS2023

Join us at one of our most popular destinations for the TMS Annual Meeting & Exhibition: San Diego, California! Historically, San Diego has hosted the Society's best-attended meetings, and—with more than 4,500 abstracts submitted—we expect strong attendance once again for TMS2023.

WHY TMS2023

"I really enjoy meeting new collaborators, catching up with friends and colleagues, attending excellent programs and symposia, having wonderful hallway conversations, and exchanging crazy ideas scribbled on restaurant napkins."

—Fadi Abdeljawad,
*Assistant Professor, Department of Mechanical Engineering and
Department of Materials Science & Engineering,
Clemson University*



KEY DEADLINES

January 31, 2023: Discount Registration Deadline

February 23, 2023: Housing Deadline



SCAN ME

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