JOM THE MAGAZINE

APRIL 2023

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ABOUT THE COVER

David Rasel, TMS Head of Visual Communications, used an artificial intelligence (AI) bot called MidJourney to render 2023 TMS President Brad Boyce as an additive metal sculpture for this month's cover. To create the image, Rasel inputted Boyce's headshot into MidJourney as the source photo and experimented with several prompts or keywords that served as instructions for how to render the image. The prompts were carefully chosen to ensure that the final image accurately represented Boyce's likeness while also showcasing unique features and characteristics, resulting in a fusion of technology and artistry. See "2023 TMS President Brad Boyce: Building the Future with TMS" starting on page 8 for an introduction to this year's president.

Access Technical Journal Articles

TMS members receive free electronic access to the full library of TMS journals, including *JOM*. Technical articles published in *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 science 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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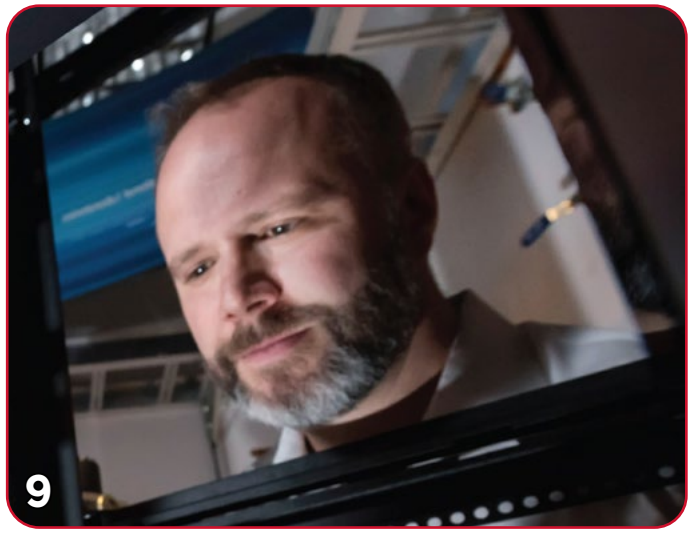

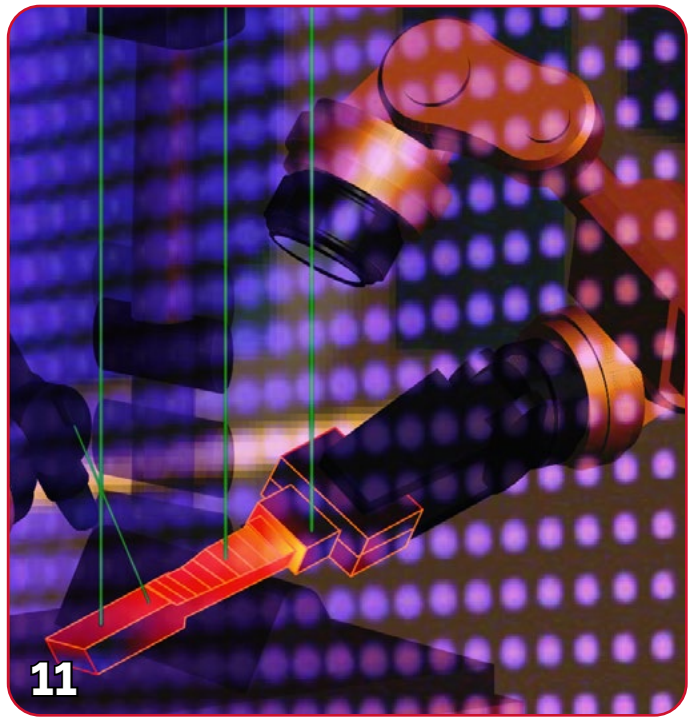

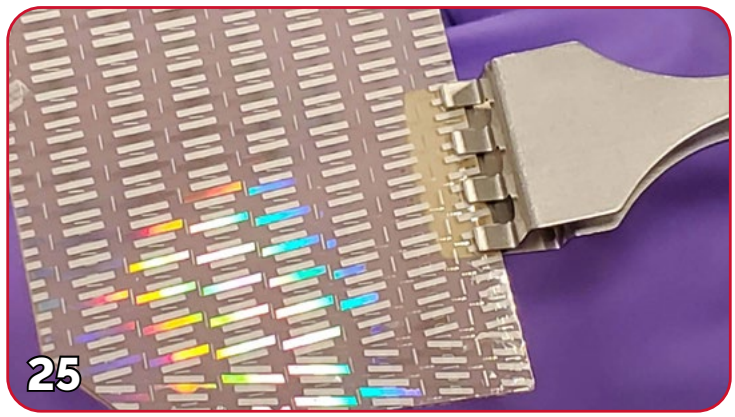

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IN THE FINAL ANALYSIS

JOM THE MAGAZINE

Volume 75
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"The first time a student realizes that a little learning is a dangerous thing is when he brings home a poor report card."

—Mark Twain

James J. Robinson
Executive Director

@JJRofTMS

While it is not quite a report card, I annually prepare the Executive Director Report for the Board of Directors on the Society's concluded year of performance. In general, the report summarizes progress toward goals assigned by the Board of Directors to the Executive Director (um, me). It also highlights notable developments in the realm of strategic and operational activities. Round it up, and the report forms a broad perspective on the Society's health, resilience, and vitality. The Board takes the report into consideration in preparing my performance review. The penalty for delivering a bad report card? No allowance? More likely, the next report card will be delivered by a different Executive Director.

The 2022 report comprises 25 entries. It is seven times longer than this column. So, I can't share it all with you here, but I can provide some highlights of the highlights. Here is what is top of my mind.

The toughest passage? 2022 was the year in which the impacts of the pandemic accumulated to the point that the Society could no longer lean into the philosophy of "waiting out the pandemic." Anticipating recovery sooner than it came, we had maintained full operating capacity, gone full speed in service of existing initiatives, and continued to undertake new initiatives. By October 2022 our events business was only sluggishly returning to normal. Losses mounted and a significant operating deficit became inevitable for 2022, and a sizeable one was looming for 2023. The Board's guidance? Cease maintaining operating capacity as if "normal" was to return in 2023 and instead govern from the perspective of developing a 2023 operating budget that would have a much-reduced deficit and that 2024 be either breakeven or generate a surplus. The reduction in the planned 2023 operating deficit was achieved by restructuring staff, renegotiating the headquarters lease to reduce the amount of office space required, and employing other cost-cutting/revenue-boosting tactics.

"The report forms a broad perspective on the Society's health, resilience, and vitality."

The most enjoyable passage? Leadership explored the creation of a "third annual" meeting. Yes, yes, . . . the world just groaned, "Oh no, not another conference!" But be of good cheer: This new event will not be meeting proliferation but rather meeting consolidation. Debuting midyear 2024, the annual TMS Specialty Congress will create a single big tent to house complementary existing and emerging specialty meetings of the Society. In addition to TMS offering fewer individual meetings, the initiative will build synergies among TMS specialty conference communities. The TMS Specialty Congress 2024 will pilot the new concept and comprise symposia on artificial intelligence, robotic forming, and mechanical behavior. TMS Specialty Congress 2025 will house TMS meetings on artificial intelligence, three-dimensional materials science, and integrated computational materials engineering. The 2026 installment is still evolving but will include artificial intelligence, high-entropy alloys, and at least one additional meeting.

The most aspirational passage? Through retreats and strategic planning by the Board of Directors, the focus on the TMS Aspires Strategic Plan remained strong. Indeed, the plan is expanding to consolidate a number of aspirational plans of the Society. Additions are being made to provide guidance for the future of the TMS Annual Meeting & Exhibition, to incorporate the TMS Resolves Plan (i.e., abolish barriers to the engagement of members), to add an expansion of the TMS Fall Meeting profile within MS&T, and to add a fourth goal ("TMS aspires to be a society that empowers industry to be at the leading edge of science and engineering").

Ostensibly, I've shared excerpts from the Executive Director Report. No doubt that I was engaged to some degree with all of it. The reality: The outcomes are the handiwork of a thousand volunteers, our headquarters staff, and many contractors. Teamwork. Despite some difficult passages, the team has a strong story to tell.

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JOM TECHNICAL TOPICS

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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 for access to technical journal articles on the Springer website.

APRIL 2023

Materials Interactions with Molten Salt for Nuclear Reactors

Scope: This invited topic includes papers on the topic of material interactions with high-temperature molten salts. Interactions can include corrosion and other type of degradation mechanisms, deposition, irradiation damage and irradiation effects on corrosion, methods for the study of materials interactions with molten salts, interaction of conventional and novel materials with molten salts, effect on mechanical and surface properties and any other types of physical or chemical interactions between materials and high temperature molten salts. Can include experimental, modeling, or theoretical analysis.
Editors: **Raluca Scarlat**, University of California, Berkeley, and **Stephen Raiman**, University of Michigan
Sponsor: Invited

Reprocessing and Recycling of Tailings from Metallurgical Process

Scope: In recent times, extensive research and cross-industry collaborative activities have contributed to the development of economical and sustainable routes to utilize tailings, extractive waste and metallurgy slags as secondary resource. This special topic features manuscripts on advances in reprocessing and recycling of tailings from various metallurgical processes such as minerals processing, hydrometallurgical and pyro-metallurgical extraction processes.
Editors: **Hong (Marco) Peng**, University of Queensland; **Fiseha Tesfaye**, Metso Outotec Finland Oy; **Joseph Hamuyuni**, Metso Outotec; **Chukwunwike Iloeje**, Argonne National Laboratory; and **Alexandra Anderson**, Gopher Resource
Sponsors: Recycling and Environmental Technologies Committee, Energy Committee, and Process Technology and Modeling Committee

The Incorporation of Secondary and Recycled Materials in a Primary Smelting Flowsheet

Scope: With an increase in the amounts of materials being consumed, the quantity of secondary and recycled materials is rapidly growing. While dedicated secondary smelters exist for processing these materials, the incorporation of these feeds in a primary smelter offers a low cost and easy way to increase the amount of these materials being processed. This topic focuses on the challenges and opportunities in incorporating secondary and recycled materials in a primary smelter.
Editors: **Jeff Chen**, University of Queensland, and **Stuart Nicol**, Glencore Technology
Sponsor: Pyrometallurgy Committee

Contribute to *JOM*: The Journal

Visit **www.tms.org/JOM** to access author tools that will answer your questions during every step of the manuscript preparation process, from determining the appropriate technical topic for your paper to reading the final product on SpringerLink.

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

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TMS MEMBER NEWS

JOM THE MAGAZINE

Share the Good News!

Contact Kelly Zappas at kzappas@tms.org to share your professional accomplishments. Please note that only news submitted by current TMS members will be considered.

Allison Beese Selected as Co-Director for CIMP-3D

Allison Beese was selected to serve as co-director of the Center for Innovative Materials Processing through Direct Digital Deposition (CIMP-3D) at Pennsylvania State University (Penn State) as of January 2023. CIMP-3D is a state-of-the-art processing laboratory for the additive manufacturing (AM) of materials such as polymers, ceramics, and metals for use in fields including aerospace, medical, energy, and defense industries. CIMP-3D brings together experts from across Penn State including the College of Engineering, the College of Earth and Mineral Sciences, the Materials Research Institute, and the Applied Research Laboratory.

Beese, a TMS member since 2014, has served on a multitude of TMS committees including the Mechanical Behavior of Materials Committee, the Content Development and Dissemination Committee, the Emerging Professionals Committee, and more. She is currently a member of the Additive Manufacturing Committee and the Education Committee. Beese is a recipient of the 2015 Structural Materials Division (SMD) Young Leaders Professional Development Award and the 2018 American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) Robert Lansing Hardy Award. She is also the recipient of an NSF Faculty Early Career Development Program (CAREER) Award.

Jeremy T. Busby Named Associate Laboratory Director at ORNL

Jeremy T. Busby was named the associate laboratory director for the Fusion and Fission Energy Science Directorate at Oak Ridge National Laboratory (ORNL). In this position, he will oversee the facilities, capabilities, and personnel who are addressing extending operations of the U.S. nuclear reactor fleet, investing in economical and flexible advanced reactor systems, and making fusion energy part of the U.S. energy portfolio.

Busby began at ORNL in 2004 and previously served in several leadership roles, including as director of the Nuclear Energy and Fuel Cycle Division. He is a fellow of the American Nuclear Society and a recipient of the Presidential Early Career Award for Science and Engineering and the Secretary of Energy Achievement Award. A TMS member since 1997, Busby is a frequent attendee of TMS meetings and has previously served on the TMS Nuclear Materials Committee. *(Photo Credit: Oak Ridge National Laboratory)*

New AIME Oral History from Carolyn Hansson

The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) has released a new video, *"Of Mini Skirts & Metallurgy; Forging a Career in a Male-dominated Field,"* from TMS member Carolyn Hansson as part of the AIME Oral History Project. This project supports the Institute's mission, by preserving and promoting achievements in the fields and sharing prominent member stories with future generations.

Hansson, a TMS member since 1968, was the first female student to attend the Royal School of Mines at Imperial College and had to navigate the unwelcoming all-male environment. In 1961, she continued her education, earning a Ph.D. Hansson went on to work in both industry and academia, having an international career with positions in the UK, the USA, and Canada.

Hansson is a member of the 1997 class of TMS Fellows. She is also the recipient of the 1970 AIME Robert Lansing Hardy Award, the 2016 Frank Crossley Diversity Award, and the 2019 TMS/ASM Joint Distinguished Lectureship in Materials and Society Award.

Visit the Oral Histories web page at **aimehq.org** to learn the story of your profession in the words of those who have lived it.

John R. Scully Leads Multi-University DARPA Project

John R. Scully, Charles Henderson Chaired Professor of Materials Science and Engineering, School of Engineering and Applied Science, University of Virginia (UVA), is leading a multi-university research team to aid the Department of Defense in predicting when aircraft need to be maintained and when fast-moving vehicles need to be inspected. The work is supported by a four-year, $4.3 million grant from the Defense Advanced Research Projects Agency (DARPA).

Scully, a TMS member since 1992, is a recipient of the 2018 Light Metals Division (LMD) Magnesium Technology Award. He served as a member of the study team for the recent TMS accelerator study, *Defining Pathways for Realizing the Revolutionary Potential of High Entropy Alloys*. Scully was also part of the expert instructor team for the TMS High Entropy Alloys 2022 online course.

Elizabeth J. Opila Appointed Department Chair at UVA

Elizabeth J. Opila has been named chair of the University of Virginia's (UVA) Department of Materials Science and Engineering. Opila joined UVA in 2010 and most recently served as the Rolls-Royce Commonwealth Professor of Materials Science and Engineering since 2021. She is also the director of the Rolls-Royce University Technology Center for Advanced Materials Systems and occupies a courtesy appointment in the Department of Mechanical and Aerospace Engineering.

Opila is a fellow of the American Ceramic Society and the Electrochemical Society. A TMS member since 2006, Opila is a frequent attendee of TMS annual meetings. She served as an organizer for both the TMS 2022 Annual Meeting & Exhibition (TMS2022) and the TMS 2023 Annual Meeting & Exhibition (TMS2023). Opila was also a member of the expert instructor team for the TMS High Entropy Alloys 2022 online course.

In Memorium

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

Robert Balluffi passed away in December 2022. A TMS member since 1946, Balluffi began attending the Massachusetts Institute of Technology (MIT) in 1941. In 1943, he was drafted into service during World War II and returned to the U.S. and MIT in 1946. He earned a B.S. and a Sc.D. from MIT in 1947 and 1950, respectively. He went on to work as a researcher at Sylvania Research Laboratory and at Columbia University. He then served as a professor in the materials science fields at the University of Illinois at Urbana-Champaign, Cornell University, and MIT. Balluffi was a member of the 1978 class of TMS Fellows and the recipient of the 1982 Institute of Metals/Robert Franklin Mehl Award.

Mats Hillert, a TMS member since 1954, passed away in November 2022. Hillert received a B.S. in chemical engineering from Chalmers Technical University in 1947. In 1948, he began working as a scientist at the Swedish Institute for Metals Research. From 1953 to 1956, Hillert studied at MIT, earning both a master's degree and a Sc.D. In 1961, he was appointed full professor at the Royal Institute of Technology (KTH), a role he served in for 30 years until his retirement. After he retired, he continued to serve as Professor Emeritus at KTH until his passing. A 1980 TMS Fellow, Hillert was also a fellow of the Royal Swedish Academy of Engineering Sciences, the Royal Swedish Academy of Sciences, ASM International, and the Metallurgy and Materials Society (MetSoc). He was also the recipient of the 1974 Institute of Metals/Robert Franklin Mehl Award, the 1999 William Hume-Rothery Award, and the 2012 Cyril Stanley Smith Award.

William A. Larson passed away in November 2022. A TMS member since 2010, Larson received a doctorate degree from the University of Minnesota in 1978. From 1978 to 2009, he worked as a materials engineer at the Dow Chemical Company. He then went on to work for Hemlock Semiconductor from 2009 to 2019. He continued to work as a consultant for Hemlock Semiconductor from 2019 until his passing.

Pentti O. Kettunen, a TMS member since 1967, also passed away recently.

Kathy Lu Elected President of Sigma Xi

Kathy Lu has been elected president of Sigma Xi, the Scientific Research Honor Society, and will serve a three-year term in this role beginning July 1, 2023. Sigma Xi is over 125 years old and aims to recognize achievements in science and engineering, encourage research, and promote integrity in science and engineering. The society has almost 400 chapters worldwide.

Lu, professor, Department of Materials Science and Engineering, Virginia Polytechnic Institute and State University (Virginia Tech), has been a TMS member since 2015. Lu is a member of the 2022 class of TMS Fellows. She has served on several TMS committees, including the Powder Materials Committee, the Surface Engineering Committee, and the Professional Development Committee. She currently holds a position on the Materials Processing & Manufacturing Division (MPMD) council.

Dierk Raabe Receives Honorary Doctorate from NTNU

Dierk Raabe, director, Max-Planck-Institut für Eisenforschung, was appointed with an honorary doctorate from the Norwegian University of Science and Technology (NTNU) in December 2022. This title honors Raabe's undertakings in sustainable metallurgy and alloy design. Raabe has been a TMS member since 1994. He is a recipient of the 2018 American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) Champion H. Mathewson Award and the 2020 Light Metals Subject Award – Aluminum Alloys. Raabe is also a recipient of the Leibniz Award and two Advanced Grants of the European Research Council.

Raabe recently presented the TMS webinar, The Science Behind Green Steel. TMS members can view the on-demand recording at no cost in the TMS Webinar Library at **www.tms.org/WebinarLibrary**.

Get Started Using Your Member Benefits

Welcome to the new members who have joined us as a result of attending the TMS 2023 Annual Meeting & Exhibition (TMS2023) in San Diego, California. If you haven't had the chance to try out your new member benefits yet, here are a few tips to get you started:

1. Log In: Start all of your membership interactions by logging in to **members.tms.org**. You should have received an email from TMS with your log in information.*

2. Update Your Profile: The more we know about your technical interests, the better we can customize your membership and notify you of relevant opportunities. You can select up to five technical interests and choose the TMS technical division that best describes your work. (Find your profile under Member Tools.)

3. Follow Up with Contacts from TMS2023: Lost someone's contact information? Navigate to the Membership Directory to search for colleagues you met during TMS2023 and send a note to reconnect.

4. Check Out Your Full Journal Access: *JOM* is one of six TMS journals you can access as a member. Log in for full access to current and archived issues of TMS journals, as well as to 20 additional journals from Springer.

5. Browse our Online Libraries: Did you know that as a member you have access to a TMS Member Library of nearly 3,000 technical articles from TMS publications? Browse this and other online libraries and journals through **members.tms.org.**

For questions about your membership, contact the TMS Membership Team at **membership@tms.org** or 1-800-759-4867 (U.S. and Canada only) or 1-724-776-9000 (all other countries). Press '1' to speak to a membership representative.

**Please note that if you registered after the early registration deadline or on site at TMS2023, your membership may not have been processed yet and you will receive your welcome email soon.*

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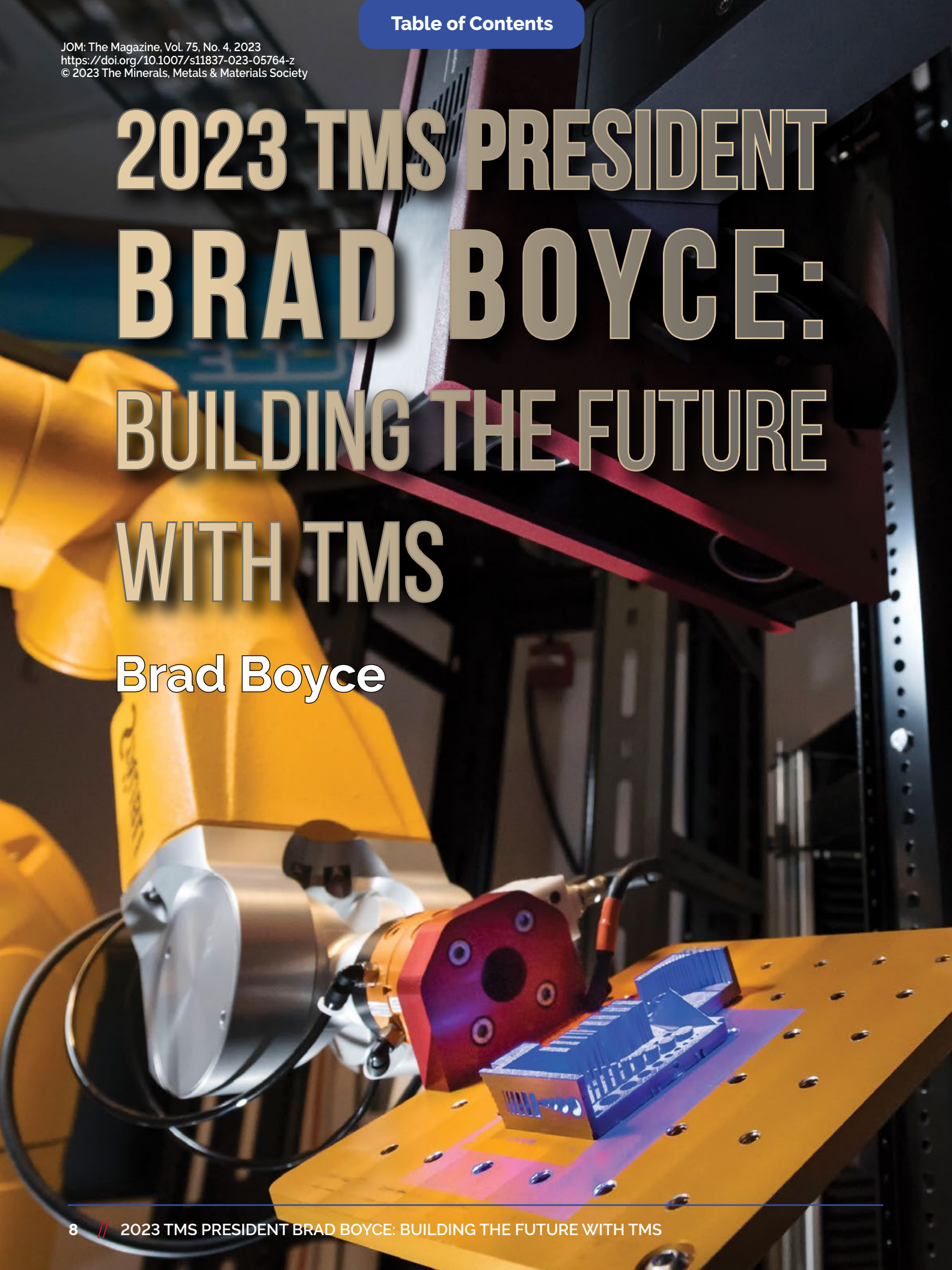
2023 TMS PRESIDENT BRAD BOYCE: BUILDING THE FUTURE WITH TMS

Brad Boyce



At the TMS 2023 Annual Meeting & Exhibition (TMS2023) in San Diego, California, I was installed as the 2023 president of The Minerals, Metals & Materials Society. I take on this responsibility with profound humility, honor, and a sense of purpose.

You see, TMS is more than just a professional society to me. It's more than a collection of diverse scientists and engineers, many of whom gather together every year in the spring at the TMS Annual Meeting or at our numerous other events throughout the year.

To me, TMS is a home and a family. While we may not share the same genetic material, our bonds do run deep. As a community, we share a mutual history together. Our passion for materials innovation glues us together. We travel around the country and around the world so that we can share our ideas and break bread together. Our colleagues become our friends. As we socialize with others who face similar struggles and challenges, we learn that we are not alone. TMS offers us a place where we belong. That sense of belonging, that sense of home, is strong in many of our members.

Together, this community we call TMS builds the future. Our materials profession enables the technologies that solve society's problems and improve our standard of living. Over the last few decades, I have had a front row seat to watch my colleagues in the materials profession change the world we live in.

Brad Boyce watches as the custom robotic workcell he developed, known as Alinstante, performs an automated three-dimensional scan of an additively manufactured part. (Photo by Randy Montoya)

I've watched the light emitting diode, or LED, go from an unsolved materials challenge to a product that lights up our entire world, with the potential to reduce global carbon dioxide emissions by a billion tonnes. I've watched our automobiles and airplanes become safer, more reliable, and more efficient, because our members invented new alloys and improved engineering practices. Our smartphones by themselves represent a multitude of materials innovations, from their powerful but miserly processors to their fracture-resistant glass. Materials also enable important medical technologies, such as artificial hearts and additively manufactured prosthetics, that help humans live healthier and longer. And our innovations address environmental concerns, for example, by replacing toxic materials like lead-based solder with safer alternatives and inventing catalysts that can scrub pollutants from the atmosphere. We are not only advancing technology, but many of our members are also mentors and teachers, training the next generation of scientists and engineers to be able to address future challenges that are unknown today.

"1,000. THIS IS THE NUMBER OF MEMBERS WHO VOLUNTEER THEIR TIME TO THE CAUSE THAT IS TMS."

At the 2023 TMS-AIME Awards Ceremony, held as part of TMS2023 in March, we recognized many great visionaries who are enabling a better society. Every year we do this. Every year, another collection of innovators steps up on stage to take a small piece of the credit that they so well deserve. It was a privilege to be part of that event this year, and I had a front row seat while we honored these superheroes and geniuses.

Now I begin to look forward to the year ahead of me as the 2023 TMS president. As your president, I am mindful of the heritage and identity that has defined us as a community. But I am also aware that we must always adapt as the world evolves around us. Our members are more diverse, more innovative, and more connected than ever. Likewise, TMS must evolve and adapt.

I have one datapoint to share with you today: 1,000. This is the number of members who volunteer their time to the cause that is TMS. This is an enormous resource of human capital, an intellectual juggernaut of invested individuals working toward a common cause: to grow our diversity, accelerate our innovation, and improve our connections. As we do this together, we will become more nimble, more responsive, and more informed about the challenges facing our field. Together, we will find new pathways to collaborate on topics of mutual interest. Together, we will shape the future of this society, the future of our profession, and the future of the world.

Editor's Note: **This article is based on the speech Boyce delivered on March 22 at the TMS 2023 Annual Meeting & Exhibition in San Diego, California. He was installed as the 2023 TMS President on March 23.**

MEET THE 2023 TMS BOARD OF DIRECTORS

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INTRODUCING NSF'S HAMMER ENGINEERING RESEARCH CENTER: *HYBRID AUTONOMOUS MANUFACTURING MOVING FROM EVOLUTION TO REVOLUTION (HAMMER)*

BY GLENN S. DAEHN, JIAN CAO, JOHN LEWANDOWSKI, TONY SCHMITZ, JAG SANKAR

We are pleased to announce to the materials community that as of September 1, 2022, a coalition of universities was awarded a National Science Foundation (NSF) Engineering Research Center (ERC) with the title *Hybrid Autonomous Manufacturing—Moving from Evolution to Revolution* (HAMMER). With a successful renewal, this is planned as a 10-year project with $52 million in federal funding. The coalition was led by The Ohio State University, in collaboration with Case Western Reserve University, Northwestern University, North Carolina Agricultural and Technical State University, the University of Tennessee, Knoxville, and a network of societies and companies.

The center's title describes its core ideas quite well. *Hybrid Manufacturing* refers to using all appropriate tools to manufacture a part, and use them where they make sense, always with digital control. This follows the natural progression of digital manufacturing where numerically controlled machining started the revolution, while additive manufacturing used similar control processes to build materials. A central idea here is to add numerically controlled deformation to the mix. Deformation is, of course, excellent for shape making, and this community knows that thermomechanical processing is arguably our most powerful approach for optimizing microstructure and resulting properties.

Incidentally, the concept of numerically controlled deformation was detailed in a TMS report, *Metamorphic Manufacturing: Shaping the Future of On-Demand Components.* (See sidebar on

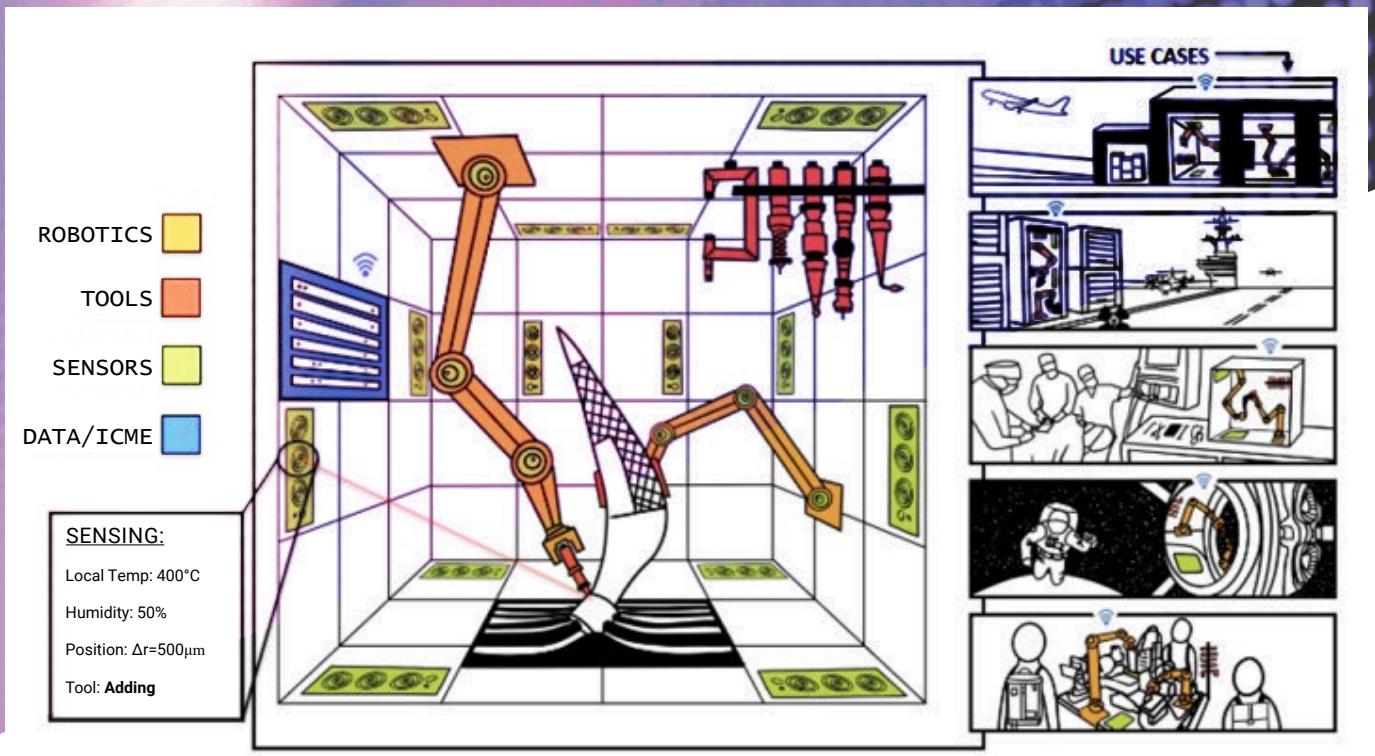

Figure 1: Schematic concept for the Auto-FAB—Autonomous Factory/Automaton Box—that is at the center of the NSF-HAMMER-ERC program. (Credit: HAMMER-ERC, hammer.osu.edu. Reproduced with permission.)

page 13.) This project is also significant in that four of the five principal investigators of the HAMMER program served on that TMS study team that led the development of the report.

Our next word, *Autonomous* describes that these will be automated systems that make decisions, learn, and store their learning in the cloud so that learning can be shared from one system to another. In this way, multiple tools for addition, subtraction, deformation, positioning, and inspection may be integrated, and control schemes will improve over time. The *Evolution* in foundational tools in sensing, robotics, integrated computational materials engineering (ICME), and even logistics will be harnessed to usher in a *Revolution* where quality-assured components will be manufactured in a distributed manner without long supply chains. A schematic figure for our approach is shown in Figure 1 and illustrates an Auto-FAB—an Autonomous Factory/Artisan Box. Multiple tools can act on a part in a suite of sensors recording operations, and this data stream may represent a digital thread for quality assurance. Several use cases are also indicated on the right of the figure.

We believe that this vision can fundamentally change manufacturing, but it requires many talents acting over many years. To advance this vision, the HAMMER-ERC has four primary research thrusts:

- **The *Design* thrust** will develop comprehensive system-level design methods that can concurrently design material, topology, and flexible manufacturing process sequences to meet social and economic needs. This will tackle the issue of the enormous design space that is developed by concurrently considering multiple product design options with multiple manufacturing sequences and varied material sources.

- **The *Tools and Process Convergence thrust*** will provide an extensible framework for design and control of "tools" to complete individual processes, sequence processes, measure results *in situ* and physically connect processes by part transfer without loss of dimensional or materials data.

- **The *Materials State Awareness* thrust** will develop fast-acting, reduced-order models, necessary to plan, execute and self-correct an Auto-FAB manufacturing sequence. The goal is to calculate and manage uncertainty in properties/performance of the manufactured part in such a manner that we might move the field towards model-based certification instead of the current paradigm of locking-down a process that has been proven by many destructive tests.

- **The last research thrust is *Control, Intelligence, and Autonomy*** which will develop manufacturing problem-centric artificial intelligence (AI) methods and integrate them with empirical knowledge, process physics, and high-fidelity simulations. This will be coupled with *in situ* sensing data to enable AI-enhanced control and intelligence for autonomous hybrid manufacturing processes.

The research is the foundation of the center and, in each case, fundamental technical questions are at the core. We also see four areas where we can move quickly to demonstrate and test outcomes from this approach. These are called testbeds in the language of the ERC program.

The first of these we refer to as *Numerical Forming*, which we define as manufacturing products with geometry and microstructure controlled by numerically controlled incremental open die forging with material-state aware. When successful, the numerical forming testbed will enable industrial collaborators to translate the research to manufacture forming with purposeful gradients in properties using smaller, more agile equipment integrating real time information about related manufacturing supply chains. Also, the evolution of this approach will largely decouple product and press size, allowing the rapid production of very large forgings without large dies or presses.

This approach is next coupled with preforms created by additive manufacturing, casting, or welding. We refer to this as *Additive Manufacturing + X*. Thermomechanical processing, (thermal processing with deformation) provides far more flexibility to create an optimal microstructure. Large grains can be refined and any porosity from solidification can be eliminated. This use of hybrid processing has special appeal in this area.

Our *Point of Care Manufacturing* testbed is focused in healthcare clinics on the use of bending, possibly hybridized with other processes. Use of dimensional data and multiple processes, including deformation, can create medical devices customized for a given patient. Personalized medical devices are already in wide use for joint replacements, fracture and graft fixation hardware, heart valves, surgical guides, limb prostheses, and dental implants. This has the potential to replace current practice where a surgeon may spend hours bending skeletal fixation plates to that model by hand, one at a time. Our approach will send computed tomography data to a bank of robots that would fabricate components quickly. One could envision gaining as much as a day, an advance that would quickly bring this technology to the clinic.

Our most outward and student-engaged testbed is in *Physical Exploration and Training—Factory Automaton Boxes (PET-FABs)*. These will provide inexpensive, short learning curve suites of equipment and software that can be used for student engagement, rapid innovation, teaching, and competition. HAMMER will develop standard equipment and training modules for many educational settings.

Possibly the most exciting and important part of this initiative is that the NSF-ERC program is focused on using the technical research as a base for positive social change. In the language of the Engineering Research Centers, this is captured in four foundational elements: Convergent Research (which we have already covered), Education and Workforce Development, Diversity and Culture of Inclusion, and an Innovation Ecosystem.

Do You Have Industry News to Share?

This article is the latest installment in an occasional *JOM: The Magazine* article series that features a case study or non-technical project overviews with strong industrial and/or manufacturing applications. To suggest an article idea, contact Kelly Zappas at kzappas@tms.org.

The HAMMER-ERC will establish robust programs in each of these areas. *Education and Workforce Development* will reach wide audiences through collaboration with other educational institutions, community colleges, societies, and makerspaces. Areas of special emphasis will include training trainers (high school, community college, industry) and the development of PET-FABs as educational platforms. Our *Diversity and Culture of Inclusion* Program will focus on including and promoting the participation of under-represented groups (minority, female, rural, economically disadvantaged) in advanced manufacturing programs. For instance, our partner, North Carolina A&T State University, the largest US educator of African American engineers, plans to initiate a Hybrid Autonomous Manufacturing Ph.D. program. The base of all this is the *Innovation Ecosystem* that will build community and use the results of HAMMER to start and enhance businesses.

We will try to adapt the cultural attributes that made Silicon Valley so successful to our HAMMER team. Those include trust, fairness, openness, and paying forward. External companies and researchers are welcome to participate in deep technical discussions by joining and executing a non-disclosure agreement so important concepts can be developed and protected. Intellectual property will be aggregated into a not-for-profit corporation that will be a catalyst for new ventures and systems.

We invite you to join us. We are just getting started but are thrilled about the opportunities that the HAMMER NSF-ERC provides. We believe that this is the kind of public-private partnership that can bring new technology and a larger, better trained and more diverse workforce forward. Visit hammer.osu.edu to learn more and contact us.

ABOUT THE AUTHORS

Glenn S. Daehn is the Mars. G Fontana Professor of Metallurgical Engineering in the Department of Materials Science and Engineering at The Ohio State University. He has wide interests in manufacturing, deformation processing, and university-society engagement. He is the principal investigator of the NSF-HAMMER-ERC and led the 2019 TMS Metamorphic Manufacturing study group.

Cardiss Collins Professor **Jian Cao** of Northwestern University specializes in innovative manufacturing processes and systems, particularly in the areas of deformation-based processes and laser additive manufacturing processes. She is the founding director of the university research center on Manufacturing Science and Innovation at Northwestern. Cao has been involved with TMS activities since 2001.

John Lewandowski is Distinguished University Professor at Case Western Reserve University. He served as the director of the Advanced Manufacturing and Mechanical Reliability Center (AMMRC) and the Nitinol Commercialization Accelerator Laboratory (NCAL) and is a 2022 TMS Fellow.

Tony Schmitz is a professor at the University of Tennessee, Knoxville, where he is the director of the Machine Tool Research Center, and holds a Joint Faculty appointment with Oak Ridge National Laboratory (ORNL). His research expertise is machining dynamics and metrology.

Jag Sankar has developed high-profile, advanced, broad-based materials innovation centers, including, but not limited to, multiple NSF, Army, Department of Energy, and Navy programs at North Carolina A&T State University (NCAT). Under his leadership, from 2008-2022, NCAT was chosen as the lead to house the NSF's Gen 3 – ERC for Revolutionizing Metallic Biomaterials (RMB). Sankar's team received the 2023 TMS Light Metals Division Magnesium Technology Best Poster Award.

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CELEBRATING EMERGING PROFESSIONALS:

THE 2023 TMS YOUNG LEADER AWARD RECIPIENTS

MEGAN ENRIGHT

TMS emerging leaders represent the exceptional future of the materials science and engineering field. These special honors are for members of the Society who are in the early stages of their careers and celebrate their achievements as they grow and reach for new heights.

The TMS Young Leaders Professional Development Awards are presented by each of the five technical divisions of TMS. They provide financial assistance to attend the TMS annual meeting, where recipients have access to a variety of leadership development and networking opportunities. In addition to these awards, TMS supports its early career members in their professional growth and leadership development through other recognitions and opportunities intended to facilitate networking and advancement within the Society.

Each of the following individuals were presented with their awards at the TMS 2023 Annual Meeting & Exhibition (TMS2023), March 19–23, 2023, in San Diego, California, USA. Though TMS2023 has already occurred, be sure to add these new colleagues to your network and your professional community. Join us in congratulating the following recipients!

YOUNG LEADERS PROFESSIONAL DEVELOPMENT AWARDS

EXTRACTION & PROCESSING DIVISION (EPD)

"As a young researcher it is not only inspiring, but also a great opportunity to meet excellent professionals from the Society."
—Adamantia Lazou

Will Hannemann
Senior Consultant, Aurecon

"I am honored to receive the 2023 TMS EPD Young Leaders Professional Development Award. TMS has greatly assisted in developing my professional career through networking opportunities. I have benefited from the activities I've participated in. Being an editor for *JOM* and working alongside industry experts deepened my knowledge of pyrometallurgy. Thank you, TMS!"

Adamantia Lazou
Researcher, Norwegian University of Science and Technology

"I am proud to be selected as one of the recipients of the EPD Young Leaders Award. As a young researcher it is not only inspiring, but also a great opportunity to meet excellent professionals from the Society. For me, TMS is an outstanding society where multidiscipline professionals can discuss the symbiosis of materials, sustainability, technology and innovation, and fundamental research."

FUNCTIONAL MATERIALS DIVISION (FMD)

"[I] am highly appreciative of the support provided…to early career scientists, both in terms of delivering talks to a large and diverse materials community and in organizing symposia and other events."
—Arun Kumar Mannodi Kanakkithodi

Jing Du
Associate Professor, Pennsylvania State University

"It is my great honor to be selected for the TMS FMD Young Leaders Professional Development Award. I have been attending TMS conferences and serving on the Biomaterials Committee since 2017. With the support of this award, I look forward to more fully participating in TMS activities and networking with prominent Society members."

Arun Kumar Mannodi Kanakkithodi
Assistant Professor, Purdue University

"It is a great honor to be selected by the distinguished members of the Functional Materials Division for the 2023 Young Leaders Professional Development Award. I have regularly attended TMS and MS&T meetings for a few years now and am highly appreciative of the support provided at these meetings to early career scientists, both in terms of delivering talks to a large and diverse materials community and in organizing symposia and other events. I look forward to participating in many future activities courtesy of FMD/TMS, as an organizer and as an attendee, as I continue my growth as a materials scientist and faculty."

ARE YOU A 2024 YOUNG LEADER?

TMS Young Leaders Professional Development Award recipients are innovative individuals who represent the future of the minerals, metals, and materials community. A common thread among these individuals is their dedication to advancing their professional careers and leadership skills, including being active as TMS volunteers and aiding in the facilitation of TMS' strategic initiatives.

Do you, or someone you know, fit these criteria? Visit the TMS Honors and Awards website at **awards.tms.org** to learn more and apply. Applicants must be TMS members in good standing who are age 40 or younger. Awardees must also demonstrate a desire to play an active role in TMS and the potential to advance to volunteer leadership roles with the Society.

The deadline to submit applications for the 2024 Young Leaders Awards is August 15, 2023.

LIGHT METALS DIVISION (LMD)

"TMS brings together experts and leaders from every materials-related discipline, who share and publicize the latest technical developments of their respective fields."
—Scott Sutton

Mertol Gökelma
Researcher, İzmir Institute of Technology

"I am honored to receive this award from a society where academia and industry come together to discuss the new materials technologies and meanwhile shape the future of the metal industry. I will devote my faithful efforts to promote productive and active exchange within the Society in the future."

Scott Sutton
R&D Manager, Mag Specialties Inc.

"TMS brings together experts and leaders from every materials-related discipline, who share and publicize the latest technical developments of their respective fields. TMS meetings, and the professional Society itself, have both been an excellent resource for me in academia and in my professional career. I am greatly honored to receive this award, and I look forward to giving back to the TMS community."

MATERIALS PROCESSING & MANUFACTURING DIVISION (MPMD)

"Since attending my first meeting in 2014, I have been extremely impressed by the bottom-up approach TMS takes towards programming and outreach."
—Matthew Daly

Matthew Daly
Assistant Professor, University of Illinois, Urbana-Champaign

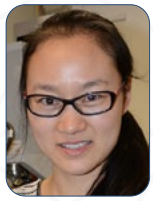
"I am deeply honored to receive this professional development award from the MPMD. Since attending my first meeting in 2014, I have been extremely impressed by the bottom-up approach TMS takes towards programming and outreach. This approach to volunteerism has been key to my engagement with the community, and I look forward to continuing my service to the division and the Society through the functions and activities of this award."

Yufeng Zheng
Assistant Professor, University of Nevada, Reno

"I feel extremely honored to receive the 2023 TMS MPMD Young Leaders Professional Development Award! Ever since I first attended a TMS annual meeting in 2011, TMS has become my home community because TMS provided tremendous opportunities to develop my technical expertise in materials science, enhance my leadership skills, and expand my network with materials science researchers worldwide. Through this precious award, I look forward to continuing making contributions to the MPMD and the TMS community and I am committed to passing along these opportunities to the young materials science researchers and students."

STRUCTURAL MATERIALS DIVISION (SMD)

"Ever since I joined TMS as a Ph.D. student, the annual meeting & exhibition…has become and will remain my premier networking event to share and discuss research, form collaborations, and foster existing relationships with international colleagues."
—Christopher Zenk



Dong Liu
Associate Professor, University of Bristol

"I am absolutely thrilled to receive this award—it helps to promote my research profile to let more people know about my work at Bristol. This also plays an important role for my next-step career development as an academic."

Christopher Zenk
Group Leader, Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

"I am extremely grateful and honored to be selected for the TMS SMD 2023 Young Leaders Professional Development Award. Ever since I joined TMS as a Ph.D. student, the annual meeting & exhibition, with experts present for every material system and method, has become and will remain my premier networking event to share and discuss research, form collaborations, and foster existing relationships with international colleagues. I'm looking forward to taking on more responsibilities in the Structural Materials Division of the TMS Foundation."

EARLY CAREER FACULTY FELLOW

"TMS provides me an opportunity to connect with researchers from industry, academia, and national laboratories and explore new research avenues and collaborations."
—Grace Gu

Danielle Cote
Assistant Professor, Worcester Polytechnic Institute

"It is such an honor to be recognized for this award. I would like to thank my nominators as well as the Society for the recognition. I look forward to using these new resources to grow my involvement and leadership within TMS."

Presentation: *"The Role of Early Career Professionals in Increasing Diversity in STEM Professions"*

Grace Gu
Assistant Professor, University of California, Berkeley

"I am honored and grateful to receive this award made possible by the TMS Foundation. TMS provides me an opportunity to connect with researchers from industry, academia, and national laboratories and explore new research avenues and collaborations. I look forward to contributing to future TMS activities and further interacting with the TMS community."

Presentation: *"Managing Tradeoffs in Materials and Life"*

ENHANCE YOUR LEADERSHIP SKILLS, APPLY TO ATTEND THE ELA CONFERENCE

TMS is now accepting applications for the 2023 Emerging Leaders Alliance (ELA) conference. This conference provides interdisciplinary training for future leaders of the science and engineering community. TMS is one of eight partner societies supporting the ELA conference and the attendance of TMS members is made possible through the support of the TMS Foundation.

Applicants must be TMS members, typically between ages 24–40, with rising or current leadership positions within their organizations. Send a letter of interest, one or two letters of recommendation, and a resume or curriculum vitae to Deborah Hixon, TMS Awards Program Manager, at hixon@tms.org to apply. Applications are due by **May 15, 2023**.

FRONTIERS OF MATERIALS AWARD

"I look forward to giving back to the materials community by organizing a symposium on complex intermetallics, bridging emergent research in crystallography, mathematics, physics, and geology—fields that were traditionally underrepresented in past meetings."
—Ashwin Shahani

Alison Dunn
Associate Professor, University of Illinois, Urbana-Champaign

"Thank you to TMS for this honor of organizing a focused session on hydrogel mechanics! Not only is it an exciting interdisciplinary area, the community at TMS is ideal for deep discussions to truly push new ideas forward."

Ashwin Shahani
Assistant Professor, University of Michigan

"I am honored and humbled to receive the Frontiers of Materials Award. I have had the pleasure of attending the TMS annual meetings for the past decade and presenting my research almost every year within that timeframe. I look forward to giving back to the materials community by organizing a symposium on complex intermetallics, bridging emergent research in crystallography, mathematics, physics, and geology—fields that were traditionally underrepresented in past meetings."

Yuji Zhao
Associate Professor, Rice University

"As one of the oldest and most prestigious professional societies in materials science, TMS has played an indispensable role in my scientific career as well as my personal growth. For more than 14 years since I was a graduate student of Shuji Nakamura's at University of California, Santa Barbara, I have participated in various TMS conferences and published in TMS journals on the topics of electronic materials and wide bandgap semiconductors, which offered tremendous scientific, educational, and professional experiences. I am humbled and forever grateful to receive the TMS Frontiers of Materials Award, and I look forward to organizing the Frontiers of Materials Symposium on ultrawide bandgap materials and making more contributions to the TMS community as well as the broader field of materials science."

YOUNG INNOVATOR IN THE MATERIALS SCIENCE OF ADDITIVE MANUFACTURING AWARD

"As it has been for me, I am sure that TMS will be the place where future generations of materials scientists gather to get inspired, discuss ideas, and bring innovation to this exciting and ever-growing field."

—Matteo Seita

Matteo Seita
Assistant Professor, University of Cambridge

"It is a great honor for me to receive this award from TMS. I consider TMS as the place where my aspirations to work on additive manufacturing (AM) 'crystallized' back in 2015. That meeting, I believe, was the first one that included an entire symposium dedicated to AM, which I attended wholly. I remember listening to inspiring talks and running my ideas by the people who were at the top of the field. One year later, I found myself starting my own research group to work on those very same ideas. As it has been for me, I am sure that TMS will be the place where future generations of materials scientists gather to get inspired, discuss ideas, and bring innovation to this exciting and ever-growing field."

A NEW INTERNATIONAL SCHOLAR AWARD

In 2024, TMS and the Korean Institute of Metals and Materials (KIM) will award the inaugural Young Leaders International Scholar Award - KIM. This award will encourage international collaboration between the two societies and will provide new opportunities for emerging professionals to attend the KIM annual meeting and present at international sessions. Applications are due by **August 15, 2023**, to be considered for this award. Information on how to apply will be available soon at **awards.tms.org**.

YOUNG LEADERS INTERNATIONAL SCHOLAR AWARD - JIM

"It will be an honor and a privilege to represent the Society at the upcoming JIM meeting."

—Damien Tourret

Damien Tourret
Researcher, IMDEA Materials

"I am honored to receive this recognition from my peers and grateful to the TMS Foundation for the great opportunities they provide for early career scientists and engineers to grow, learn, and broaden their horizons. It will be an honor and a privilege to represent the Society at the upcoming JIM meeting."

HEAR FROM A PAST RECIPIENT

The Young Leaders International Scholar Award – JIM, jointly administered by TMS and the Japan Institute of Metals and Materials (JIM), promotes activities for emerging professionals and strengthens collaborations between these two international societies. Recipients travel to the JIM annual meeting where they can present papers at international sessions. Learn more about Victoria Miller's, the 2022 recipient, experience in her article, "Magnesium and Castles: The Travel Diary of a TMS/JIM International Scholar" featured in the January 2023 issue of *JOM: The Magazine*.

JIM YOUNG LEADER

Kazuki Imasato
Researcher, National Institute of Advanced Industrial Science and Technology

Presentation: *"Discovery of Triple Half-Heusler with Low Thermal Conductivity"*

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GENEROUS MEMBERS KEEP TMS FOUNDATION ON A PATH TO PROGRESS

Lynne Robinson

Carl Cady

The TMS Foundation successfully navigated a volatile economy in 2022, with its year-end appeal efforts posting $186,155—the third best year on record, and a marked increase from 2021. Carl Cady, TMS Foundation Board of Trustees chair, noted that the leadership and commitment of the trustees deserved special recognition for the TMS Foundation's continued rebound from challenges posed by the global pandemic.

"We had a very good year in our outreach, thanks to the efforts of our Foundation Board of Trustees and the strength of the programs that we support," said Cady. "It is largely through our ongoing efforts to keep the Foundation as a visible part of TMS that we are becoming more successful in our fundraising. I am honored to serve with so many distinguished members of TMS on the Board of Trustees who are willing to financially support our programs, but are also willing to give the time necessary to do our outreach. Thank you all for your support."

While every donation in 2022 made a difference, Cady noted that the Foundation also greatly benefited from acts of extraordinary generosity. "I would like to acknowledge and am grateful for the support of several long-time TMS members," said Cady. "Robyn and Rob Wagoner, who are TMS Foundation Diamond Society members, donated $50,000 this year. Rob's service to the Foundation is exceptional. It was his vision and commitment that led to the Foundation's revitalization in 2014, with his helming it as the Board of Trustees Chair."

"I am also pleased to welcome two inaugural Platinum Society members this year, namely Marc Meyers and Ken Kinsman," Cady continued. "Marc Meyers' 2022 contribution of $24,000 is to be used to create funding for a travel grant focused on assisting international attendees to attend our annual meeting, and Ken Kinsman's $10,000 2022 donation continues to build on years of generosity. I also thank Don Sadoway for his very generous donation of $24,000."

In February 2020, just weeks before the global pandemic shutdown, the TMS Foundation Board of Trustees committed to a series of strategic fundraising goals—and held to those despite what unfolded over the next several years. In November 2022, the Foundation announced significant progress on two of those goals.

Beginning with the TMS 2023 Annual Meeting & Exhibition (TMS2023), the Foundation expanded the TMS Family Care Grant program to fund a total of 30 grants per year (up from the previous 20 grants). These grants assist annual meeting 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. In addition, starting with the next available awards cycle, the TMS Foundation has expanded the number of TMS Young Leaders Professional Development Awards from two per technical division to three,

for a total of 15 opportunities for early career professionals to benefit from this program each year.

This initial expansion marks the halfway point to the Foundation's strategic goals of doubling the number of available awards offered by these two programs. "Our short-term goal now is to bring back the scholarships that were cut a decade ago when we realized the outflow of funds was unsustainable," said Cady. "We intend to add scholarships back in as they become fully endowed."

"Both the Foundation's current and future accomplishments are made possible by the continued support of the membership of our Society," Cady continued. "I thank everyone who generously made a donation to the Foundation over the past year. Your support is what kept us moving forward."

Cady is looking ahead to another year of progress for the TMS Foundation and invites all TMS members to be part of that success story.

"The TMS Foundation supports programs that are intended to help the members of our Society and to acknowledge the contributions that they make to it," he said. "I would encourage everyone to make a donation no matter how small it is. Your support really does help and matter. We are a volunteer society that functions very well because we all care. The content at our meetings, the organization of the symposia, the programming—all of it is largely done by volunteers. Our Foundation is just one more opportunity for all of us to make a difference. Thank you all again for your support of TMS."

The 2022 Annual Giving Honor Roll and Lifetime Giving Honorific Societies on the following pages recognize those donors who so generously gave their support in the past year. You can also view the Honor Roll online at **www.TMSFoundation.org/HonorRolls**.

To earn a spot on the 2023 Honor Roll, make a donation at **www.TMSFoundation.org/Contribute**. For details about donation options, visit **www.TMSFoundation.org** or contact TMS staff at 1-724-776-9000.

Thank You to Our 2022 Donors

1871 Legacy Circle

Wasil Dyrkacz
Lucinda and Martin Glicksman
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Diamond Society ($100,000 or more)

Lucinda and Martin Glicksman
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Robyn and Rob Wagoner

Platinum Society ($50,000 to $99,999)

Kenneth R. Kinsman
Marc A. Meyers

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Garry W. Warren and Larry Goldman*
Joan and James A. Yurko

Titanium Society ($10,000 to $19,999)

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Thank You to Our 2022 Donors *(Cont.)*

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***Deceased**

2022 Annual Giving Honor Roll *(List updated annually)*

The TMS Foundation offers its sincere thanks to all of the donors listed below. Together, these individual contributions will help to shape the future of the minerals, metals, and materials professions.

Foundation Leader ($2,500 or more)

Carl M. Cady
Joseph D. Defilippi
James C. Foley
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Diane and David Matlock
Marc A. Meyers
Tina and Daniel B. Miracle
Lallie and Ray D. Peterson
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David Alan Shifler in Memory of Robert B. Pond Sr.
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Joan and James A. Yurko
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Leah and Paul R. Ohodnicki Jr.
Jane E. Black and Gregory B. Olson
Tresa M. Pollock in Honor of Ali Argon
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Malcolm Stocks
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https://doi.org/10.1007/s11837-023-05768-9

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In Case You Missed It:

BUSINESS NEWS FROM THE FIELD

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

JOM THE MAGAZINE

Submit your announcement or press release to Kelly Zappas at kzappas@tms.org.

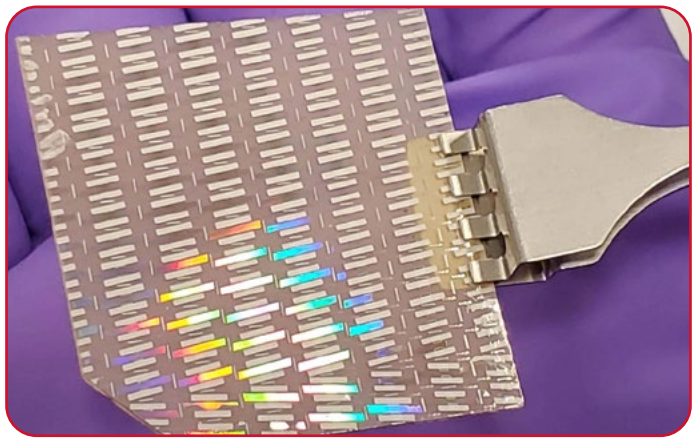
Vancouver, Canada: B2Gold concluded 2022 as the seventh consecutive year that they have met or exceeded production guidance. In 2022, they produced 1.03 million oz. of gold, with 36% of the total produced in the fourth quarter. B2Gold has three operating mines, Fekola in Mali, Masbate in the Philippines, and Otikoto in Namibia. Fekola (pictured above) was the stand-out of the year with 598,661 oz. produced in the year. (Photo Credit: B2Gold)

Mill Steel Co. Expands into Stainless Steel and Aluminum

Grand Rapids, Michigan, USA: Mill Steel Co., one of the largest flat-rolled steel distributors in North America, is expanding into stainless steel and aluminum markets through acquisitions of the Cleveland Metal Exchange and the Chicago Stainless Metal Exchange. The acquisitions of these distributors in Ohio and Illinois are Mill Steel Co.'s largest acquisitions to date. The deal closed in January 2023 and will allow Mill Steel Co. to offer a full range of stainless steel and aluminum products, increasing access to manufacturing, automotive, and construction customers in markets in the southeast, mid-Atlantic, and western United States.

Glycine Leaching Technology Selected for TAD Incubator

Prague, Czech Republic: Draslovka Holding's glycine leaching technology was selected to be part of OZ Materials' Think & Act Differently (TAD) Incubator and the Waste-to-Value Challenge. Draslovka Holding specializes in cyanide-based chemicals and sustainable solutions for the metal mining industry. The glycine leaching technology is an alternative to traditional acid and cyanide leaching. It enables the recovery of base and precious metals from tailings and other lower grade resources due to its selectivity of gangue minerals and the recyclability of glycine. This improves the sustainability and cost of the production process.



Orono, Maine, USA: Researchers at the University of Maine are developing new wireless sensors (pictured above) for monitoring the functionality of nuclear power plant equipment. This project is being conducted by the University of Maine's Frontier Institute for Research in Sensor Technologies (FIRST) and is aided by a $500,000 award from the U.S. Nuclear Regulatory Commission to create and test sensors that can withstand the harsh environments of nuclear facilities. Researchers are hopeful that these sensors will improve plant safety, reduce maintenance costs, and advance performance, efficiency, and reliability of facilities. (Photo Credit: University of Maine)

Europe's Largest Deposit of Rare Earth Metals Discovered

Luleå, Sweden: The Swedish mining company, LKAB, has discovered the largest deposit of rare earth metals in Europe. Near LKAB's iron ore mine in Kiruna, Sweden, the cache sits within the Arctic Circle. Exploration into the area discovered an estimated one million tons of rare earth oxides. primarily comprised of iron ore, the deposit also contains a notable amount of phosphorus. LKAB has been mining in this area since 1850. In 2023, they plan to apply for an exploitation concession to investigate the conditions for mining the deposit.

SPOD Lithium Corp. Discovers LCT Pegmatites

Vancouver, Canada: On the MegaLi lithium project in the James Bay region of Québec, Canada, SPOD Lithium Corp. field crews have identified lithium-cesium-tantalum (LCT) pegmatites. In October 2022, a trip was conducted in the MegaLi area to explore the area's lithium potential and uncover new LCT pegmatites via geological mapping and sampling. With these positive results, the expansion of the exploration program is currently being planned.

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TMS MEETING HEADLINES

JOM THE MAGAZINE

Meeting dates and locations are current as of February 1, 2023. For the most recent updates on TMS-sponsored events, visit **www.tms.org/Meetings**.

Superalloy 718 & Derivatives 2023

May 14–17, 2023

Pittsburgh, Pennsylvania, USA

Housing Deadline: April 24, 2023

This event will feature the keynotes: "Meeting the Challenges of the Future by Understanding Our Past," by Melissa Martinez, ATI Metals, and "Application of Computational Materials and Process Modeling to Current and Future Aero-engine Component Development and Validation," from David Furrer, Pratt & Whitney.

www.tms.org/Superalloy718-2023

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

May 21–25, 2023

Orlando, Florida, USA

Housing Deadline: April 29, 2023

ICME 2023 is the only congress dedicated to bringing all stakeholders together from across nations, disciplines, and organizations to focus on integration priorities and gaps that need to be addressed in order to advance the field.

www.tms.org/ICME2023

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

October 1-5, 2023

Columbus, Ohio, USA

Housing Deadline: September 7, 2023

TMS presents robust programming, networking and social activities, and professional development events tailored to its members' interests within the broader structure of the MS&T conference series, giving members an opportunity to experience both their TMS community and the resources of all the MS&T partnering societies.

www.tms.org/TMSFall2023

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

November 12–15, 2023

Pittsburgh, Pennsylvania, USA

Abstract Deadline: June 16, 2023

HEA 2023 is a cross-disciplinary technical forum designed to share the latest research advances in single-phase and multiphase metallic, intermetallic, and ceramic high entropy materials for functional or structural applications.

www.tms.org/HEA2023

// Other Meetings of Note

11th Pacific Rim International Conference on Advanced Materials and Processing (PRICM11)

November 19-23, 2023

Jeju, South Korea

www.pricm11.org

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

TMS 2025 Annual Meeting & Exhibition (TMS2025)

March 23–27, 2025

Las Vegas, Nevada, USA

www.tms.org/TMS2025

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

10th International Symposium on Lead and Zinc Processing (PbZn2023)
October 18–20, 2023
Changsha, China
Co-sponsored by TMS

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

SAVE THE DATE

THE WORLD COMES HERE.

TMS 2024

153rd Annual Meeting & Exhibition

MARCH 3–7, 2024

HYATT REGENCY ORLANDO | ORLANDO, FLORIDA, USA

#TMSAnnualMeeting | www.tms.org/TMS2024

JOIN US NEXT YEAR FOR TMS2024

Next year we'll come together at a new meeting venue: the Hyatt Regency Orlando in Orlando, Florida.

This location will host all conference programming and activities in 2024, so plan to stay at the headquarters hotel for easy access to events throughout the week. With five on-site restaurants and a number of amenities, everything you need will be at your fingertips.

MARK YOUR CALENDAR WITH THESE KEY DATES

May 2023: Call for Abstracts Opens
October 2023: Registration Opens
March 3–7, 2024: Conference Dates

SEE YOU IN ORLANDO!

REGISTER TODAY

COM CIM ICM 2023
CONFERENCE OF METALLURGISTS
MET SOC

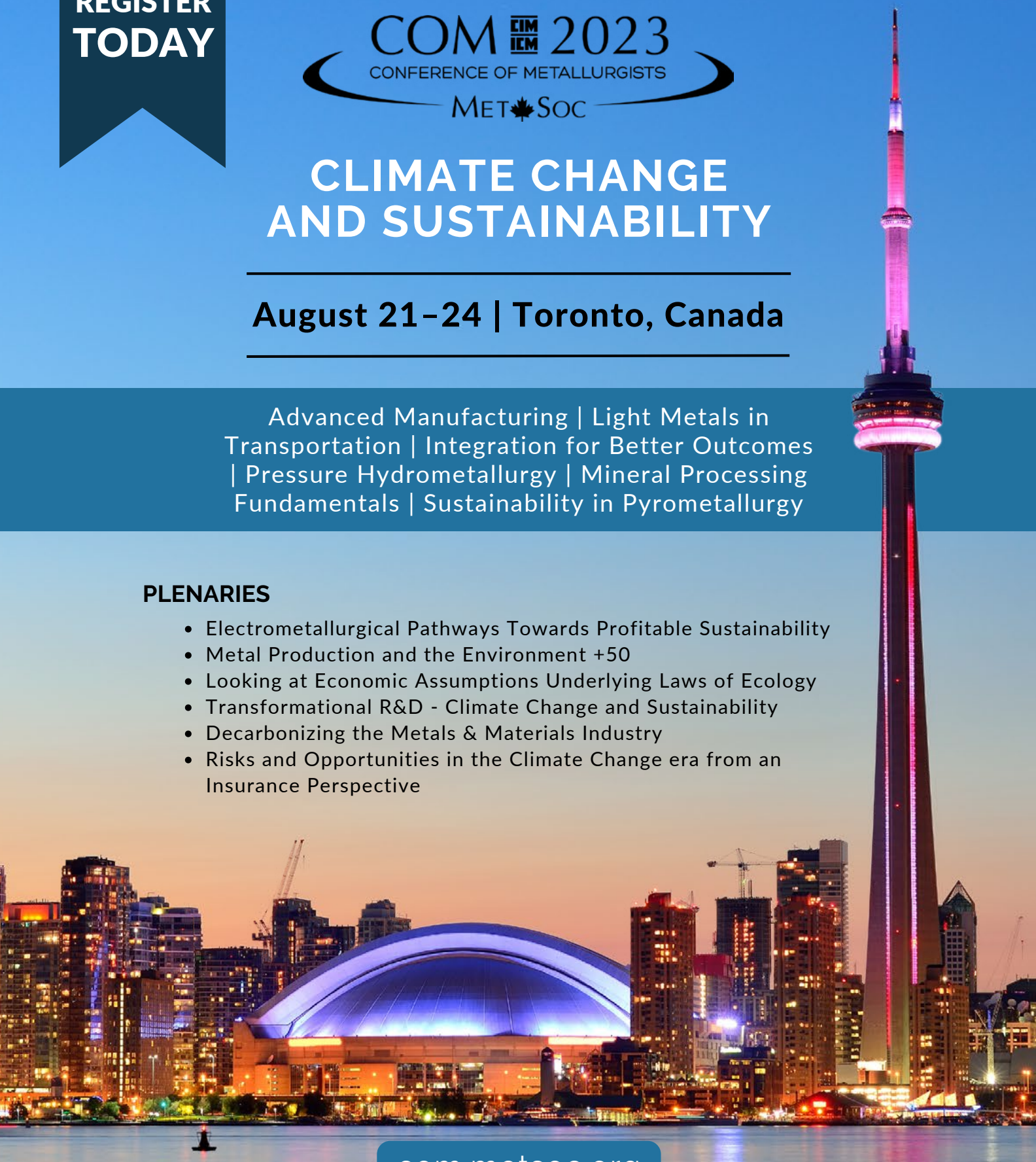
CLIMATE CHANGE AND SUSTAINABILITY

August 21–24 | Toronto, Canada

Advanced Manufacturing | Light Metals in Transportation | Integration for Better Outcomes | Pressure Hydrometallurgy | Mineral Processing Fundamentals | Sustainability in Pyrometallurgy

PLENARIES

- Electrometallurgical Pathways Towards Profitable Sustainability
- Metal Production and the Environment +50
- Looking at Economic Assumptions Underlying Laws of Ecology
- Transformational R&D - Climate Change and Sustainability
- Decarbonizing the Metals & Materials Industry
- Risks and Opportunities in the Climate Change era from an Insurance Perspective



com.metsoc.org

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

TMS SPECIALTY CONGRESS 2024

JUNE 16-20, 2024
Cleveland Hilton | Cleveland, Ohio, USA
#TMSSpecialtyCongress

SAVE THE DATE

ONE REGISTRATION. THREE MEETINGS. COUNTLESS BENEFITS.

The TMS Specialty Congress annually convenes the Society's recurring specialty meetings under one roof with a single registration fee. Explore your technical interest in a focused, small event environment, while also having access to cross-disciplinary learning and collaboration opportunities with aligned materials communities. **Call for abstracts opens June 2023.**

PLAN TO JOIN US AT OUR INAUGURAL CONGRESS IN 2024!

2024 CO-LOCATED MEETINGS

Key issues and future pathways in the implementation of artificial intelligence.

Science and technology associated with numerically controlled forming methodologies.

Cutting edge R&D efforts surrounding mechanical behavior over a wide range of material types.

For details and to sign up for updates, visit:
www.tms.org/SpecialtyCongress/2024

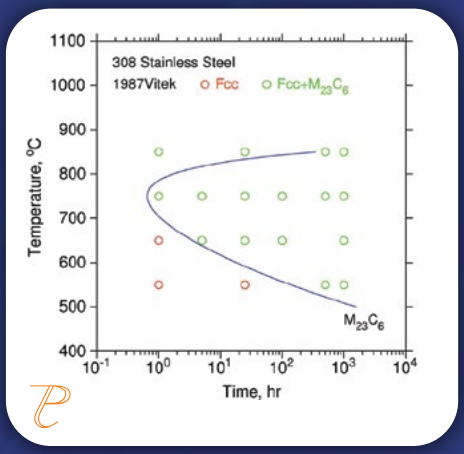
Thermo-Calc Software

Empowering Metallurgists, Process Engineers and Researchers

What if the materials data you need doesn't exist?

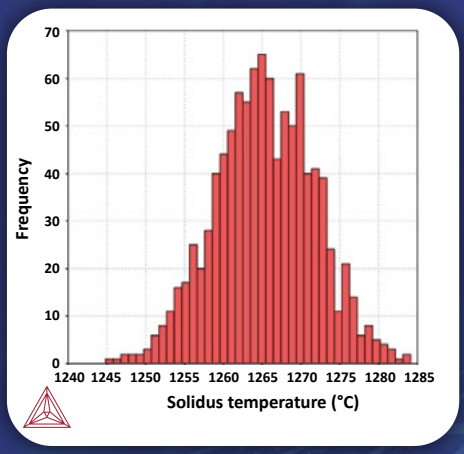
Gain insight into materials processing

Precipitation



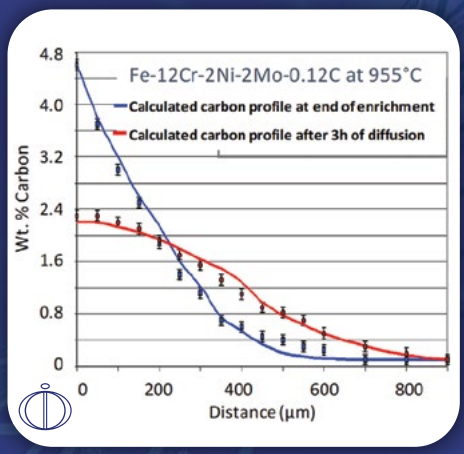
Time temperature precipitation of $M_{23}C_6$ in 308 stainless steel

Solidification



Solidus variation within Alloy 718 specification (Gaussian, n=1000)

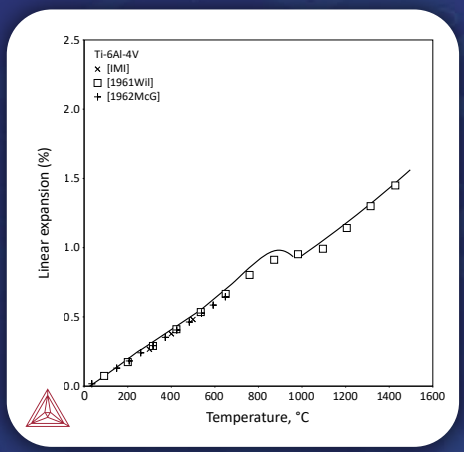
Diffusion



Carbon diffusion profile near surface during carburization of a martensitic stainless steel

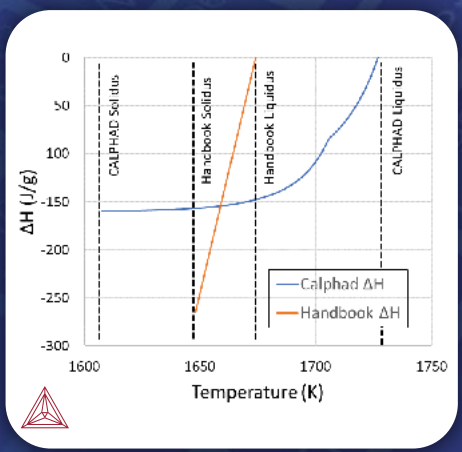
Predict a wide range of materials property data

Thermophysical Data



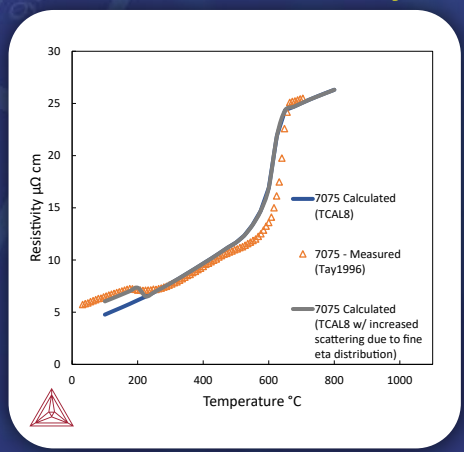
Linear expansion vs temperature for Ti-6Al-4V

Thermodynamic Properties



Calculated latent heat compared to handbook values for a specific 316L stainless steel chemistry

Electrical Resistivity



Calculated electrical resistivity of aluminum alloy 7075

www.thermocalc.com/jom

info@thermocalc.com