

JOM THE MAGAZINE

OCTOBER 2023

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

INSIDE THE INTERNATIONAL SCHOLAR PROGRAM



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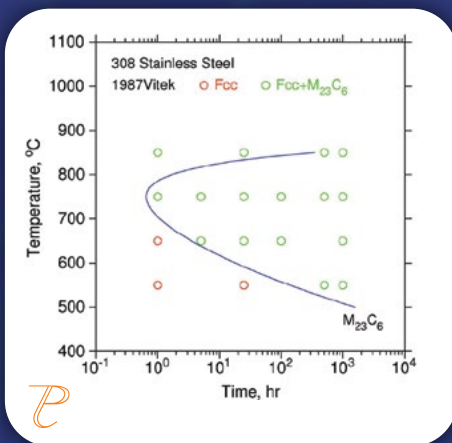
Thermo-Calc Software

Empowering Metallurgists, Process Engineers and Researchers

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

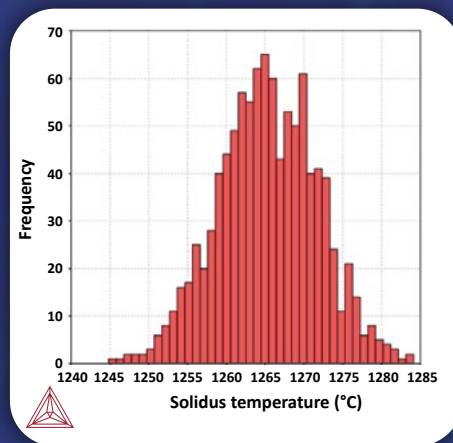
Gain insight into materials processing

Precipitation



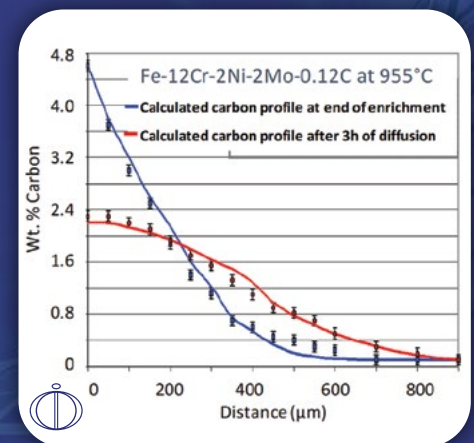
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Solidification



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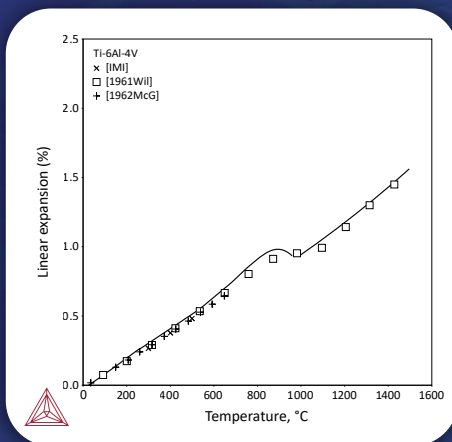
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Carbon diffusion profile near surface during carburization of a martensitic stainless steel

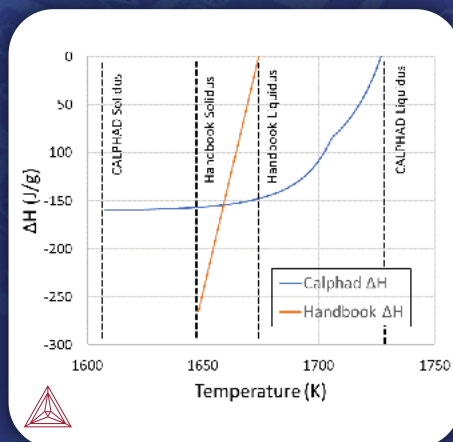
Predict a wide range of materials property data

Thermophysical Data



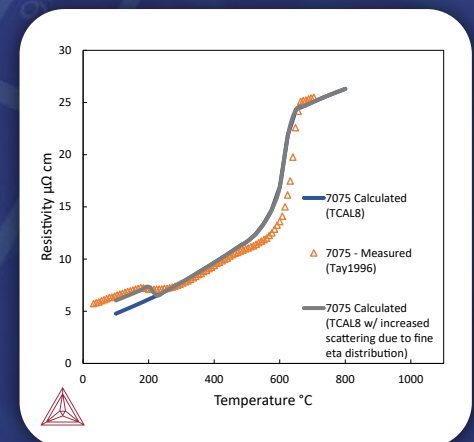
Linear expansion vs temperature for Ti-6Al-4V

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

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ABOUT THE COVER



The TMS Young Leaders International Scholar program lets early-career professionals travel to international conferences to present their research at TMS partner society meetings. This month's cover features (from left to right) two TMS scholars who attended the Japan Institute of Metals and Materials (JIMM) 2023 Spring Meeting—Michael Titus and Damien Tourret—and Jahyun Koo, a scholar from the Korean Institute of Metals and Materials (KIM) who will attend the TMS 2024 Annual Meeting & Exhibition in March. Learn more about this program in a pair of articles starting on page 8. Cover designed by Bob Demmler, TMS Visual Communications Coordinator.



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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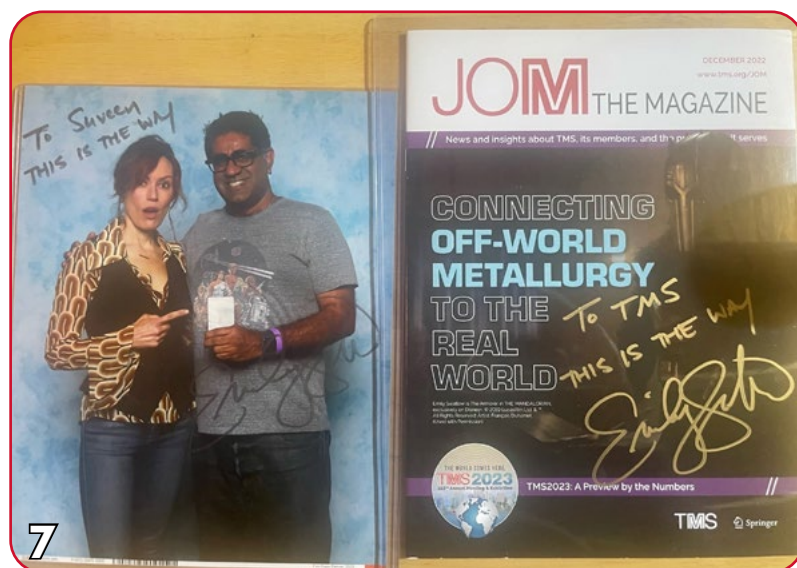
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Photo Credit: Balena



Photo Courtesy of Rivers of Steel



IN THE FINAL ANALYSIS

"The global effort to curb carbon emissions is accelerating demand for clean energy technologies and the materials they rely on. . . [Supply] risks could jeopardize the ability to reduce greenhouse gas emissions within the desirable timeframe to avoid significant climate change."

—U.S. Department of Energy, *Critical Materials Assessment 2023*

Curbing carbon emissions, ensuring a reliable supply chain of critical materials, and deploying clean energy . . . these are all topics that you would expect to see discussed in earnest at a TMS conference and featured within our publications. Perhaps you would expect to find broader analysis within one of the "science and technology accelerator studies" that the Society produces. Our studies seek to help experts articulate viable solutions and provide well-considered advice to address complex problems in materials.

Being learners in general and mindful stewards of our own rigorous study methodologies, we within TMS are enthusiastic readers of the materials reports produced by others. Today's case in point: *Critical Materials Assessment 2023*, which was released in July by the Department of Energy. The topics hold perennial stature within TMS, especially as nations and consumers alike look to rebuff climate change and embrace electric vehicles and non-fossil-fuel energy solutions. We all know that we need a lot of lithium to satisfy a seemingly insatiable demand curve, but the greening of the energy supply requires a lot of other metals from less well-trafficked corners of the Periodic Table.

The newest clean energy initiatives are turbocharging demand for critical materials. A few TMS anecdotes to support this assertion: Earlier in 2023, TMS President Brad Boyce, Public and Governmental Affairs Committee Chair Mike Titus, and I visited Congressional offices with our battery of TMS talking points. A topic of bipartisan interest? Critical materials. How or where do we get more? Complementarily, TMS participated in a just-completed multi-society workshop funded by the United Engineering Foundation. The goal: Identify solutions to increase the supply of critical materials or decrease their demand in industry. Back to customary TMS knitting, critical materials (and rare earths) will crosscut many symposia planned for TMS2024.

What does the new Department of Energy report say? I can do no justice to its 267 pages here, but *Critical Materials Assessment 2023* has a strong focus on clean energy materials and the associated supply chain. It emphasizes that "supply chain bottlenecks can occur at any stage of the value chain—from mining and refining to component and even subsystem manufacturing. The bottlenecks result from a combination of factors such as material availability, equipment availability, workforce availability and quality, logistics, regulatory frameworks, and market conditions." And that was before the varied impacts of the pandemic!

The report identifies metals based on criticality to energy applications and degree of risk in the supply chain to get them. It is observed, for example, that dysprosium, cobalt, gallium, graphite, iridium, neodymium, and terbium have "high" criticality in the short term because of their combined importance to energy and their supply risk. Lithium, with its importance to energy storage, is "near" critical in the short term. Other near-critical materials are uranium, nickel, electrical steel, magnesium, platinum, silicon carbide, fluorine, and praseodymium. Among the energy materials applications demanding these materials are vehicles, stationary storage, hydrogen electrolyzers, solar energy, wind energy, nuclear energy, the electrical grid, solid-state lighting, and microchips.

The challenges are significant, and the Department of Energy plans to continue issuing the *Critical Materials Assessments* every third year going forward. I'll plan to keep reading them.

Volume 75

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October 2023



James J. Robinson
 Executive Director



James Robinson

"The newest clean energy initiatives are turbocharging demand for critical materials."

Find peer-reviewed technical articles covering the full range of minerals, metals, and materials science and engineering in the October issue of *JOM: The Journal*. Each issue features several technical topics presenting a series of related articles compiled by guest editors. A preview of October technical topics and articles are listed below. TMS members can log in to www.tms.org/Journals for full access to technical articles from *JOM: The Journal* and additional TMS journals.

OCTOBER 2023

Advanced Materials for Additive Manufacturing

Editors: Allison Beese, Penn State University; and Michael Kirka, Oak Ridge National Laboratory

Sponsor: Additive Manufacturing Committee

"Microstructure and Elevated Temperature Flexure Testing of Tungsten Produced by Electron Beam Additive Manufacturing," **Haohzhi Zhang**, et al.

"Investigation of Microstructure and Wear Properties of Stellite 6 Laser Additive Manufactured Layers on Martensitic Stainless Steel Substrate," **S. Marandi**, et al.

"Microstructure Evolution and Mechanical Properties of Ti and Zr Micro-Alloyed Al-Cu alloy Fabricated by Wire + Arc Additive Manufacturing," **Siyue Fan**, et al.

"Microstructure and Mechanical Properties of an Advanced Ag-Microalloyed Aluminum Crossover Alloy Tailored for Wire-Arc Directed Energy Deposition," **Thomas Klein**, et al.

"Microstructures, Mechanical and High-Temperature Tribological Properties of Dual-Phase Fe₅₀Mn₃₀Co₁₀Cr₁₀ High-Entropy Alloy Fabricated by Laser Metal Deposition," **Ming Sun**, et al.

"Finite Element Analysis of Additively Manufactured Continuous Carbon Fiber-Reinforced Composites," **Chensong Dong**

"Effect of Variable Specific Energy Laser Remelting on the Morphology, Microstructure, and Mechanical Properties of Ta/Ni-Based Composite Coatings," **Jiangtong Yu**, et al.

"Work Hardening and Kinetics Analysis of Al_{0.3}MnCrCoFeNi High Entropy Alloy," **Hamed Kaypour**, et al.

Friction Stir Based Solid-State Additive Manufacturing

Editors: Rajiv Mishra, University of North Texas; and Hang Yu, Virginia Tech

Sponsor: Other (Invited)

"Friction Stir Based Solid-State Additive Manufacturing," **Rajiv Mishra**, et al.

"A Novel Approach for Enhanced Mechanical Properties in Solid-State Additive Manufacturing by Additive Friction Stir Deposition Using Thermally Stable Al-Ce-Mg Alloy," **Anurag Gumaste**, et al.

"Solid-State Additive Manufacturing of AA6060 Employing Friction Screw Extrusion Additive Manufacturing," **S.S. Rezaeinejad**, et al.

"Correlation of Microstructure and Local Mechanical Properties Along Build Direction for Multi-layer Friction Surfacing of Aluminum Alloys," **Zina Kallien**, et al.

"Investigation of Raster Pattern Spacing and Direction for Friction Stir Additive Manufacturing of Al-5083," **David Garcia**, et al.

"SolidStir Additive Manufacturing: A Novel Deformation-Based Additive Manufacturing Using Friction Stir Technology," **Ravi Sankar Haridas**, et al.

"Microstructure Evolution and Mechanical Properties of Single-layer Multipass Overlapped Al-Mg-Mn-Sc-Zr Alloy Fabricated via Additive Friction Stir Deposition," **Z. Shen**, et al.

Pyrometallurgical Techniques Driving Recycling and the Circular Economy

Editors: Will Hannemann, Aurecon; Mohamed Elzohiery, Guardian Industries; and Stuart Nicol, Glencore Technology

Sponsor: Pyrometallurgy Committee

"Experimental Study and Thermodynamic Modelling of Equilibrium Distributions of Ni, Sn and Zn Between Slag and Black Copper for E-Scrap Recycling Applications," **Svetlana Sineva**, et al.

"An Investigation on Inclusions Forming During Remelting of Aluminum and Magnesium Scraps Under a Salt Flux," **İrem Yaren Çapkın**, et al.

"Industrial Tests Using Carbide Silicon and Briquettes from Quartz Sand and Petroleum Coke in Silicon Electrothermy," **Dimitry Pruttskov**, et al.

TMS MEMBER NEWS

Share the Good News!

Contact Kelly Zappas, *JOM: The Magazine* editor, at kzappas@tms.org to share your professional accomplishments. Please note that only news submitted by current TMS members will be considered.

C. Cem Tasan Tenured at MIT



C. Cem Tasan, a TMS member since 2012, is the newly tenured Thomas B. King Associate Professor at the Massachusetts Institute of Technology (MIT). At MIT, Tasan explores the boundaries of metallurgy and solid mechanics to discover how metals break and deform, while also designing new kinds

of damage-resistant alloys. His group also studies the responses of metal samples to stress and other stimuli using in-situ electron microscopy. In 2020, they developed new in-situ methods for studying the effects of hydrogen in metals, which could help with the transition to clean hydrogen energy.

Tasan studied metallurgical and materials engineering at the Middle East Technical University

in Turkey. He then went on to earn a Ph.D. from the Eindhoven University of Technology in the Netherlands. After working at the Max Planck Institute for Iron Research in Germany following his Ph.D., Tasan moved to MIT in 2015.

Tasan has previously served on the TMS Steels Committee and has organized symposia at every TMS Annual Meeting & Exhibition since 2020. Additionally, Tasan was an organizer for the 2nd World Congress on High Entropy Alloys (HEA 2021) and is again a member of the organizing committee for the upcoming the 3rd World Congress on High Entropy Alloys (HEA 2023), scheduled for November 12–15, 2023, in Pittsburgh, Pennsylvania. Tasan is a recipient of the 2020 Early Career Faculty Fellow Award and the 2020 American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) Robert Lansing Hardy Award.

TMS Members Honored by IOM3



Several TMS members were honored with awards from the Institute of Materials, Minerals & Mining (IOM3) in 2023. The recipients will be presented with their awards at the 2023 IOM3 Awards Day on Thursday, December 7, 2023. Congratulations to the following recipients!



Geoffrey A. Brooks

Contribution to Knowledge Silver Medal

Lewis R. Owen
(Not Pictured)

Bessemer Gold Medal

Geoffrey A. Brooks



M.A. Rhamdhani



Gerbrand Ceder

Adrian Normanton Award

Geoffrey A. Brooks
and M.A. Rhamdhani

Charles Harchett Award

Gerbrand Ceder
and Bin Ouyang (Not Pictured)

Welcome to New Material Advantage Chapter



The Student Program for Materials Science and Engineering

The TMS Board of Directors has approved a new Material Advantage chapter charter for the Universidad Pedagógica y Tecnológica de Colombia.

Welcome to the Material Advantage and TMS family!

Terence Langdon Honored by ABM

Terence G. Langdon, a TMS member since 1966, was awarded a Senior Career Award by the *Journal of Materials and Research Technology* at the Associação Brasileira de Metalurgia, Materiais, e Mineração (ABM) annual meeting in August 2023. This award is presented to an individual with outstanding accomplishments in materials science and engineering that are globally recognized.

Langdon has previously served as a member of the Mechanical Behavior of Materials Committee. He is also recipient of the 2005 Structural Materials Division (SMD) Distinguished Scientist/Engineer Award, the 2012 Acta Materialia Gold Medal Award, and the 2018 Oleg D. Sherby Award. In 2005, he was elected as a TMS Fellow for "outstanding contributions to our understanding of the mechanisms of high-temperature deformation and superplasticity of metals, alloys, and ceramics."



Terence G. Langdon (left) received the Senior Career Award at the ABM annual meeting in São Paulo, Brazil, from Marc Meyers (right), Editor-in-Chief of the *Journal of Materials and Research Technology*.

Add a Joint Membership to IOM3 or ABM When You Renew for 2024

It's time for TMS members to renew their memberships for 2024. During the renewal process, members have the option to purchase joint memberships to the Institute of Materials, Minerals, and Mining (IOM3) and the Brazilian Metallurgical, Materials, and Mining Association (ABM). These joint memberships offer access to select membership resources and event discounts from these partnering societies for a reduced rate.

IOM3 is the U.K. engineering institution whose activities encompass the whole materials cycle, from

exploration and extraction, through characterization, processing, forming, finishing, and application, to product recycling and land reuse. ABM has a particular focus on the exchange of technical and scientific knowledge and the permanent pursuit of improvement of those professionals involved in the metals and materials development.

Learn more about these programs in the Membership Add-ons section of www.tms.org/ **Membership** and purchase them when you renew your membership at www.tms.org/ **Renew**.

Integrating Materials and Manufacturing Innovation Seeks Submissions for Topical Collection



Integrating Materials and Manufacturing Innovation is seeking submissions for the new topical collection, **Harnessing the Power of Materials Data**. The widespread use of data exploitation techniques such as machine learning and artificial intelligence has illuminated the need for community-wide

adoption of FAIR data principles for materials data and deeper investments in general in the materials data infrastructure. This topical collection will provide insights on the state-of-the-art efforts aimed at harnessing the power of materials data. Topics for this collection will include, but are not limited to:

- Best practices in materials repository design supporting FAIR data principles, and associated success stories with these practices
- Case studies in development and application of standards, vocabularies, ontologies, natural

language processing, large language models, and other AI-driven frameworks to the management, analysis, and exchange of data

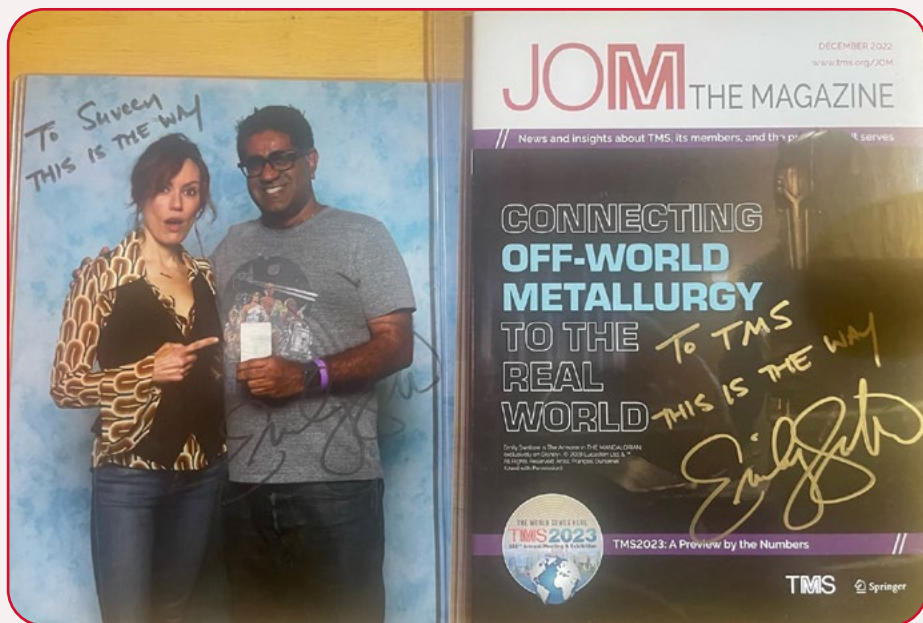
- Design of laboratory workflows to reduce the burden of data management and ease the sharing of materials data
- Large language model applications related to materials in, for example, structured data extraction from text, software interface design, modeling, and education
- Approaches to training and equipping the workforce to become data savvy

The guest editors for this topical collection are **James Warren**, National Institute of Standards and Technology, and **Ben Blaiszik**, University of Chicago.

To submit your work, go to www.editorialmanager.com/immj. After logging in, choose "Submit New Manuscript", and then select article type "Thematic Article." When reaching the "Additional Information" screen, indicate that you are submitting for the topical collection "Materials Data" from the list of options. Author instructions and additional journal details are available at www.springer.com/40192. Article submissions are due by **October 31, 2023**.

TMS, This Is the Way

Suveen Mathaudhu, the TMS Structural Materials Division (SMD) Chair on the TMS Board of Directors, met with **Emily Swallow**, the Armorer from Disney+'s *The Mandalorian* and *The Book of Boba Fett*, and received a signed copy of the December 2022 *JOM: The Magazine* issue featuring the article, "This is the Way: Tracing the Path between Damascus Steel and Beskar," by Mathaudhu, Eric M. Taleff, and Jeffrey Wadsworth. Swallow's character was pictured on the front cover of the issue. Read this article at www.tms.org/JOM.



In Memoriam

Ronald Armstrong, a TMS member since 1976, passed away in May 2023. Armstrong had an impressive career which had a profound effect on the materials science and engineering field. In 1958, Armstrong graduated with a Ph.D. from Carnegie Mellon University. Following graduation, he conducted postdoctoral research at Leeds University in the U.K. where he worked with Sir Norman Petch. His career led him to live and work all over the world, including positions at Westinghouse, Brown University, and, most recently, as professor emeritus at the University of Maryland. Armstrong is most known for the Zerilli-Armstrong constitutive equation, used globally and embedded in many FEM codes, and the significant strides he made in grain size effects in metals. He also made important contributions to the mechanical properties of explosives, shear localization, and X-ray diffraction topography. Armstrong was a recipient of the 1962 AIME Robert Lansing Hardy Award which recognizes a young person in the broad fields of metallurgy and materials science for exceptional promise of a successful career.

In May 2023, **Ulrich F. "Fred" Kocks**, a TMS member since 1977, passed away. Kocks earned a master's degree in physics from the University of Göttingen, and in 1955 he emigrated to the United States, where he studied and received a Ph.D. in applied physics from Harvard University, graduating in 1959. He went on to teach at Harvard University in the Division of Engineering and Applied Physics until 1965. He then pursued his passion for research, working at Argonne National Laboratory and Los Alamos National Laboratory, including becoming a founding member of the Center for Materials Science at Los Alamos National Laboratory in 1983. He retired from Los Alamos in 1999 and then served as a distinguished professor at the University of California, San Diego. Kocks was known for his seminal contributions to deformation kinetics, contributions related to strain hardening, and work on crystal plasticity. Kocks was inducted into the 1987 class of TMS Fellows. In 1999, he was elected to the National Academy of Engineering "for advancements in the theory of strength, kinetics of plasticity of metals, and texture analysis."

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

Hans Diderik Faaberg

Gerald Madden

Frank T. Wimmer, PE

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INSIDE THE TMS YOUNG LEADERS INTERNATIONAL SCHOLAR PROGRAM

Kelly Zappas

Travelling to an international conference to present research can be a valuable experience for an early-career professional, helping to broaden their horizons and providing unique opportunities for professional development. It's an experience that can also be out of reach, financially, for someone still establishing themselves in the profession.

The **TMS Young Leaders International Scholar Program** is designed to provide individuals with these resume- and confidence-building experiences through funding from the TMS Foundation and its donors. Currently, TMS is engaged in three exchange programs, in partnership with the Japan Institute of Metals and Materials (JIMM), the Federation of European Materials Societies (FEMS), and the Korean Institute of Metals and Materials (KIM).

TMMIS

The Minerals, Metals & Materials Society



The Japan Institute of Metals and Materials



FEDERATION OF EUROPEAN MATERIALS SOCIETIES

KIM+

대한금속·재료학회
THE KOREAN INSTITUTE OF METALS AND MATERIALS



TMS sent its first scholars to a JIMM conference to present their work in 2006 and has been funding travel to these meetings for award recipients ever since. In 2013, TMS entered a similar partnership with the Federation of European Materials Societies (FEMS), sending scholars to present their work every other year at the FEMS EUROMAT conference. Over the years, more than 25 early-career TMS members working in industry, academia, and government, have benefited from the scholar program. In return, JIMM and FEMS have sent scholars to present their work at the TMS Annual Meeting & Exhibition.

In 2022, TMS and the Korean Institute of Metals and Materials (KIM) entered an agreement for a new KIM International Scholar Award. (Fittingly, that agreement was signed by 2022 TMS President Jud Ready, who was one of the first recipients of the JIMM International Scholar Award in 2006.) At press time, TMS was still accepting applications for its first KIM International Scholar, who will travel to the KIM Fall Conference in October 2024. KIM has already selected their inaugural award recipient, who will present their work at TMS2024. See the sidebar for more information on the KIM awardee.

In the past few years, travel plans have been interrupted or delayed for award recipients due to cancelled events and COVID-related travel restrictions. As a result, two TMS members traveled to JIMM's 2023 Spring Meeting, held March 7-10, 2023, at the University of Tokyo. **Damien Tourret**, from the IMDEA Materials Institute in Madrid, Spain, was the 2023 award recipient, and **Michael Titus** of Purdue University in West Lafayette, Indiana, USA, was the 2020 award recipient. In this October issue of *JOM: The Magazine*, you can read Tourret's first-hand account of his visit to Japan and his experience as a JIMM scholar. Titus's story will appear in a future issue of *JOM: The Magazine*.

KIM Announces First International Scholar to TMS

The Korean Institute of Metals and Materials (KIM) has selected its first international scholar as part of the joint TMS/KIM International Scholar program. **Jahyun Koo**, an assistant professor at the Korea University School of Biomedical Engineering, will travel to the TMS 2024 Annual Meeting & Exhibition in Orlando, Florida, where he will deliver the presentation, "Electrochemically Controlled Drug Delivery Valve that Exploits Crevice Corrosion."



Jahyun Koo, 2024 KIM Young Leaders International Scholar

Although the deadline has passed to apply for the 2024 awards, applications will be accepted through August 15, 2024 for the 2025 TMS Young Leaders International Scholar awards. In 2025, TMS will select a total of three award recipients to attend the FEMS, JIMM, and KIM conferences.

Visit www.tms.org/YoungProfessionals to learn more about these and other opportunities available to emerging professionals through TMS.



Michael Titus, 2020 TMS Young Leaders International Scholar – JIMM

Damien Tourret, 2023 TMS Young Leaders International Scholar – JIMM



Support Emerging Professionals through the TMS Foundation

The TMS Foundation funds programs for early-career professionals, including the TMS Young Leaders International Scholar Program and the TMS Young Leaders Professional Development Award, as well as scholarships for undergraduate and graduate students and much more. Read "Making an Impact: The TMS Foundation 2022 Annual Report" in this October issue of *JOM: The Magazine* for a more complete look at the work of the TMS Foundation, and consider making a contribution at www.TMSFoundation.org to help programs like these continue to thrive.

A SCHOLAR'S SCIENTIFIC AND CULINARY ODYSSEY THROUGH THE LAND OF LEGENDARY SWORDSMITHS AND COMPUTER-GENERATED CRYSTALS

Damien Turret

My fascination with Japan started at an early age. Like most kids of my generation, I grew up devouring manga, watching anime, and playing Japanese videogames. Years later, I came to realize that Japan was home to countless pioneering discoveries. In the field of metallurgy, this is perhaps best illustrated by the country's legendary bladesmithing. Close to my scientific interests, namely in computational modeling of crystal growth, milestone contributions from Japan go from Kobayashi's first-ever computer-generated phase-field dendrites¹ to massively parallelized simulations of entire dendritic "forests" at record-breaking scale.²

In 2019, I was invited by Professors Takaki of the Kyoto Institute of Technology and Ohno of Hokkaido University to co-organize a symposium at the then-upcoming COMPSAFE conference to be held in Kobe in March 2020. All plans were lined up to visit several research institutions across the country. However, as the world was coming to the realization of the looming global health crisis, the TMS Annual Meeting of February 2020 in San Diego was to be my last international in-person conference for the next couple of years.

From top, clockwise: Damien Turret visits the Torii gates at Fushimi Inari Shrine during his trip to Japan; a view of Mount Fuji from the bullet train between Tokyo and Kyoto; Turret at the Kyoto Institute of Technology with Professor Takaki (rightmost) and group members; Turret at the University of Tokyo with Professor Shibuta (top row, second from left) and group members.



Damien Tourret (second from right) on the way to dinner with, from left to right, professors Katsube, Yasuda, and Narumi of Kyoto University.

As such, when I received the great honor of being selected as the 2023 Japan Institute of Metals and Materials (JIMM)/TMS Young Leaders International Scholar, I was determined to make the most of it and decided to complement the annual 2023 JIMM Spring Meeting with visits and seminars in no less than four renowned research groups in three different cities across the country.

My first stop was Tokyo, a city whose scale, pace, and energy suffice to humble even the most experienced travelers. The cherry blossom season was barely starting, but many plum trees were already close to full bloom. My first visit was kindly hosted by Professor Shibuta at the University of Tokyo. There, I presented some recent research lines in the field of computational modeling of advanced manufacturing of metals and alloys at IMDEA Materials Institute (Madrid, Spain) and engaged in stimulating discussions on atomistic modeling of solid-liquid interfaces—thereby also gathering some useful tips on resulting data postprocessing technicalities.

The next day, before the start of the JIMM meeting, I had the opportunity to explore some of Tokyo's touristic highlights, such as Asakusa district. A look at the city from above at the Tokyo Skytree observation deck also provided me with a sense of the city's vertiginous scale. The JIMM Spring meeting was held on the Komaba Campus of the University of Tokyo in the following days. There, we (fellow TMS/JIMM awardee Mike Titus of Purdue University and I) were warmly welcomed and guided by JIMM Executive Director Hideaki Yamamura.

On the first evening of the conference, we were treated to a delightful welcome dinner hosted by the JIMM Board of Directors. The dinner took place in the Shibuya district, home to the world-famous Scramble Crossing and its bronze statue of the loyal Hachikō. It was a great opportunity to meet outstanding researchers from both Japanese and Korean materials societies. It was also a reminder of how small the world sometimes is, realizing I had colleagues/friends in common with some of my tablemates.

After the conference, I had the chance to visit Meiji Shrine and the nearby Shinjuku Gyoen National Garden before making my way to Kyoto. Japanese bullet trains (Shinkansen) are famous for their punctuality, speed, and smooth ride, and my trip to Kyoto was no exception. Remarkably, the Tokyo-Kyoto line also offers breathtaking views of the country's most revered mountain, Mt. Fuji, which is pictured on the opening page of this article.

Kyoto is known as "The City of Ten Thousand Shrines" and hosts a great number of temples, shrines, palaces, and gardens. So, naturally, I spent the rest of the weekend exploring the city and its surroundings, such as Arashiyama Bamboo grove, and many temples such as Ninna-ji, Ryōan-ji, and Kinkaku-ji—the latter being better known as the "Temple of the Golden Pavilion."

Starting my second week in Japan, I resumed my scientific journey with a visit to the Kyoto Institute of Technology, kindly hosted by Professor Takaki. There, after my seminar, I had the chance to attend short presentations by various group members and to have enlightening scientific exchanges on topics related to large-scale phase-field modeling of dendritic solidification and the coupling between crystal growth and semi-solid deformation.

For my second visit in Kyoto, Professor Yasuda welcomed me to Kyoto University. On my first day there, I was introduced to an impressive variety of furnaces for in-situ X-ray imaging of metal solidification experiments. Professor Yasuda is a pioneer of in-situ imaging of metallic microstructure formation and evolution. He and his group, in typically Japanese fashion, have perfected their craft to a level more often seen in Swiss watchmaking than in an academic research lab. The day continued with a series of presentations and discussions involving several group members, capped off by a lovely dinner in a traditional Kyoto-style restaurant, where we were joined by Assistant Professors Narumi and Katsube (Kyoto University) and Professor Takaki. On my second day at Kyoto University, I gave a seminar



Sushi dinner in Sapporo with Professor Ohno (second from right) of Hokkaido University and group members.

which had kindly been advertised and arranged in a hybrid format, thus allowing scholars from other universities across the country to attend and take part in subsequent discussions. Later in the afternoon, I made my way to Osaka airport to fly to the last and northernmost stage of my journey.

In addition to its namesake beer and its cuisine (such as ramen and seafood), the city of Sapporo on the northern island of Hokkaido is famous for its snow festival. So, it should be of no surprise that my visit there was punctuated by a few dendritic ice crystals falling from the sky—better known to most people as snowflakes. My visit to Hokkaido University was graciously hosted by Professor Ohno. Here, I delivered the final seminar of my trip. This was followed by discussions on various research activities across the materials science and engineering department with Professor Muira and on the integration of computational modeling and experiments (e.g. via data assimilation techniques) with Professor Ohno.

The following morning, I started my journey onward to the TMS 2023 Annual Meeting & Exhibition in San Diego. As is the case every year, this was a great opportunity to both catch up with old friends and colleagues and to make new ones.

In addition to the inspiring scientific exchanges, my most vivid memories of Japan will remain the remarkable hospitality, the inner peace from a stroll through its traditional gardens, and the wonderful cuisine. Regarding the latter, I would be remiss not to emphasize the absolute treasure that is Japanese food—from the buzzing streets of the Tsukiji fish market to the many quaint traditional restaurants. The late chef and insatiable explorer Anthony Bourdain once wrote, "If I had to eat only in one city for the rest of my life, Tokyo would be it." While the rest of my culinary journey was equally as sensational as its Edo stage, I cannot help but relate.

Alas, I am not able to name every single one of the amazing people I met along the way and who made my journey unforgettable. However, I will long harbor fond memories of their kind welcome through lab visits, scientific discussions, and guidance in exploring the finest local cuisine and spirits. I can only conclude by expressing my heartfelt gratitude to not only all my wonderful hosts in Japan, but also to the TMS Foundation for making this all possible, and by most enthusiastically encouraging anyone eligible for the TMS Young Leaders International Scholar Award to apply.

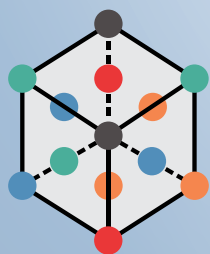
References

1. R. Kobayashi: "A Numerical Approach to Three-Dimensional Dendritic Solidification," *Exp. Math.*, 3, 59–81 (1994).
2. T. Shimokawabe, et al., "Peta-Scale Phase-Field Simulation for Dendritic Solidification on the TSUBAME 2.0 Supercomputer," *Proceedings of 2011 International Conference for High Performance Computing, Networking, Storage and Analysis*. (New York, NY: IEEE, 2011, pp. 1-11).

Damien Turret is a researcher with IMDEA Materials in Madrid, Spain. Turret received an M.Sc. in mechanical engineering from INSA Toulouse (France) and a Ph.D. in materials science and engineering from École des Mines de Paris (Mines ParisTech, France). In 2017, he joined IMDEA Materials Institute to lead the research group on Modelling and Simulation of Materials Processing. Before joining IMDEA, he was a director's postdoctoral fellow at Los Alamos National Laboratory in Los Alamos, New Mexico, USA. He also held postdoctoral positions at the German Aerospace Center (DLR in Cologne, Germany) and at Northeastern University (Boston, Massachusetts, USA).

EXPLORE PROGRESS AND INNOVATION WITH WORLD-CLASS EXPERTS: A PREVIEW OF HEA 2023

Megan Enright



3rd WORLD CONGRESS ON
HIGH ENTROPY ALLOYS
HEA 2023



"High entropy alloys (HEAs) are an emerging class of materials with exciting potential. The TMS World Congress on High Entropy Alloys is a one-stop shop to learn about new developments in the field and connect with leading experts," said **Andrew Detor**, chair of the 3rd World Congress on High Entropy Alloys (HEA 2023), which is scheduled for November 12–15, 2023, at the Omni William Penn Hotel in Pittsburgh, Pennsylvania, USA. "Having attended the inaugural and second congresses, and now helping organize the upcoming third meeting, I am looking forward to our world-class

lineup of presenters and seeing all the progress made in the field over the past couple of years."

HEA 2023 is a cross-disciplinary technical forum designed to share the latest research advances in single-phase and multi-phase metallic, intermetallic, refractory, and ceramic high entropy materials for functional or structural applications. HEA 2023 will feature highly focused technical talks on topics that include fundamental theory of alloy design, computational modeling and simulation, properties, processing, and applications of high entropy alloys.

TECHNICAL PROGRAM FEATURES

HEA 2023 will convene stakeholders from across academia, government, and industry to address many fundamental issues in HEAs, as well as to examine their properties and potential engineering applications.

"The technical program will enable not only deep dives into topics like alloy design; theory and computational modeling; processing; advanced characterization and testing, including high-throughput, autonomous, and machine learning assisted approaches; ceramic and refractory HEAs; coatings and thin-films; mechanical and functional behaviors; performance in extreme environments; and novel applications for attendees at all stages of their careers but will also summarize the state-of-the-art for those simply wanting to learn more," said **Amy Clarke**, HEA 2023 programming chair. "I am especially interested in [learning about] recent advances in processing and refractory HEAs and current/future visions for autonomous exploration of HEAs [at HEA 2023]," she continued.

The specific technical topic areas for HEA 2023 will include, but are not limited to:

- Novel Applications of HEAs
- Alloy Design
- High-throughput, Autonomous, and Machine Learning Assisted HEA R&D
- Fundamental Theory and Computational Modeling
- Characterization Techniques for HEAs
- Supply Chain, Recycling, and Sustainability of HEAs
- Processing of HEAs (welding, joining, brazing, additive manufacturing)
- HEA Coatings and Thin Films
- Functional Properties (e.g., HEAs in catalysis)
- Environmental Resistance (corrosion and oxidation)
- Mechanical Properties
- Irradiation Resistance
- Ceramic HEAs
- Refractory HEAs

PUBLICATION OPPORTUNITY

Congress participants are encouraged to submit their work to the TMS journal *Metallurgical and Materials Transactions A*, which will be publishing a topical collection dedicated to the congress. This collection will take the place of a traditional conference proceedings publication. Only submissions from attendees will be considered for this collection. Submissions will go through the journal's standard peer review process and there is no guarantee of acceptance. Submissions are due **January 31, 2024**.



PLENARY AND INVITED SPEAKERS



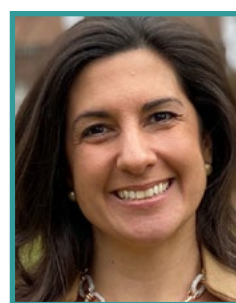
Zhaoping Lu



Evan Ma



Daniel B. Miracle



Mitra Taheri

HEA 2023 will feature four plenary presentations from experts. These leaders in the field of HEAs will set the tone for this robust technical program. The HEA 2023 plenary speakers will include **Zhaoping Lu**, University of Science and Technology Beijing, and **Mitra Taheri**, Johns Hopkins University. In addition, **Evan Ma**, Xi'an Jiaotong University, will give the presentation, "Designing Chemical Inhomogeneities in Concentrated Complex Alloys to Circumvent the Strength-Ductility Trade-Off," and **Daniel B. Miracle**, Air Force Research Laboratory, will present the talk, "High-Entropy Alloys—A Twenty-Year Perspective."

The technical sessions will highlight the breadth of advances, challenges, and opportunities for HEAs

and will feature a diverse range of invited speakers, including **Diran Apelian**, University of California, Irvine; **Rajarshi Banerjee**, University of North Texas; **Todd M. Butler**, Air Force Research Laboratory; **Rodrigo Freitas**, Massachusetts Institute of Technology; **Easo George**, University of Tennessee and Ruhr University Bochum; **Austin Mann**, Boeing Research & Technology; **Andrew Minor**, University of California, Berkeley and Lawrence Berkeley National Laboratory; **Shyue Ping Ong**, University of California, San Diego; **Karin Ratschbacher**, GfE Metalle und Materialien GmbH; **Robert O. Ritchie**, University of California, Berkeley; **John Sharon**, Raytheon Technologies; and **Ravit Silverstein**, University of California, Santa Barbara.

NETWORKING AND SOCIAL EVENTS

HEA 2023 will have several networking opportunities that provide attendees with a chance to informally discuss the latest developments in high entropy alloys, while also making valuable professional connections. Get to know potential collaborators, mentors, and colleagues by attending the following events.

The Sunday Night Welcome Reception: This is a great opportunity to introduce yourself to fellow attendees and exhibitors you'll be seeing throughout the week. Light refreshments will be served.

The Poster Session and Reception on Monday Night: View the latest research on display at the poster reception and enjoy refreshments while mingling with presenters and exhibitors.

The Congress Dinner on Tuesday Night: Continue to meet and network with congress attendees at the congress dinner. While there is no additional fee to attend the dinner, you must indicate that you will be attending when registering for the congress.

OPTIONAL SITE TOUR: CARRIE BLAST FURNACE HISTORICAL SITE

In addition to the robust technical program, HEA 2023 will also feature an optional tour of the **Carrie Blast Furnace Historical Site**. Over the course of the two-hour guided tour, attendees will hear stories about the site's technology, including why it is nationally significant, as well as get to know the culture of its workers. Participants will also learn about the iron-making process, from the movement of the raw materials to the tapping of the furnaces that produced fiery molten iron.

This tour will take place on **Thursday, November 16, 2023**. An additional ticket purchase must be made during your registration in order to participate. The ticket price includes admission to the site, tour gear, and transportation to and from the site. Transportation space is limited, and tickets are sold on a first-come, first-served basis.

Learn more about this tour and register to attend today at www.tms.org/HEA2023.



Carrie Blast Furnace Historical Site is the location of the optional site tour for HEA 2023 attendees. *Photo Courtesy of Rivers of Steel.*

ATTEND HEA 2023

"I am excited for HEA 2023! As a past attendee, and speaker at the second congress, I can attest to the fact that this specialty event brings together academia, government, and industry to discover and discuss the latest developments in this quickly evolving field," Clarke said.

HEA 2023 will provide attendees with valuable networking opportunities and will attract research leaders from across the globe, as well as students and

post-doctoral fellows interested in the science and engineering of metallic materials and high-performance alloys. The congress will allow scientists and engineers to collaborate on this promising technology and, hopefully, help facilitate and accelerate widespread application and adoption of these materials.

Make sure you are part of these exciting conversations by attending HEA 2023. Register today at www.tms.org/HEA2023.

BOOK YOUR ROOM BY OCTOBER 12 AND SAVE

HEA 2023 will take place at the Omni William Penn Hotel in Pittsburgh, Pennsylvania. A block of rooms has been reserved at the hotel at a special rate for your convenience. In addition to saving you time and money, staying at the congress location will give you convenient access to technical session rooms and social functions, allowing for plenty of informal networking opportunities with your congress colleagues. To take advantage of this special rate, accommodations must be secured by **October 12, 2023**. Book your room today at www.tms.org/HEA2023.



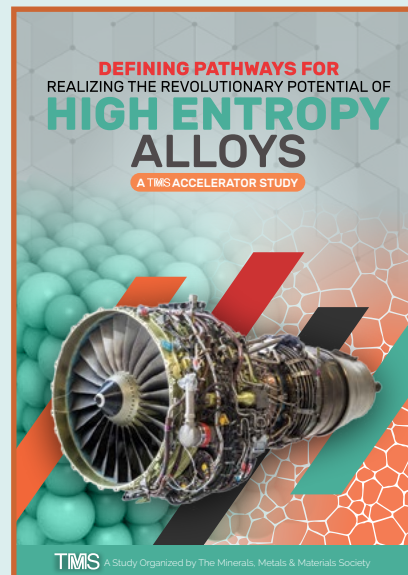
Photo Courtesy of the Omni William Penn.

DOWNLOAD THE HEA ACCELERATOR STUDY

Scientific exploration in the field of high entropy alloys has recently exploded. HEA development offers tremendous potential not only for expanding scientific knowledge, but also for creating a broad range of revolutionary products for strategic, economic, and national security benefits.

Defining Pathways for Realizing the Revolutionary Potential of High Entropy Alloys is a TMS science and technology accelerator study published in 2021 and organized by TMS on behalf of the Defense Advanced Research Projects Agency (DARPA) via the Air Force Research Laboratory (AFRL). This study examines the extensive work being performed in this emerging field with the goal of providing science and technology pathways to accelerate realization of the wide-reaching potential of HEAs in some key application areas and alloy categories.

Learn more about this study and download a free copy today at www.tms.org/HEAPathways.



MEET THE HEA 2023 ORGANIZING COMMITTEE

HEA 2023 is organized by the following leaders in the field:

Chair: Andrew Detor,
Defense Advanced Research Projects Agency

Programming Chair: Amy Clarke,
Colorado School of Mines

Martin Heilmaier,
Karlsruhe Institute of Technology (*Not Pictured*)

Keith Knipling,
Naval Research Laboratory

Elizabeth Opila,
University of Virginia

Oleg N. Senkov,
MRL Materials Resources LLC and Air Force Research Laboratory

C. Cem Tasan,
Massachusetts Institute of Technology

Mike Titus,
Purdue University



Andrew Detor



Amy Clarke



Keith Knipling



Elizabeth Opila



Oleg N. Senkov



C. Cem Tasan



Mike Titus

What Is Your TMS Member Type?

Brad Boyce



WHAT IS YOUR TMS MEMBER TYPE?

This might seem like an odd question, but my intention is not to assess your personality or working style. Rather, I want you to take a moment to consider whether you are an associate member of TMS or a professional member.

It might be that you are neither. Perhaps you're an undergraduate or graduate student in the Material Advantage program or part of our three-year Recent Graduate program (which, if you aren't aware, offers free and reduced-cost memberships to recent graduates for the first three years following graduation). But most of you likely fall into the category of either professional or associate member.

WHAT'S THE DIFFERENCE?

While the formal definitions are spelled out in the "Professional or Associate?" sidebar, the primary difference is your qualifications—and how much we know about them. In order to be approved for professional membership by the TMS Board of Directors, you must hold a minimum of a baccalaureate degree and three years of work experience or have five years of relevant work experience. If you don't meet these criteria or if you have not provided TMS with your credentials, you are likely categorized as an associate member.

WHY DOES IT MATTER?

Achieving the status of professional member with TMS is not automatic and should be considered an important recognition of professional achievement. The TMS bylaws specify the necessary credentials for professional members, with the TMS Board needing to formally approve an individual for professional membership based on demonstration of those credentials. Achieving TMS Professional Membership is yet another way to demonstrate your qualifications to your colleagues and the greater materials community. When a potential employer or collaborator sees that you are a TMS professional member, they know that you have a strong educational or work background in the field (or a combination of both). To help you communicate this, TMS has developed badges that you can use on your social media profile or in your email signature. We'll be sending our professional members a link to these resources during the membership renewal process this fall.

HOW DO I KNOW WHICH TYPE I AM?

Log in to members.tms.org and go to "Edit Your Profile" (found under Member Tools). Your member type will be listed in the box on the left side of the page.

PROFESSIONAL OR ASSOCIATE?

Excerpted from Section 2.2 of the TMS Bylaws

PROFESSIONAL MEMBER:* A candidate for election as Professional Member shall be a person of integrity actively involved as a professional with materials science, engineering, and/or application in these fields for at least 3 years following granting of at least a baccalaureate degree from a recognized university (as may be determined by the Board of Directors) in materials science, materials engineering, metallurgy, metallurgical engineering, or another science or engineering discipline related to the field. The requirement for the baccalaureate degree may be waived if the candidate possesses a minimum of 5 years experience and is a practicing professional in materials science and engineering or a closely related field. A Professional Member has full voting privileges.

ASSOCIATE MEMBER: A candidate for Associate Member shall be a person of integrity who, while not possessing the academic or technical experience required of a Professional Member, is professionally active in fields that are sufficiently related to the advancement of materials science and engineering and its affiliated industries. An Associate Member has full voting privileges.

***Note that starting in 2024, only professional members will be eligible to receive *JOM: The Magazine* in print. Both professional and associate members will continue to have access to the magazine electronically.**

OCTOBER CHECKLIST: UPDATE YOUR PROFILE AND RENEW YOUR MEMBERSHIP

There are two relatively simple steps you can take this month to secure your full TMS member benefits for the coming year:

1. RENEW YOUR MEMBERSHIP:

- Log in to members.tms.org.
- Click on "Renew Membership".
- Make your membership selections. Be sure to include any add-ons like affiliate memberships with partnering international societies or a subscription to the Light Metals or OneMine online libraries.
- Pay your dues for 2024. We've simplified the process for renewing members this year, minimizing the number of screens you need to click through to get to the checkout.

2. UPDATE YOUR PROFILE:

- At the end of the renewal process, click the link to your membership profile.
- Review the information we have on file for you.
- Add any missing education and/or employer information so that we can verify your status as a professional member and continue to mail your print *JOM: The Magazine* subscription.

Be sure to take action by December 31 to renew your membership for 2024. All member benefits—including access to meeting discounts—will be suspended on January 15, 2024.

HOW DO I SWITCH FROM ASSOCIATE TO PROFESSIONAL MEMBER?

Through the Edit Your Profile page, you can add to the information we have on file for you. Enter the name of the college or university you attended, the degree earned, and your graduation year or enter the names of companies where you've been employed. Once we verify the information, you will be upgraded to professional membership.

I'd encourage you to visit members.tms.org today to make sure that your information with TMS

is up-to-date and to renew your membership for 2024. By acting now, you'll ensure continued access to *JOM: The Magazine*, lock in your discounted member rate on registration for events like the TMS 2024 Annual Meeting & Exhibition, and enjoy the prestige of belonging to a respected international community of minerals, metals, and materials scientists and engineers.

The 2022 TMS Annual Financial Report

Jud Ready and
James J. Robinson



For much of its history, TMS has enjoyed a relatively steady level of prosperity. There have been a few bumps along the way, but in general, we have been able to serve our members and the profession well, while carefully managing our finances. In years when business was good—and there were many—we set aside money in our reserves for a rainy day. This foresight turned out to be invaluable, as 2022 was a year full of rainy days.

It was, to put it plainly, an exceptionally difficult year for TMS. We began to recover from the pandemic in earnest, holding the TMS 2022 Annual Meeting & Exhibition—a hybrid in-person and virtual event—early in the year and the fully in-person Materials Science & Technology conference in the fall. While events like these were important steps on the road to our recovery, attendance (and ability to cover costs) lagged in comparison to typical years. Our business models were strained by the slow recovery, and our expenses significantly exceeded our revenue for the year.

Over the past three years, TMS has contended with disruptions to many of our traditional revenue streams. During the pandemic, as we pivoted to virtual events and looked for new ways to keep our members connected online, the Society began spending more money than it was earning. Grants from the U.S. Federal Government and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) helped offset losses in our operations in 2020 and 2021, but by 2022, these subsidies were no longer available. As a result, in 2022, TMS withdrew approximately \$2 million from its reserves to offset deficit operations. To better position ourselves for 2023, we engaged in aggressive cost-cutting by reducing the number of headquarters staff, downsizing our headquarters footprint and renegotiating our lease, and curtailing expenditures on many programs.

It was a difficult thing to do, but careful preparation during our prosperous years meant that adequate

funds were available to help us offset our losses in 2022. We don't expect to rebound completely for 2023, but our position is much stronger going into that year. We are optimistic for a return to balanced operations in 2024.

Other than carefully managing financial accounts, there are causes for optimism. Looking past 2022, strong attendance at the TMS 2023 Annual Meeting & Exhibition in San Diego, California, surpassed many pre-pandemic attendance numbers, and a traditional number of abstracts has been submitted for the TMS 2024 Annual Meeting & Exhibition in Orlando, Florida, showing signs that these flagship events for TMS have recovered. Beyond these main events, we are also optimistic about plans for the TMS Specialty Congress—a new meeting concept that combines many of our specialty conferences into one broader event, bringing more people together in a single location and reducing the need to travel to multiple specialty conferences.

It has, undoubtedly, been a challenging few years for TMS, but thanks to the foresight of our TMS volunteer and staff leadership and the tireless efforts of our many TMS volunteers and exceptional staff, we are moving through these tough times and looking ahead to brighter days.



Jud Ready
2022 TMS President



James J. Robinson
TMS Executive Director

WHO WE ARE

Our Membership Totals

Students

4,270

Professionals

6,350

Total Membership

10,620

Where Our Members Work

Academia

41%

Government

16%

Industry

35%

Retired

8%

Unknown

1%

Where Our Members Live

United States

63%

Canada

4%

Asia

12%

Europe

16%

Latin America, Caribbean

2%

Oceania

2%

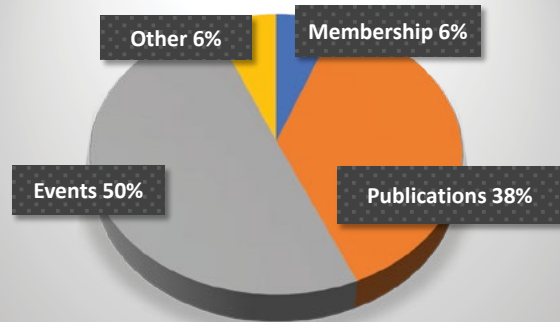
Africa

1%

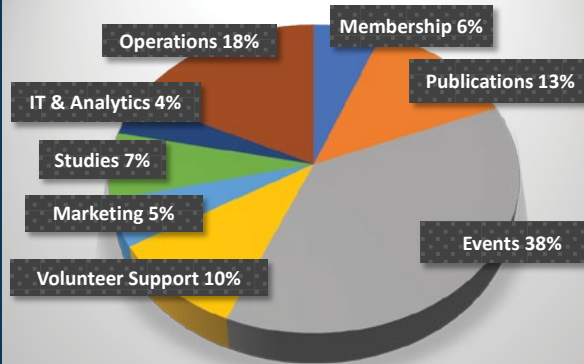
*Percentages may not add up to 100% due to rounding.

2022 FINANCIAL REVIEW

2022 Operating Revenues by Program Area



2022 Operating Expenses by Program Area



Summary Of Operations Revenues And Expenses

Years ending December 31, 2022 and 2021

REVENUES	2022	2021
Membership & Customer Service	\$381,297	\$402,865
Content	\$2,490,325	\$2,558,889
Events, Education & Exhibits	\$3,312,185	\$1,855,645
Volunteer Support	\$1,424	\$4,776
Marketing & Communications	\$1,000	\$41,719
New Initiatives, Science, and Engineering	\$313,641	\$176,706
IT and Data Analytics	\$0	\$0
Executive & Operations	\$98,449	\$1,792,370
TOTAL REVENUES	\$6,598,321	\$6,832,970

EXPENSES	2022	2021
Membership & Customer Service	\$477,430	\$312,460
Content	\$1,078,231	\$942,533
Events, Education & Exhibits	\$3,255,236	\$1,389,631
Volunteer Support	\$865,117	\$675,291
Marketing & Communications	\$391,598	\$428,763
New Initiatives, Science, and Engineering	\$578,195	\$487,906
IT and Data Analytics	\$336,158	\$522,278
Executive & Operations	\$1,531,396	\$1,411,870
TOTAL EXPENSES	\$8,513,361	\$6,170,732

EXCESS OPERATIONS REVENUE	(\$1,915,040)	\$662,238
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JOM: The Magazine, Vol. 75, No. 10, 2023
<https://doi.org/10.1007/s11837-023-06114-9>
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TMS FOUNDATION

Making an Impact

The TMS Foundation 2022 Annual Report



WE HAVE GOOD NEWS TO SHARE



Carl Cady
Chair, TMS Foundation Board of Trustees
Member, TMS Foundation Gold Society

Thanks to our generous donors and the commitment of our Board of Trustees, 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. (For a snapshot of the Foundation's donation performance for the entire year, please see the chart on the next page.)

While every donation in 2022 made a difference, the Foundation also greatly benefited from acts of

extraordinary generosity. In particular, I'd like to recognize the support of Robyn and Rob Wagoner, TMS Foundation Diamond members, who donated \$50,000 in 2022. This is the latest testament to their long-standing, exceptional commitment to the Foundation and its important work.

It is the belief in the TMS Foundation's mission, as exemplified by Robyn and Rob, that has enabled us to make progress on our strategic goals, which the TMS Foundation Board of Trustees adopted in February 2020, just weeks before the global pandemic shutdown. In November 2022, the Board of Trustees 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 a 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 available awards.

I thank everyone who made a donation to the TMS Foundation in 2022. As you can see, every dollar makes an impact and enables us to help even more students and emerging professionals at the most vulnerable stages of their careers. With your generous support, I look forward to sharing even more good news on the TMS Foundation's accomplishments in 2023!

Sincerely,

"Being a part of TMS has shaped and helped to facilitate every stage of my career. As a student, I ran around watching talks and networking, which set me up for my post-doc and faculty position. Now that I'm on the tenure-track, TMS Young Leader activities and the TMS Foundation International Scholar Award are helping me to broaden my horizons even further."

—**Victoria Miller**,
University of Florida
TMS Young Leaders
International Scholar
Award—Japan
Institute of Metals
and Materials



2022 FOUNDATION BOARD OF TRUSTEES

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SECRETARY	
James J. Robinson TMS Executive Director	

2022 PROGRAM IMPACTS

The TMS Foundation supports students and early career professionals with meaningful financial assistance and impactful career-building experiences. **In 2022 alone**, the TMS Foundation made a difference in the careers and lives of those representing the future of our profession by conferring the following scholarships, grants, and awards:



16
Student Scholarships



33
Student Travel Grants to TMS Conferences



21
Awards Supporting Early Career Development



18
Family Care Grants
(in collaboration with TMS)

AND, THERE'S MORE...

Strengthening the Materials Community: Additional programs supported by the TMS Foundation encourage diversity within the professions, develop and support outstanding mentors or educators, and encourage the pursuit of distinguished achievements at every career stage.

Educational Outreach: The TMS Foundation also supports the TMS Bladesmithing Competition for college students, as well as student participation in the Electronic Materials Conference and the ASM Materials Camps.

To learn more about the mission, vision, and history of the TMS Foundation, visit www.TMSFoundation.org

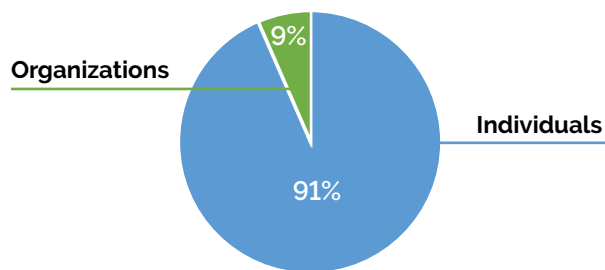
The TMS Foundation is a unit of The Minerals, Metals & Materials Society (EIN: 25-1484913), which is a qualified 501(c)3 tax-exempt organization. Official registration and financial information may be obtained from the Pennsylvania Department of State by calling toll-free, within Pennsylvania, 1-800-732-0999. Registration does not imply endorsement.

TMS FOUNDATION 2022 FINANCIAL OVERVIEW

The financial information below provides two perspectives on the TMS Foundation's performance in 2022:

- Donations, inclusive of new endowments being established
- Program expenditures, including all gifts issued through the Foundation

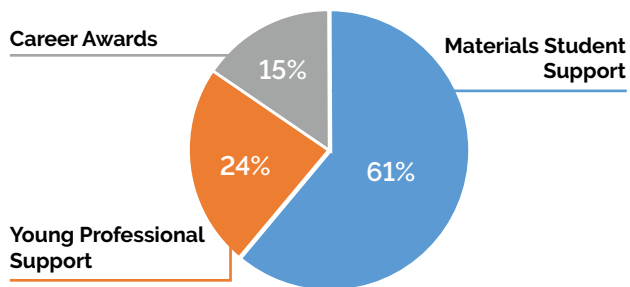
2022 TMS FOUNDATION GIVING



Total Contributions \$237,349

CONTRIBUTIONS	% Total	
Individuals	91%	\$216,287
Organizations	9%	\$21,062

2022 TMS FOUNDATION PROGRAM EXPENDITURES



Total Program Expenditures \$141,744

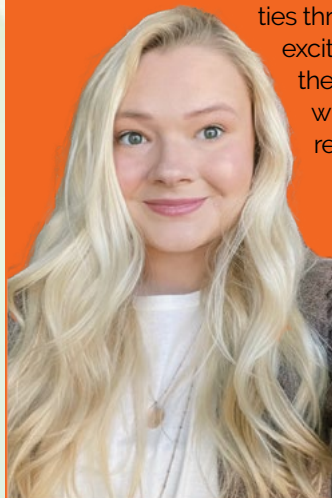
PROGRAM EXPENDITURES	% Total	
Materials Student Support	61%	\$89,126
Young Professional Support	24%	\$33,821
Career Awards	15%	\$21,797

THANK YOU TO OUR 2022 DONORS

In addition to special donor groups like the **1871 Legacy Circle** for individuals who have provided for the TMS Foundation through planned giving, the TMS Foundation celebrates its donors through its **Lifetime Giving Honoric Societies** and the **Annual Giving Honor Roll**. With their generous contributions to the TMS Foundation, our donors are making a significant and permanent impact on the future of the minerals, metals, and materials professions.

To view current members of both honor rolls, visit www.TMSFoundation.org/HonorRolls.

"TMS and the TMS Foundation have provided a plethora of scholarship, networking, and materials-related sources that are truly valuable to its members. TMS has enabled me to connect to others in my field and develop strong engineering ties through networking. I am excited to see my future with the assistance of TMS to help with my college support and resources."



—**Tylee Oldham**
University of Kentucky
2022 Functional
Materials Division
Gilbert Chin Scholarship
Recipient

ORGANIZATIONAL GIVING

Thank you to the following companies and organizations for supporting the TMS Foundation in 2022. We applaud their commitment to developing a workforce that is ready to take on the challenges of an ever-changing science and engineering landscape.



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In Case You Missed It:

BUSINESS NEWS FROM THE FIELD



Heidelberg, Germany: With support from the European Union (EU) Innovation Fund, one of the world's largest funding programs for low-carbon technologies, Heidelberg Materials will pioneer a fully decarbonized cement production plant. The GeZero Carbon Capture and Storage (CCS) project features a unique approach which will model a solution for inland sites. It will include a transport solution until necessary pipeline infrastructure is available. This plant will be the first European cement plant to produce fully decarbonized cement and clinker. Construction of this site will begin in 2026. (Pictured is the design of the GeZero Carbon Capture and Storage Plant. Photo Credit: Heidelberg Materials)

Collaboration on Sustainable Lithium-Ion Battery Recycling

Toronto, Ontario, Canada: Li-Cycle Holdings Corp. and EVE Energy Co., Ltd. have signed a memorandum of understanding to explore lithium-ion battery recycling solutions for EVE battery materials. Together they will investigate sustainable solutions for recycling EVE lithium-ion battery materials in the North American market and battery manufacturing scrap generated in manufacturing facilities in Malaysia and Hungary.

Rio Tinto and Giampaolo Group Joint Venture for Low-Carbon Aluminum

London, United Kingdom: Rio Tinto and the Giampaolo Group will form a joint venture to manufacture and market recycled aluminum products. This agreement reflects the partners' commitment to meeting the demand for low-carbon aluminum, a key material in energy transition. Based on the terms of this agreement, Rio Tinto will acquire a 50% equity stake in Giampaolo's Matalco business for \$700 million, subject to closing adjustments. Matalco is a producer of high-quality aluminum billet and slab products and operates six facilities in the United States and one in Canada. This collaboration will allow Rio Tinto to provide a wider range of high-quality and low-carbon primary, recycled, and blended aluminum products.

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.



Tel Aviv, Israel: Balena, a materials science company that makes advanced biodegradable polymer materials for the fashion industry, is introducing a collaboration with designer Kitty Shukman on the 3D-printed shoes pictured above. These unique shoes use Balena's BioCir™, a fully compostable and biodegradable elastomer. The design emulates the structure of roots beneath the foot, while integrating branches and stems to the upper section. (Photo Credit: Balena)

Glencore to Purchase Argentinian Copper Project

Baar, Switzerland: Glencore Technology is set to purchase a majority stake, 56%, in Pan American Silver Corp.'s Minera Agua Rica Alumbreira (MARA) in Argentina for \$475 million. Glencore will have complete ownership of the project having already partially owned it and acquiring an 18.75% stake from Newmont Corp. last year. The MARA project was established in December 2020 by Glencore, Newmont, and Yamana Gold Inc. and has a proven and probable mineral reserve of 5.4 million tons of copper and 7.4 million ounces of gold.

NanoTech Pioneers Climate-Resistant Materials

Houston, Texas, USA: NanoTech Inc. is developing a series of climate-resistant materials with the goal of decreasing carbon emissions and a return on investment for building owners. Their flagship product, the Nano Shield Cool Roof Coat™, is a waterproof thermal coating that harnesses heat resistant technology to cut the energy HVAC systems need for commercial space cooling. This breakthrough innovation virtually eliminates heat penetration via the roof by building on the superficial solar ray reflection of white coatings and paint.

TMS MEETING HEADLINES

Meeting dates and locations are current as of July 31, 2023.
 For the most recent updates on TMS-sponsored events, visit www.tms.org/Meetings.



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

November 12–15, 2023
 Pittsburgh,
 Pennsylvania, USA

**Housing Deadline:
 October 12, 2023**

The HEA 2023 Plenary Session will feature lectures by **Zhaoping Lu**, University of Science and Technology Beijing; **Evan Ma**, Xi'an Jiaotong University; **Daniel B. Miracle**, Air Force Research Laboratory; and **Mitra Taheri**, Johns Hopkins University.

www.tms.org/HEA2023



TMS 2024 Annual Meeting & Exhibition (TMS2024)

March 3–7, 2024
 Orlando,
 Florida, USA

**Housing Deadline:
 February 6, 2024**

Make your plans to travel to TMS2024 where all technical programming, as well as the meeting's all-conference social and networking events, will be held under one roof at the Hyatt Regency Orlando in Orlando's International Drive Entertainment District.

www.tms.org/TMS2024



TMS Specialty Congress 2024

June 16–20, 2024
 Cleveland,
 Ohio, USA

**Abstract
 Submission Deadline:
 October 30, 2023**

The TMS Specialty Congress 2024 will be "built on deep technical content that comes from our members" and "bottoms-up science, research, and engineering," according to **Tim Rupert**, Program Chair on the TMS Board of Directors.

www.tms.org/SpecialtyCongress/2024



15th International Symposium on Superalloys (Superalloys 2024)

September 8–12, 2024
 Champion,
 Pennsylvania, USA

**Manuscript
 Submission Deadline:
 January 31, 2024**

Superalloys 2024 will convene the superalloys community to share innovations in materials processing, properties, coating technology, industrial applications, and the development of new superalloy compositions.

www.tms.org/Superalloys2024

Other Meetings of Note



TMS Fall Meeting 2024 at Materials Science & Technology 2024 (MS&T24)

October 6–9, 2024
 Pittsburgh, Pennsylvania,
 USA

www.tms.org/FallMeeting/TMSFall2024



TMS 2025 Annual Meeting & Exhibition (TMS2025)

March 23–27, 2025
 Las Vegas, Nevada,
 USA

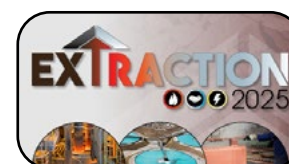
www.tms.org/TMS2025



TMS Specialty Congress 2025

June 15–19, 2025
 Anaheim, California,
 USA

www.tms.org/SpecialtyCongress/2025



Extraction 2025 Meeting & Exhibition (Extraction 2025)

November 16–20, 2025
 Phoenix, Arizona,
 USA

www.extractionmeeting.org/Extraction2025

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

11th Pacific Rim International Conference on Advanced Materials and Processing

November 19–23, 2023
 Jeju, South Korea

Co-sponsored by TMS

Materials in Nuclear Energy Systems (MiNES 2023)

December 10–14, 2023
 New Orleans, Louisiana, USA

Co-sponsored by TMS

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153rd Annual Meeting & Exhibition

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at the Hyatt Regency Orlando resort for the meeting that brings the global minerals, metals, and materials communities together.

This is a new venue for TMS, and the resort will be the location for all TMS2024 programming and events. Plan to stay at the headquarters hotel for easy access to activities, five on-site restaurants, and a number of additional amenities.

MARK YOUR CALENDAR WITH THESE KEY DATES

October 2023: Registration Opens | **February 6, 2024:** Housing Deadline
March 3–7, 2024: Conference Dates

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TMS SPECIALTY CONGRESS 2024

JUNE 16-20, 2024

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2024 CO-LOCATED MEETINGS



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www.tms.org/SpecialtyCongress/2024



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