

JOM THE MAGAZINE

OCTOBER 2024

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

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“TMS has significantly benefited my work and professional development during my attendance at the TMS 2023 Annual Meeting & Exhibition, where I was able to present my research and connect with other researchers working in similar areas.”

—Cynthia Rodenkirchen,
*2024 International Symposium on
Superalloys Graduate Scholarship Recipient*



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ABOUT THE COVER



The photo on this month's cover shows the modular MSX process, developed by Momentum Technologies, which can process highly contaminated/diverse complex feedstocks such as mixed scrap lithium-ion battery (LIB) "black mass." Beginning on page 9, you can read more about the technology in our interview with Robert Miles, chief technology officer and co-founder of Momentum. Cover designed by David Rasel, TMS Senior Manager, Brand and Digital Assets.



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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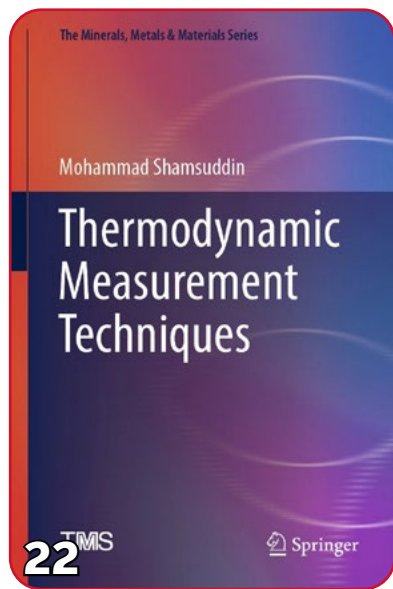
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IN THE FINAL ANALYSIS

"A paradigm shift in materials innovation has been brewing over the past decade, fueled by exponential advancement of AI and autonomous experimentation."

— Dana Weinstein, U.S. Office of Science and Technology Policy

Having just marked its 13th anniversary, the Materials Genome Initiative (MGI) both reflects the evolution of the materials field and influences the trajectories of materials professionals and students. Scientists and engineers from many disciplines are energized by the MGI's strategic plan, which seeks to unify the "materials innovation infrastructure" employing a "framework of integrated advanced modeling, computational and experimental tools, and quantitative data." Government support of, and coordination for, the MGI within the Executive Branch has endured through the last three U.S. presidential administrations. What a testimony to its continued relevance!

The MGI has been embraced by many TMS members and volunteers as both a beacon and a rallying point. As you have likely read in *JOM* and experienced at our events, TMS has engaged in many efforts to support the precepts of the MGI. Improving the present and stage-setting the future is what this Society does really, really well. I don't exaggerate in saying this is baked in the TMS genome.

TMS activities in the domains of the MGI are well known. They include launching a scholarly journal for the community within a year of the MGI being announced: *Integrating Materials and Manufacturing Innovation*. In the year that the MGI launched, TMS held the first in its ongoing and much-lauded conference series: World Congress on Integrated Computational Materials Engineering (ICME). One year later, the Society launched a companionable new event series: The International Congress on 3D Materials Science (3DMS). More recently, we debuted another event that leans hard toward the MGI—the World Congress on Artificial Intelligence in Materials and Manufacturing (AIM). On a parallel track over the last 15 years (predating the launch of the MGI), TMS has conducted and distributed many essential and rigorously prepared science and technology accelerator studies in areas supportive of the MGI domains. The newest will be released at this month's MS&T24: *A Revolution in Digital Manufacturing: Integrating Machines, Robotics, Artificial Intelligence, and Forming Technologies*.

While deeply immersed, TMS does not have a monopoly on supporting the MGI. There are so many great efforts in so many areas. Some examples that very recently crossed my desk:

- The Materials Genome Initiative's Interagency Working Group on Autonomous Materials Innovation Infrastructure issued the report from its workshop to develop a baseline of current capabilities and gaps in said infrastructure. This includes autonomous experimentation. Many TMS member names can be found among the list of organizers and participants.
- The Office of Science and Technology Policy recently convened leaders from many sectors to articulate "AI Aspirations" for seven sectors, one of which is an "AI Aspiration for Sustainable Materials," which focuses most intensely on semiconductor technology and the manufacture of semiconductors.
- The National Institute of Standards and Technology announced plans to establish a new Manufacturing USA Institute focused on using artificial intelligence to improve the resilience of U.S. manufacturing.

As these initiatives proceed, TMS will certainly not slow its momentum on concomitant activities. Just the opposite. For example: October 30th is the deadline for abstract submissions to TMS Specialty Congress 2025. The second installment of this big tent meeting round up will be home to the 8th ICME, the 7th 3DMS, and the 3rd AIM—all in service of another 1st class and essential MGI experience.



James J. Robinson
Executive Director



James Robinson

"TMS has engaged in many efforts to support the precepts of the MGI. Improving the present and stage-setting the future is what this Society does really, really well."

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.

Below is a sample of articles that will appear in the October issue, based on information available at press time.

For the most up-to-date article listing, visit www.tms.org/JOM.

OCTOBER 2024

Advances in Biomaterials and Materials for Biomedical Applications

Editors: Steven Naleway, University of Utah; Ling Li, Virginia Polytechnic Institute and State University; Vinoy Thomas, University of Alabama at Birmingham; Jeff Bates, University of Utah; Jingjie Hu, North Carolina State University

Sponsor: Biomaterials Committee

"Advances in Biomaterials and Materials for Biomedical Applications," **Vinoy Thomas**, et al.

"Ultrasonic Synthesis of Ag@CNT-Based Metal-Organic Framework (MOF) for Enhanced Synergetic Antimicrobial Activity Against *Staphylococcus aureus*," **Dilip Kumar Chandra**, et al.

"An Investigation on the Effect of Contrast Agents in the Chitosan-Nanoclay Shear Thinning Hydrogel for Trans-Catheter Arterial Embolization," **P.J. George Varghese**, et al.

"Ambient Dual Cross-Linked Interpenetrating Polymer Hydrogel Networks: Synthesis, Characterization, and Potential for Wearable Biosensing Devices," **Ashwin Velraj**, et al.

"Plasma/Ozone-Induced PolyNaSS Graft-Polymerization onto PEEK Biomaterial for Bio-Integrated Orthopedic Implants," **Chandrima Karthik**, et al.

"Fabrication of Porous Zn Alloy Scaffolds Coated with Hydrophobic Film and Their In Vitro Biodegradation Properties," **Donghui Yang**, et al.

"Glycemic Marker Correlation with Collagen Denaturation and Non-Enzymatic Collagen Cross-Linking in Age-Associated Bone Resistance," **James Rosenberg**, et al.

"Increased AGE Cross-Linking Reduces the Mechanical Properties of Osteons," **Ihsan S. Elnunu**, et al.

"Tannic Acid-Loaded MgO- and ZnO-Doped Antibacterial Hydroxyapatite for Orthopedic and Dental Applications," **Claire Putelli**, et al.

"Influence of the Structural Mechanics and Surface Properties of Injectable Chitosanmethacrylate-Based Hydrogels for Autologous Chondrocyte Implantation," **Kirthana Mohan**, et al.

"The Composition of Graded Dental Zirconias," **Anvita Maharishi**, et al.

Bridging Scale Gaps in Multiscale Materials Modeling in the Age of AI

Editors: Yue Fan, University of Michigan; Liang Qi, University of Michigan

Sponsor: Computational Materials Science and Engineering Committee

"Material-Response-Informed DeepONet and Its Application to Polycrystal Stress-Strain Prediction in Crystal Plasticity," **Junyan He**, et al.

"Data-Driven Insights into the Structural Essence of Plasticity in High-Entropy Alloys," **Chi-Huan Tung**, et al.

"Machine Learning-Driven Identification of Favorable Dopants for Activating Non-basal $\langle c+a \rangle$ Slip in Mg Alloys," **Yidi Shen**, et al.

"An Artificial Intelligence Constitutive Model for Amorphous Solids Utilizing Graph Neural Networks," **Jia-Le Tao**, et al.

"A Review of Cluster Dynamics in Studying Radiation Damage: Dominant Factors and Practical Implications," **Yaoxu Xiong**, 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.

TMS Members Inducted into National Academy of Inventors



Nikhil Gupta



Ambreen Nisar



Tanaji Paul



Jud Ready



Sourabh Saha

Five TMS members were selected to join the National Academy of Inventors' (NAI) 2024 Class of Senior Members. The 124 academic inventors from the NAI's Member Institutions were formally inducted during the NAI 13th Annual Meeting in June 2024. Senior Members are active employees or faculty, scientists, and administrators with success in patenting, licensing, and commercialization, and who have produced technologies that could impact society.

Consisting of more than 4,600 individuals from more than 260 Member Institutions, the NAI was founded to recognize and encourage inventors with U.S. patents, enhance the visibility of academic technology and innovation, encourage the disclosure of intellectual property, educate and mentor innovative students, and create wider public understanding of how its members' inventions benefit society.

Congratulations to the following TMS members:

Nikhil Gupta is a professor at New York University. A TMS member since 1997, he has served on several committees and the Structural Materials Division (SMD) Council. In 2013, he received the SMD Young Leader Award and in 2020, was named a

Brimacombe Medalist.

Ambreen Nisar is a research assistant professor at Florida International University. She has been a TMS member since 2024.

Tanaji Paul is a research assistant professor at Florida International University. He has been a TMS member since 2020 and was previously involved in TMS activities as a student member of Material Advantage.

Jud Ready is a principal research engineer at the Georgia Institute of Technology. A TMS member since 1992, he has been a member and chair of several technical and functional committees; a board director of Membership & Student Development (2005 to 2008); and board director for Content Development & Dissemination (2010 to 2013); and served as 2022 TMS President. Ready has received the 2002 Electronic, Magnetic & Photonic Materials Division (now Functional Materials Division) Young Leader Award; the 2006 TMS/Japan Institute of Metals and Materials Young Leaders International Scholar Award; and the 2015 Brimacombe Medal Award.

Sourabh Saha is an assistant professor at the Georgia Institute of Technology. He has been a TMS member since 2024.

Stay Connected with Your TMS Colleagues: Renew Your TMS Membership Today

Retain your TMS member benefits, including access to *JOM*, in the year ahead. Click on the QR code or visit www.tms.org/Renew to extend your membership through December 2025.



Michele Manuel Named First Female Dean at University of Pittsburgh



(Photo credit: University of Florida)

Beginning September 1, 2024, **Michele V. Manuel** began a new role as U.S. Steel Dean of the Swanson School of Engineering at the University of Pittsburgh. Manuel is the first woman to hold this position. Before this appointment, she was chair of the Department of Materials Science and Engineering and the Nuclear Engineering Program at the University of Florida and the Rolf E. Hummel Professor of Electronic Materials. Her

research, which bridges academia and industry, has earned her many accolades, including membership in the National Academy of Engineering, a Presidential Early Career Award for Scientists and Engineers, and a National Science Foundation CAREER Award.

A TMS member since 2001, Manuel has been an active volunteer on various technical and functional committees. From 2017 to 2021 she served on the board of directors as the Content Development & Dissemination Chair. Additionally, she has received several TMS awards, including the 2009 Light Metals Division Young Leader Award, 2014 TMS/Japan Institute of Metals and Materials International Scholar Award, 2014 Early Career Faculty Fellow Award, and 2021 Brimacombe Medal.

Alan Ardell Awarded Dickson Emeritus Professorship



TMS member **Alan Ardell** received the 2023–2024 Edward A. Dickson Emeritus Professorship Award from the University of California, Los Angeles (UCLA). The award recognizes emeriti professors for outstanding research, scholarly work, teaching, and service and includes a prize of \$5,000. Although Ardell retired from his role as professor in the UCLA Samueli School of Engineering in 2006, he continued his work on the microstructural evolution

of alloys. From 2009 to 2012, he was the program director for the National Science Foundation's (NSF) Division of Materials Research. He has also served on various review panels and committees for the NSF, the U.S. Department of Defense, and the U.S. Department of Energy, among others.

Ardell joined the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) in 1961 as a student at Stanford University, where he earned his Ph.D. under the supervision of Oleg D. Sherby. He later became a member of TMS upon its incorporation in 1984 as a separate organization. In 1997, he was elected to the rank of TMS Fellow, and in 2024, he was awarded the TMS Oleg D. Sherby Award.

Timothy Rupert Joins Johns Hopkins

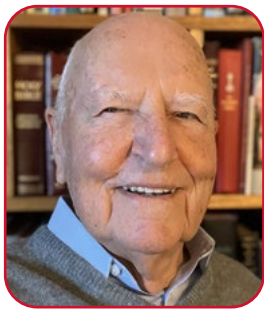


TMS member **Timothy Rupert** has accepted a position at his alma mater, Johns Hopkins University. Coming from the University of California, Irvine, Rupert began his new roles—professor of materials science and engineering and director of the Hopkins Extreme Materials Institute (HEMI)—in July 2024. At HEMI, fellows and faculty from across the university come together to “explore the science behind what happens to materials, structures, and systems under extreme conditions.” The goal is to investigate some of society's greatest challenges by examining them at their most fundamental level.

As a graduate student, Rupert began his involvement with TMS in 2010 and since then has served on various technical and functional committees. Recently, he has helped bring new ventures to fruition for the Society as a member of the 2024 and 2025 TMS Specialty Congress steering committee and by helping to establish and implement the Frontiers of Materials Award for early career professionals. In 2021, he was elected to the TMS Board of Directors to serve as Programming Director.

Rupert has received an NSF CAREER Award, a U.S. Department of Energy Early Career Research Program Award, and the ASM Bradley Stoughton Award for Young Teachers. He was awarded the AIME-TMS Rossiter W. Raymond Memorial Award in 2020; received the TMS Structural Materials Division (SMD) JOM Best Paper Award in 2017; and was named a TMS SMD Young Leader in 2015.

William D. Nix Elected to the Royal Society of London



William D. Nix of the Department of Materials Science and Engineering at Stanford University, a member of TMS/AIME since 1959, has been elected to the Royal Society of London as a Foreign Member. The induction ceremony was held in London, U.K., on July 12, 2024. Founded in 1660, the Royal Society

is the oldest scientific academy in the world and includes Isaac Newton and Charles Darwin among its past Fellows.

Nix was cited for his work on the mechanical properties of materials, especially thin films and nanoscale plasticity. His work involved the development of experimental techniques and theoretical concepts showing that size matters

and that "smaller is stronger." These effects have applications in materials science, microelectronics, and mechanics.

Among the many accolades earned throughout his career, Nix has received the AIME Champion H. Matthewson Award, the TMS Institute of Metals/Robert F. Mehl Award, the Acta Materialia Gold Medal, the TMS Educator Award (now the Julia & Johannes Weertman Educator Award), and the TMS Fellow Award (Class of 1988). He is one of few elected to both the National Academy of Engineering and the National Academy of Sciences. Nix has authored more than 500 papers and co-authored two textbooks in his field. In 2020, TMS established the William D. Nix award to honor Nix's legacy in the community and to promote continued progress and innovation related to the underlying mechanisms and mechanical behavior of macro-, micro-, and nanoscale materials.

Nikhilesh Chawla Named Associate Dean at New Purdue Campus



(Photo credit: Purdue University in Indianapolis)

Nikhilesh Chawla has been appointed associate dean for engineering at Purdue University in Indianapolis. Chawla took on this inaugural role as Purdue's newest campus opened in July 2024. He is also the Ransburg Professor of Materials Engineering and will continue work on his pioneering research in 4D materials science, introducing time to study

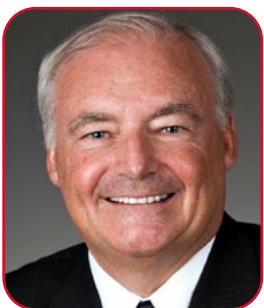
mechanical behavior as a function of external stimuli.

Before this appointment, Chawla also served as co-director of the Semiconductor Degree Programs, having joined Purdue College of Engineering in 2020. He previously worked as Fulton Professor of Materials

Science and Engineering at Arizona State University, where he was also the founding director of the Center for 4D Materials Science.

A TMS member since 1989, he has received the Structural Materials Division (SMD) Young Leaders Professional Development Award, the TMS Brimacombe Medal, the SMD Distinguished Scientist/Engineer Award, SMD JOM Best Paper Award, and Functional Materials Division (FMD) Distinguished Scientist/Engineer Award. Chawla was also awarded an NSF CAREER Award and the U.S. Office of Naval Research Young Investigator Award. In the early days of the pandemic, Chawla offered his insight and expertise as an instructor for the TMS webinar, Transitioning to Online Instruction: Tips, Tools, and Techniques. He has also served on the International Advisory Committee for the 5th International Congress on 3D Materials Science.

Larry Seeley Receives MetSoc Airey Award



Larry Seeley was named the 2024 recipient of the MetSoc Airey Award, sponsored by XPS, Expert Processing Solutions, in recognition of technical, business, and philanthropic contributions to metallurgy, education, and community. Conferred by The Metallurgy and Materials Society (MetSoc) of the Canadian Institute of Mining,

Metallurgy, and Petroleum (CIM), this award was presented at CIM's Annual Conference of Metallurgists in August 2024. Seeley has been a TMS member since 1999.

Prior to his retirement from Seeley Group Ltd., he worked with Pasinex Resources Limited, Recapture Metals Limited, Lakefield Research Limited, and Falconbridge Limited. Seeley has also held leadership positions at Ontario Tech University, Trent University, Cambrian College, University of Toronto, and Queen's University, and was a trustee and founding chair of science with Science North.

Aluminum Cast Shop Science and Technology Course



Pictured are participants of the **2024 TMS Aluminum Cast Shop Science and Technology Course**, held June 9–14, 2024, in Nashville, Tennessee. This was the latest workshop in TMS's suite of aluminum-oriented professional development courses. The next offering is the long-running **Industrial Aluminum Electrolysis Course: Advancing Aluminum Production**, scheduled for December 1–6, 2024, in Sydney, Australia. For details on course curriculum, the facility tour, and registration, visit www.tms.org/IAE2024.

In Memoriam

TMS extends its heartfelt condolences to the family, friends, and colleagues of the following members:

Daniel N. Beshers

Born on August 13, 1928, in Chicago, Illinois, and passed away January 5, 2024. He was a member of the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) since 1958 and, subsequently, a TMS member since its official incorporation in 1984.

William Thomas Denholm

Born on May 17, 1925, in Bacchus March, Victoria, Australia, and passed away May 28, 2023. He was a TMS member since 1987.

C.J. Fincham

Born in Hornsea, Yorkshire, England, in 1927, and passed away September 7, 2023. He was an AIME/TMS member since 1955.

Leonard Harris

Born in Yeppoon, Queensland, Australia, on July 12, 1927, and passed away on April 25, 2024. He was an AIME/TMS member since 1983.

John Brian Haworth

Born on January 30, 1927, in Dunkinfield, Cheshire, England, and passed away on February 24, 2024. He was an AIME/TMS member since 1946.

Gabor Kovacs

Born on September 10, 1926, in Budapest, Hungary, and passed away March 5, 2024. He was an AIME/TMS member since 1961.

Myron C. LaBarr

Born June 29, 1928, in New York, New York, and passed away January 1, 2024. He was a TMS member since 2001.

Andrew Madeyski

Born in Lwow, Poland, on March 1, 1921, and passed away on July 20, 2023. He was a TMS member since 1989.

Douglas H. Polonis

Born September 2, 1928, in Vancouver, British Columbia, Canada, and passed away September 14, 2023. He was an AIME/TMS member since 1969.

JOM: The Magazine Talks with ROBERT MILES of Momentum Technologies

Kelly Zappas



Robert Miles is chief technology officer and co-founder of Momentum Technologies, Inc., which provides modular and localized processing technology for recovering high-purity, reusable critical minerals and metals. He was one of three invited speakers at the all-conference plenary session, Translating Scientific Discovery into Impactful Innovation to Solve Critical Materials Challenges, at the TMS 2024 Annual Meeting & Exhibition (TMS2024) in Orlando, Florida. There, he spoke about the challenges and opportunities associated with bringing new technologies to market.

Pictured above and on the cover of this issue is Momentum Technologies' modular MSX platform, which offers the ability to process highly contaminated/diverse complex feedstock, such as mixed scrap lithium-ion battery "black mass."



JOM: Could you describe your technical background and how it led you to your current role?

Miles: It's kind of an eclectic background. I started out in the military. I was a Naval Academy graduate with a Physics degree, and I went into nuclear power. I was trained in nuclear power to run reactors, which I did for about five years. Then, I left that because I wanted to further my education. I went to Caltech [California Institute of Technology] and got a Ph.D. in material physics and electrical engineering. I did some work at NASA's Jet Propulsion Laboratory and IBM Research-Yorktown Heights and then wanted to get a little bit more business experience. I knew I didn't want to be in a lab for the rest of my life.

I was hired by McKinsey & Company, a big marketing consulting firm, and I was there for about four years consulting for high-tech companies, mostly oil and gas. (Because I'm in Texas, and you can't escape that!) Then, I switched over to private equity. I was hired as an entrepreneur-in-residence (EIR) at Sevin Rosen Funds, which invested in companies like Compaq Computer Corporation and Ciena Corporation, a telecommunications company. I was a venture partner and the EIR there on and off for about a decade. I worked on the entrepreneur side to help get companies going, and I also was on the investment side because I was in all the meetings where the investment decisions were made. So, I was able to see both sides, which was really, really useful.

Then my background jumps all over the place because I would do startups for a few years, then switch back to the private equity side. Then, I'd do another start up. Then, I'd get on the private equity side. So, I bounced around. In total, I believe I've done eight startups, each very different than the last. I've done everything from semantic search engines to rapid battery charging technologies. I did several different communications-related startups. I did one AI startup to predict where oil and gas operators were going to drill next. We bought mineral rights based off those predictions, and that turned out to be very, very profitable. It worked well, and no one else had done it.

I have a technical-business-entrepreneurial triad of skill sets, which dovetails well and plus, I have the private equity side. It's been a very nontraditional route; I wouldn't really call it a career path. I kind of stumbled into it. I wanted to do something different, and when you put it all together, it added up to what I'm doing now.



JOM: What is the primary focus of Momentum Technologies? What does the company bring to the market that's unique?

Miles: Momentum Technologies, which is my current company, started about six years ago. Momentum initially focused on rare earth elements with technology that was developed and patented out of Oak Ridge National Labs. We spent roughly the first

four years developing the technology, making it more efficient, and proving it out. It's a platform technology that is used to separate out different metals that are valuable and deemed to be recyclable. For lithium-ion batteries, that's lithium, nickel, and cobalt. For rare earth elements, it's neodymium, praseodymium, dysprosium—things like that. There's more that we can do, more metals that we can recover, but those are the most profitable ones.

Why is this an important point? Most places in the world want to develop a circular economy because generating these elements from mining, which is traditionally how it's been done, is a very dirty business, but it also takes a long time. It takes about ten years to commission a mine and get it up and going and there are all sorts of qualifications. That's why there aren't really any commercial mines that have been commissioned for a long time in the

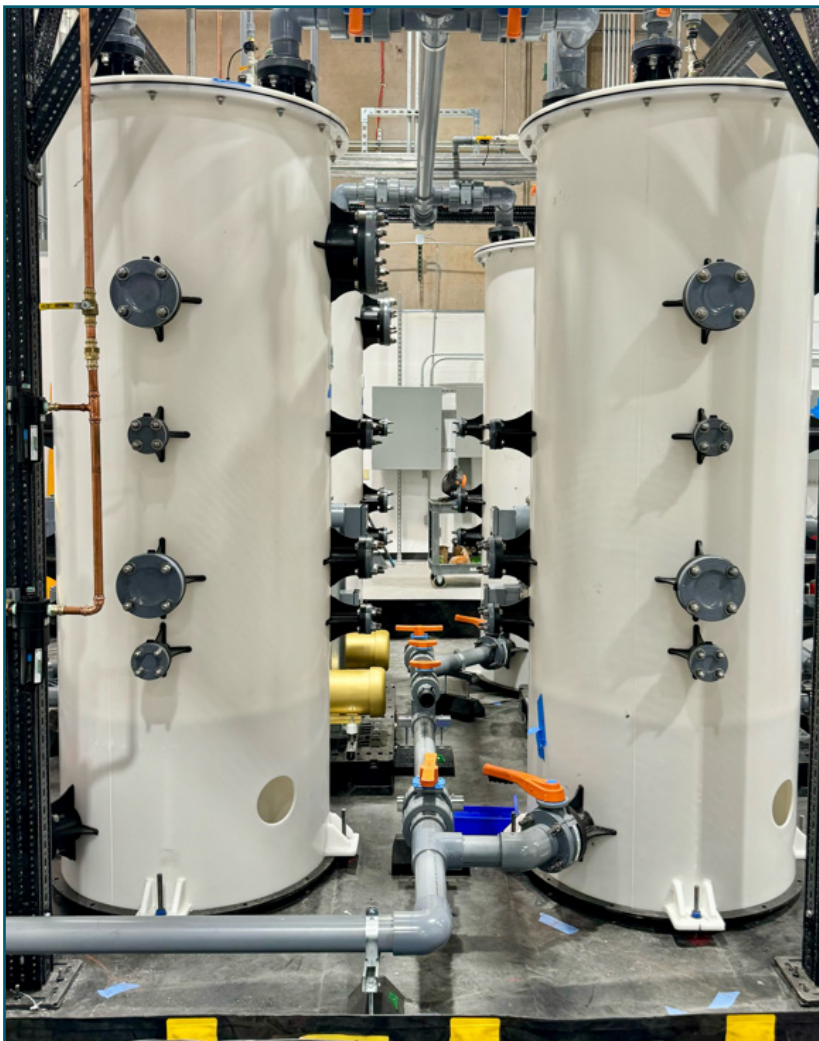
United States. What we're doing solves the problem of circular economy and sustainability. It's much more environmentally friendly, and you can do it very profitably. That's the meta problem we're trying to solve. Obviously, there are other companies out there trying to solve that as well. What makes us unique is the fact that we can do it at a wide range of scales very economically.

One of the problems with batteries is they're very distributed. They're all over the place. I mean, just look at your cell phone and look at the electric vehicle market. Batteries don't naturally aggregate anywhere. You have aggregators that are starting to emerge, but it's a very hard problem because shipping around batteries is just expensive. Logistically, from a permitting standpoint, it's tricky because it's toxic and these things can catch on fire. We solve a couple of these problems with our uniqueness. By being able to scale down very small—small meaning 100 tons per year or something like that—we can co-locate where the source is or where the source starts to aggregate.

Typically, when a company builds a hydrometallurgy plant—almost all our competitors are in hydrometallurgy—the smallest plant they'll build is, for example, 25,000 tons per year. Well, we can go well below 1,000 tons per year. The problem with 25,000 tons is you have to aggregate to get the capacity up to 80% or more, which is where the economics start to kick in. That's where Hydrometallurgy starts to economically make sense. We can make sense on much, much, much smaller scales. We can locate near manufacturing partners that have waste—whether it's mining companies or manufacturing waste or just companies that aggregate some batteries but not enough to really make it worth much. That's where we are.

The other advantage we have is that with our design, we're very modular. Even if we start small, as the supply increases, we just add what I call building blocks. So, we can start very small and grow as the supply grows, which means we can always be operating at close to 100% capacity, which is very good. We have low chemical use and low energy use. We operate at basically room temperature and atmospheric pressure. We use a little bit of pressure just to get things around, which means low operating expenses, and all our equipment is very simple. It's all plastic. It's all off-the-shelf, so we have very low capital expenditures as well.

Last of all—and this is one of the things that's most important—in an industry where chemistry changes every six months to a year, it's important to be flexible on your inputs. We're very, very flexible. Our design can adapt to a wide range of feed inputs, whether it's 5%



MSX Pre-X Leaching Tanks: Momentum Technologies' pretreatment dissolution and precipitation tanks are key components of their process used to fine-tune the feed to get the optimal performance from the MSX battery recycling process. Photo provided by Momentum Technologies.

cobalt or 20% cobalt or a lot of nickel or a little nickel, it doesn't really matter. We can also have a wide range of selections of our outputs and what we can make. By design, we're future proof.

JOM

JOM: What's next for Momentum Technologies?

Miles: We're closing a round that will allow us to build a large-scale commercial plant. We have a Scale-up Demo R&D Facility that we're generating data from that allows us to demonstrate all the unit economics. From a performance standpoint, we're basically there. We're beyond what I call the "scoping phase." We have a number of partners who want us to co-locate all over the world. They want us to set up a plant to help them. Even some companies that you would consider competitive with us—like hydrometallurgy players—are interested in partnering with us because they don't have the flexibility we have. We can actually coexist with them. If they get something that's out of spec for their system, we can offer a solution.

JOM

JOM: In your talk at TMS2024, you talked about the high failure rate for startup companies. In your experience, what is the difference between success and failure in turning research into a profitable business?

Miles: I would say the biggest error or problem researchers make—and it's understandable—is they don't really deeply understand their target market or their customer. They don't have what I call a degree of customer intimacy. For a researcher, you wouldn't expect that, right? It's not their specialty. That's why, if you're a researcher, it's always good to partner, if you can, with someone who has the bandwidth and the expertise to steer you through that customer intimacy maze. It's one thing to have a technology that solves a problem, but you have to make sure that you know who cares about the problem or if you're only solving part of the problem or if you know the alternatives to the problem that they're currently using. And that is where I think researchers kind of want to throw it over the fence and go, "Hey, I solved this problem. Someone take it and run with it!"

I used to go to universities and national labs and literally ask, "What's the latest invention? What have you guys been working on?" Someone like me, who has a technical bridge to the marketing side, is really useful. You need to either do this work yourself, or find someone who will do it, because I think the biggest error is coming up with what you think the solution is, and even if it works as advertised, you're not solving quite the right problem or for the right person. Take, for example, the semantic search engine that I worked on. We tried it for advertising, and it turned out that legal was a much better market.

JOM

JOM: What is your number one piece of advice for researchers looking to create a startup?

Miles: It's taking the time to understand your target market or customer. Just throwing things over the transom rarely works. You need to put some skin in the game—and I don't mean financial skin. I mean time. Also, besides understanding your customers, you have to be willing to undertake the journey, and a lot of people also don't understand that meaning. There's an emotional, and even a personal, toll that you need to acknowledge is going to be there if you want to do this. People usually don't start companies as option B or option C of their career. It's usually their primary goal—something that they *want* to do. So, you have to make sure that your career is in the right place or that you're willing to make that trade off. You have to make sure that your personal life is in the right place, too, and make sure that you can stand some volatility in your life. It's one of those things people underestimate, because if you don't get that right, then you lack longevity. You lack the ability to stay in the game and persist to the end, and that's what you need to do.

JOM

JOM: Is there anything you'd like to add?

Miles: I find that it's extremely exciting to start companies and very rewarding. I think, emotionally, it's the most rewarding, and if it goes well financially, they can be total game changers. I've been lucky enough to have a couple of game changers, so I'm very, very happy.

But don't underestimate the time and dedication it takes and the collaboration. You can't do it alone, even if you think you have all the answers, it's going to take other people. It's going to take people you trust and who are also very good. That narrows the Venn diagram quite a lot. Be ready and be cognizant. It's going to be a long road with a lot of ups and downs, but the end journey is crazy worth it.

This article is part of an occasional feature series in which *JOM: The Magazine* talks with industry leaders about technology developments and current issues. To suggest a candidate for a future issue, contact Kelly Zappas, *JOM: The Magazine* editor, at kzappas@tms.org.

Ni-Co 2025



Add Your Voice to the Conversation at Ni-Co 2025

Kaitlin Calva



NOVEMBER 16–22, 2025
Phoenix, Arizona, USA

The 2025 International Symposium on Nickel and Cobalt will be co-located with the Extraction 2025 Meeting & Exhibition (Extraction 2025) and the 12th International Copper Conference (Copper 2025). Learn more about each event and submit your abstract by November 1, 2024, at www.ExtractionMeeting.org/Extraction2025.

After four years, the wait is over. The nickel and cobalt community will gather again in 2025. This is your chance to add your voice to the conversation and attend the **6th International Symposium on Nickel and Cobalt (Ni-Co 2025)**, scheduled for November 16–22, 2025, at the Sheraton at Wild Horse Pass in Phoenix, Arizona, USA.

Co-located with the Extraction 2025 technical conference and exhibition and Copper 2025, Ni-Co 2025 is jointly organized by TMS; the Metallurgy and Materials Society (MetSoc) of the Canadian Institute of Mining, Metallurgy, and Petroleum (CIM); and the Society for Mining, Metallurgy & Exploration (SME).

The event is typically held every four years, and the previous installment was scheduled in conjunction with the TMS 2021 Virtual Annual Meeting & Exhibition, where the meeting space was exclusively online. In 2025, you can once again join your colleagues and friends in person to discuss challenges and solutions in this growing field.

MEET THE ORGANIZING COMMITTEE

Ni-Co 2025 Chair

- Sina Mostaghel, AtkinsRéalis

Ni-Co 2025 Co-Chair

- Stuart Nicol, Glencore Technology

Mineral Processing

- Lev Filippov, Université de Lorraine
- David Jin, AtkinsRéalis

Hydrometallurgy

- Cinziana Sist, Hatch
- James Vaughn, University of Queensland

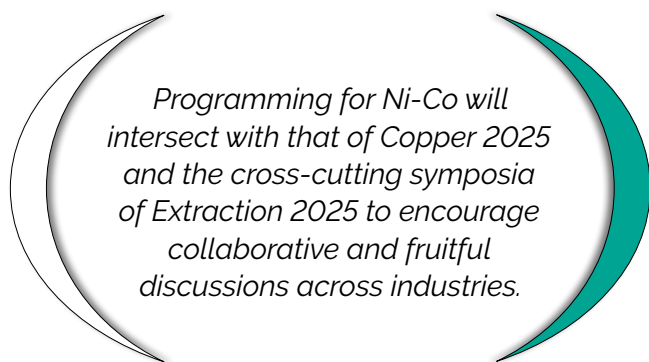
Pyrometallurgy

- Daniel Brosig, BBA
- Taufiq Hidayat, Institut Teknologi Bandung
- Reza Taleghani, Vale

Recycling

- Elmira Moosavi, ETS
- Leili Tafaghodi, McMaster University

As always, Ni-Co aims to bring engineers, operators, and researchers together from across the globe and all points in the supply chain to share the latest information on processing technologies as well as emerging technologies for both metals. Programming for Ni-Co will intersect with that of Copper 2025 and the cross-cutting symposia of Extraction 2025 to encourage collaborative and fruitful discussions across industries. As noted in the July 2024 preview article of the Extraction 2025 cross-cutting symposia, the overarching goal of the meeting is to facilitate cross-commodity learning in a way that is rarely possible. With such a diverse group of delegates expected to attend this unique, three-in-one event, opportunities to gather both formally and informally at networking activities, industry tours, professional development events, and more will be invaluable for discussing and developing more holistic solutions for a more sustainable future.



Through a keynote address, roundtable discussions, oral and poster presentations, expert-led short courses, and more, Ni-Co 2025 will focus on circular economy and battery materials. Key topics to be addressed during the symposium include, but are not limited to, mineral processing, hydrometallurgy, pyrometallurgy, and recycling. Within these topics, the following themes are planned (at press time):

- Recovery of valuable byproducts, such as platinum group metals (PGMs), scandium, etc.
- Environmental improvements
- Process optimization
- Operational improvements
- Process technology developments
- Metallurgy of nickel and cobalt ores
- Battery materials
- Sulfide and laterite processing

More program details will be released as abstracts are submitted and reviewed. Sign up on the Extraction 2025 website to receive updates via e-mail about new offerings, program information, and conference registration. Abstracts must be submitted by **November 1, 2024**.

For author guidelines and responsibilities, or to submit your abstract to Ni-Co 2025, Copper 2025, or the Extraction 2025 cross-cutting symposia, visit www.ExtractionMeeting.org/Extraction2025.

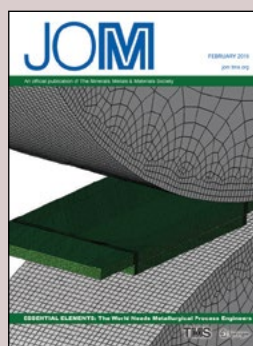
READ UP ON THE CONFERENCE AND REVISIT PAST EVENTS



July 2024



September 2024



February 2019

Look back at past issues of *JOM: The Magazine* for a preview of Extraction 2025 and Copper 2025. Find “Something for Everyone at Extraction 2025,” in the July 2024 issue, and “Metals for a Sustainable Future: A Preview of Copper 2025,” in the September 2024 issue.

You can revisit the inaugural event, Extraction 2018, in the February 2019 issue of *JOM* with the article, “The Numbers Are In: Extraction 2018 Declared a Success.” To see more from this meeting, view photos on the TMS Flickr account. The Extraction 2018 album can be found at <https://bit.ly/4cnQ9wi>.

You can also watch the full presentation, “Establishing a Domestic Cobalt Supply Chain: Unlocking Challenging Feedstocks,” delivered by Frank Santaguida of First Cobalt Corporation at the TMS 2021 Virtual Annual Meeting & Exhibition at www.tms.org/AnniversaryKeynotes. This talk was presented at the plenary session for the 5th International Symposium on Nickel and Cobalt and was selected as one of the keynote presentations honoring the 150th anniversary of TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME). The 2021 talk looked at the availability of resources around the world and the challenges this poses to the supply chain.

Kaitlin Calva is an independent contractor providing writing support for TMS and *JOM: The Magazine*.



Your 2025 TMS Membership: What's New for the Year Ahead?

Srinu Chada

I've said before that TMS is my professional home-society. It's where I found mentors who were generous with their time and their wisdom, peers who inspired my scientific pursuits, and colleagues who I can call friends. Now, as president of TMS, I want to encourage each of you to find *your* professional home with our Society. Please allow me to introduce three new programs that will help you do that in the coming year. Here's what's new for 2025.

Navigating Your TMS Membership

TMS recently launched **Navigating Your TMS Membership**, a series of orientation videos that introduce new members to the Society and help current members learn more about their benefits and the volunteer opportunities available to them. This comprehensive series, led by a group of dedicated TMS volunteers, begins with a broad overview, covering more specialized topics in subsequent videos:

- **Module 1: Introduction to Benefits and Volunteer Engagement Possibilities**
Presented by Ellen Cerreta, *Los Alamos National Laboratory*
- **Module 2: TMS Conferences and Meetings**
Presented by Alexandra (Allie) Anderson, *RHI Magnesita*
- **Module 3: TMS Technical Committees and Divisions**
Presented by Paul Mason, *Thermo-Calc Software Inc.*
- **Module 4: TMS Functional Committees**
Presented by Jonathan Madison
- **Module 5: Pathways to Volunteer Leadership Positions**
Presented by Christina Meskers, *SINTEF*
- **Module 6: Publications**
Presented by Tresa Pollock, *University of California, Santa Barbara*



Figure 1. The Navigating Your TMS Membership video series, led by a group of dedicated TMS volunteers, walks members through key aspects of their TMS membership and offers advice and pathways for deepening their participation in the Society.

Watching these videos is a great first step to better understanding how TMS can further your career, build your network, and provide you with a professional home among people who share your interests. You can view the full series of videos at www.tms.org/NavigatingYourTMSMembership.

Graduate Student Program

The new TMS Graduate Student Program is a membership package designed to meet the particular needs of students who have completed their undergraduate degrees and are pursuing graduate studies. The Graduate Student Program is different from both the Material Advantage and TMS professional membership programs in a few distinct ways.

First, the dues structure is unique.

RENEW YOUR MEMBERSHIP TODAY

www.tms.org/Renew

TMS encourages all members to renew their memberships by December 1 for the coming year. By renewing early, you'll ensure access to discounted registration on the TMS 2025 Annual Meeting & Exhibition in Las Vegas in March, uninterrupted access to your TMS journal subscriptions, and more. Annual memberships expire December 31. Please note that you have the option to renew your membership for one year, three years, or five years at a discounted price.



ADD AN INTERNATIONAL MEMBERSHIP OR LIBRARY SUBSCRIPTION

When you renew for 2025, consider purchasing additional benefits from TMS and partnering organizations at a reduced rate. These optional benefits are offered exclusively to TMS members and include:

Joint Memberships

TMS members can purchase joint memberships with the following international partner organizations, providing access to select electronic benefits from these groups at a reduced rate:

- U.K.'s Institute of Materials, Minerals, and Mining (IOM3)
- Brazilian Metallurgical, Materials, and Mining Association (ABM)

Online Library Subscriptions

TMS members can purchase subscriptions for access to the resources of the following online libraries:

- **Light Metals Digital Library:** A collection of more than 6,300 technical papers published from 1971 to 2015 as part of TMS's signature *Light Metals* proceedings series.
- **OneMine Online Library:** A collection of relevant technical papers associated with mining and minerals in one easy-to-navigate location.

Learn more at www.tms.org/Membership-Add-Ons and purchase these additional benefits during the membership renewal application.

Graduate students pay a one-time membership fee of \$75, and their membership lasts until they complete their studies (up to six years). After graduation, they'll receive their first year of TMS professional membership for free.

Second, graduate student members receive all the same benefits as professional members of the Society, including the ability to participate on TMS technical committees, which is an excellent way to meet people who work in your particular area of expertise and to access volunteer and leadership opportunities that will bolster your resume.

Graduate students can maintain their Material Advantage student memberships, as well, by paying dues annually. This will give them continued access to benefits from all four Material Advantage partner societies.

Learn more about this program and if it is right for you at www.tms.org/GradStudents.

TMS Mentoring Program

Also new for 2025 is the TMS Mentoring Program that will launch at the TMS 2025 Annual Meeting & Exhibition (TMS2025) with a special meet-up event for mentors and mentees. The program matches members who are in the early stages of their career (including graduate students) with more experienced members who will help them develop a customized leadership progression plan and facilitate

introductions to TMS members and activities.

Mentor and mentee pairings have already been matched for the 2025 program, but TMS accepts applications for mentors on a year-round basis. Visit www.tms.org/MentorProgram to sign up to be a mentor for the 2026 program, which will launch at the TMS 2026 Annual Meeting & Exhibition in San Diego, California. Applications for mentees for the 2026 program will open next year.

Join Us for Another Year of TMS Membership

I encourage you all to watch the new video series; I guarantee you'll learn something new about TMS. If you are eligible, I highly recommend joining the new graduate student program—it's a smart investment in your future career. And if you have experience to share, I urge you to join next year's class of TMS mentors. Members who are willing to invest in early career professionals will make this program thrive beyond the first year.

Stay with us for another year of TMS membership, and when you receive the next dues renewal reminder in your email, I hope you take immediate action to renew. Your prompt dues payment helps TMS to save costs on mailing printed dues bills and ensures uninterrupted access to your TMS member benefits.

Srini Chada is the 2024 TMS President and manager PM&P at General Dynamics Mission Systems.

The 2023 TMS Annual Financial Report

Brad Boyce and
James J. Robinson



After an extraordinarily difficult 2022, when the aftershocks of the pandemic deeply stressed the TMS financial position and business models, the Society began a rebound in 2023. You will see in this report that, while the Society still operated in the “red” during 2023, we were much closer to the breakeven-or-better operation to which we have long been accustomed. Our organization fought hard to make gains in 2023, and we significantly closed the shortfall of revenue against expenses. We are optimistic that 2024 will see us returning to more balanced operations.

A number of factors feed into our Society’s financial performance each year. (The diagrams on the next page show exactly how much of the “pie” is allocated to each TMS activity.) As you can see, “Events,” which includes our conferences, specialty meetings, and professional development courses (both in person and online) make up more than half of our annual revenue.

The TMS 2023 Annual Meeting & Exhibition, held in San Diego, California, was the first fully in-person installment of TMS’s flagship meeting since 2020. (TMS2021 was held as a virtual event, while TMS2022 was a hybrid in-person/virtual event.) The success of this meeting—the fourth largest in our organization’s history—was a critical milestone toward our return to normalcy. We also hosted or co-sponsored an additional 16 specialty conferences and courses (both in person and online), offering our members ample opportunities for professional development and networking. It was, quite literally, an eventful year for TMS and its members.

Publications are another crucial element of both our business and our mission—encompassing our six technical journals, our conference proceedings, our textbooks, and more. Publications continued to serve the community and the Society with excellence in 2023. For a more detailed perspective, see our article, “2023 Performance Metrics Announced for TMS Journals,” in the September 2024 issue of *JOM*.

Of course, not everything that we do at TMS brings

in revenue. We are a non-profit organization, but we do endeavor to build reserves so that we stay financially strong enough to endure “rainy days” and to support strategic initiatives that provide our members with the products and services that can help them grow their individual careers while advancing the profession as a whole. Intangibles like networking opportunities between members and the chance to hone leadership skills in volunteer roles are a big part of what we do as a Society, though these things don’t show up in any obvious way on a balance sheet.

While a focus of 2023 was improvement of the Society’s financial situation, we continued to pursue strategic initiatives and prepare for the future of our Society and our profession. Several projects that were planned in 2023 have come to fruition in 2024, including the first installment of the TMS Specialty Congress and the introduction of the TMS Mentoring Program and the TMS Graduate Student Program. We held another successful annual event with TMS2024 in Orlando and are expecting a strong turnout for the TMS Fall Meeting 2024 at Materials Science & Technology 2024 in October.

We’re proud of TMS’s performance in 2023 and especially of all the hard work by volunteers and staff to navigate challenging circumstances and consistently outperform expectations. We are optimistic that the solid groundwork we’ve laid will bring us back to balanced operations in 2024.



Brad Boyce
2023 TMS President



James J. Robinson
TMS Executive Director

WHO WE ARE

Our Membership Totals

Students

4,149

Professionals

6,587

Total Membership

10,736

Where Our Members Work*

Academia

39%

Government

18%

Industry

33%

Retired

8%

Unknown

2%

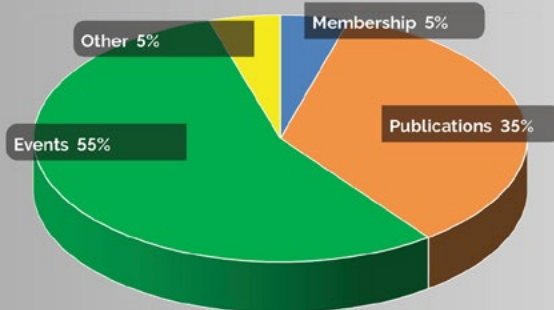
Where Our Members Live*

United States (4,221)	64%
Canada (271)	4%
United Kingdom (237)	4%
Japan (233)	4%
Germany (210)	3%
Korea, South (144)	2%
Australia (139)	2%
France (118)	2%
India (108)	2%
Other (906)	13%

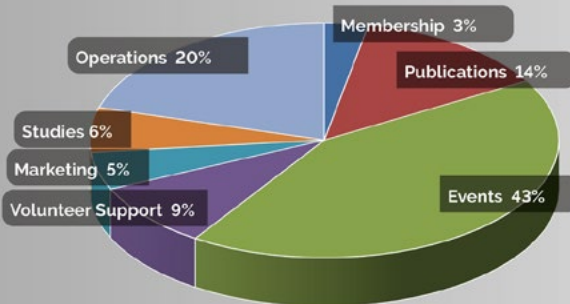
*Applies to Professional Members Only

2023 FINANCIAL REVIEW

2023 Operating Revenues by Program Area



2023 Operating Expenses by Program Area



Summary Of Operations Revenues And Expenses

Years ending December 31, 2023 and 2022

REVENUES	2023	2022
Membership & Customer Service	\$338,259	\$381,297
Content	2,652,514	2,490,325
Events, Education & Exhibits	4,173,067	3,312,185
Volunteer Support	0	1,424
Marketing & Communications	500	1,000
New Initiatives, Science, and Engineering	159,530	313,641
Executive & Operations	191,958	98,449
TOTAL REVENUES	\$7,515,828	\$6,598,321
EXPENSES		
Membership & Customer Service	\$228,567	\$477,430
Content	1,023,172	1,078,231
Events, Education & Exhibits	3,223,199	3,255,236
Volunteer Support	672,548	865,117
Marketing & Communications	502,155	391,598
New Initiatives, Science, and Engineering	463,042	578,195
Executive & Operations	1,551,073	1,867,554
TOTAL EXPENSES	\$7,663,756	\$8,513,361
EXCESS OPERATIONS REVENUE	(\$147,928)	(\$1,915,040)



TMS FOUNDATION

30 Years of Giving

The TMS Foundation 2023 Annual Report



30 YEARS OF GIVING



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

When the TMS Foundation was established in 1993, its first fundraising goals centered on providing scholarships, leadership development programs, and education for students and early-career professionals. Now, 30 years later, the Foundation continues this mission while growing both its scope and programs, as you'll see in the pages of this report.

In 2023, we were able to expand two key programs: the Young Leaders Professional Development Award and the Family Care Grant program.

The Young Leaders Professional Development

Award, which provides funding for promising early-career professionals to attend TMS conferences and participate in TMS leadership activities, added five new awards (one for each TMS technical division). This increases the number of participants and future leaders who can benefit from this important leadership development program.

We also increased the number of Family Care Grants, which provide monetary support to participants traveling to the TMS Annual Meeting & Exhibition to offset childcare or other family care expenses incurred as a result of attending the meeting. The number of grants rose from 20 to 30 in 2023, removing a barrier to participation for many meeting attendees.

Through the support of 232 donors—24 of whom made their first gift in 2023—the TMS Foundation raised a total of \$189,599 for the year. Out of that total, \$169,298 was raised during the year-end appeal campaign, which ran from October through December. We appreciate the generous contributions of all our donors, who recognize that giving to the TMS Foundation is an important way to honor and support their profession.

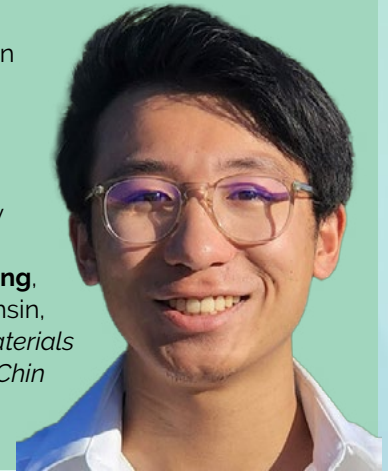
Your donations are helping the TMS Foundation to advance toward its ultimate goal of becoming self-sustaining and continuing to fund activities that support our next generation of members. In the past 30 years, we've done a lot of good for our community; we look forward to continuing the good work of the TMS Foundation for another 30 years . . . and beyond.

Sincerely,

"Two years ago, I chose to study materials science and engineering instead of medicine. Since then, the opportunities and experiences that I have gained through TMS and Material Advantage have been tremendously positive, and with the support of this award, I know that I'm on the right path. I feel like my hard work is finally paying off and is even helping me to fund my education and grow my network."

—Griffin Tong,

University of Wisconsin,
 2023 Functional Materials
 Division Gilbert Chin
 Scholarship







2023 FOUNDATION
 BOARD OF TRUSTEES

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Carl M. Cady Los Alamos National Laboratory	James J. Robinson TMS Executive Director
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Marc A. Meyers University of California, Santa Barbara	James Yurko Apple

2023 PROGRAM IMPACTS

The TMS Foundation supports students and early career professionals with meaningful financial assistance and impactful career-building experiences. In 2023 alone, the TMS Foundation made a difference in the lives of many students and early career professionals representing the future of our profession by conferring the following scholarships, grants, and awards:

- 
9 Scholarships for Promising Students
- 
36 Student Travel Grants to TMS Conferences
- 
21 Awards Supporting Early Career Development
- 
30 Family Care Grants
(in collaboration with TMS)

AND, THERE'S MORE . . .

Strengthening the Materials Community: The TMS Foundation sponsored seven awards for leaders who encourage diversity, equity, and inclusion 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.

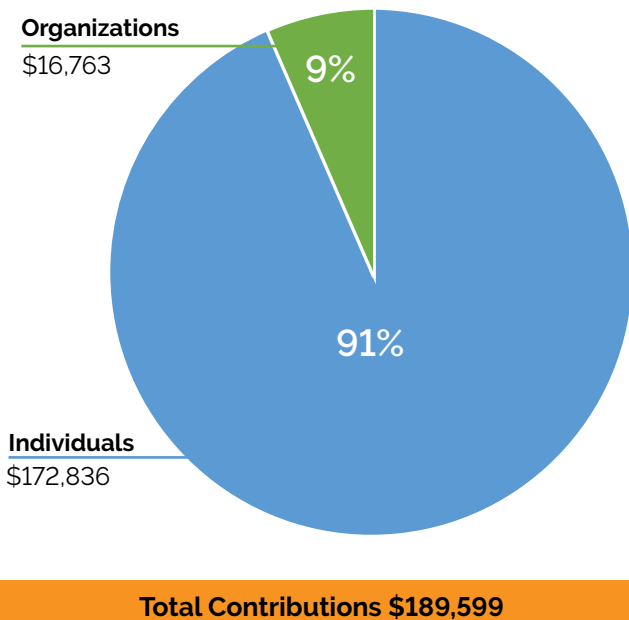
To learn more about the mission, vision, and history of the TMS Foundation, visit www.TMSFoundation.org

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.

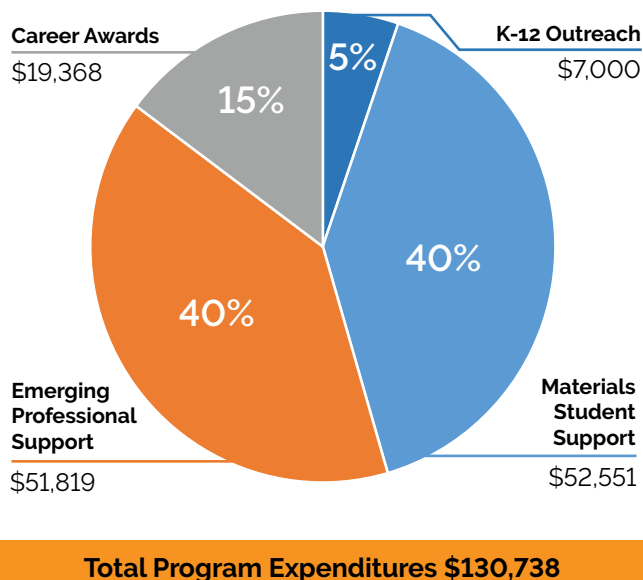
TMS FOUNDATION 2023 FINANCIAL OVERVIEW

The financial information below provides two perspectives on the TMS Foundation's performance in 2023:

2023 TMS FOUNDATION GIVING



2023 TMS FOUNDATION PROGRAM EXPENDITURES



THANK YOU TO OUR 2023 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 the **Lifetime Giving Honorable 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.



"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."

—**Danielle Cote**

Worcester Polytechnic Institute, 2023 Early Career Faculty Fellow



ORGANIZATIONAL GIVING

Thank you to the following companies and organizations for supporting the TMS Foundation in 2023. We applaud their commitment to developing a workforce that is ready to take on the challenges of an ever-changing science and engineering landscape.

Acta Materialia, Inc.

HJE Company, Inc.

Amazon Smile Foundation

**Microsoft Rewards/
Give with Bing**

Make a difference today by donating to the TMS Foundation online or mailing a check, payable to the TMS Foundation. Contact us at:

www.TMSFoundation.org
1-724-776-9000
TMSFoundation@tms.org

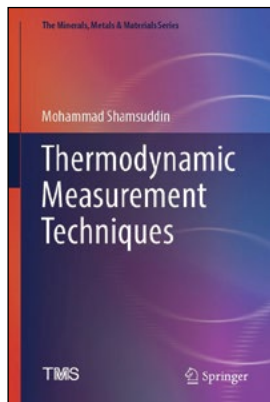
TMS Foundation
5700 Corporate Drive Suite 750
Pittsburgh, PA 15237

Recent Book Releases from TMS

Kelly Zappas

TMS

Thermodynamic Measurement Techniques, a new textbook by Mohammad Shamsuddin, is the latest addition to TMS's catalog of books published in partnership with Springer. Below is a look at the most recent titles in this collection, authored and edited by experts in the field and covering a broad range of topics. TMS members receive a 20% discount on the books included in this article and on other TMS non-proceedings titles published with Springer. (TMS members receive a 40% discount on all TMS proceedings publications.) Log in to www.tms.org/Bookstore to view a complete listing of available titles—including textbooks, handbooks, and proceedings from TMS meetings—and to access your member discount code. You can use this code during checkout on the Springer website.



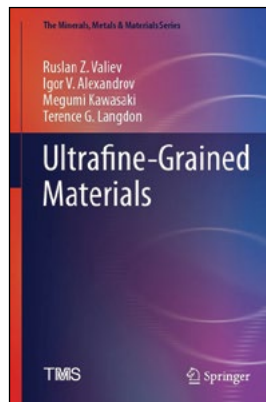
Thermodynamic Measurement Techniques

Author: Mohammad Shamsuddin

This textbook highlights the significance of various thermodynamic data required for selection and characterization of materials and discusses various solution models and the physicochemical principles

involved in thermodynamic measurement techniques.

Various techniques for measurement of thermodynamic quantities of materials such as enthalpy, free energy, and entropy are included. Techniques described in the book include calorimetry, chemical equilibria, vapor pressure, and electrochemical analysis. The book also covers general and solution thermodynamics and highlights the significance of various thermodynamic quantities required for materials characterization and development. The author goes on to discuss different thermodynamic measurement techniques in detail together with a set of more than fifty worked-out problems related to classical as well as solution thermodynamics and measurement techniques.



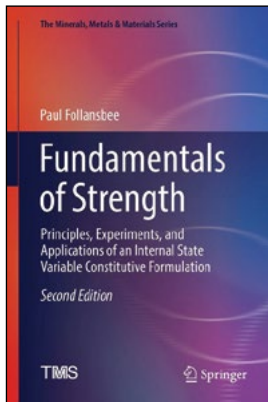
Ultrafine-Grained Materials

Authors: Ruslan Z. Valiev, Igor V. Alexandrov, Megumi Kawasaki, and Terence G. Langdon

This book summarizes and provides a detailed overview of the enhanced mechanical and functional properties of bulk nanostructured metallic materials with respect

to their potential applications. These applications include nanostructured titanium-based materials in biomedical engineering, aluminum alloys and copper in electrical engineering, and nanostructured steels in construction engineering. Moreover, this book describes the application of severe plastic deformation for the formation of hybrid metal systems from simple powders and solid metals for an enhancement in the functional properties of materials. Authored by global leaders in the field, this book serves as a bridge between researchers and professionals engineering the newest nanomaterials.

Hear from the book's authors in the article, "TMS Members Discuss New Textbook on Ultrafine-Grained Materials," published in the May 2024 issue of *JOM*.



Fundamentals of Strength: Principles, Experiments, and Applications of an Internal State Variable Constitutive Formulation, Second Edition

Author: Paul Follansbee

This second edition updates and expands on the first edition, augmenting

discussion of dynamic strain aging and austenitic stainless steels and adding a section on analysis of nickel-base superalloys that shows how the mechanical threshold stress (MTS) model, an internal state variable constitutive formulation, can be used to de-convolute synergistic effects. The new edition retains a clear and rigorous presentation of the theory, mechanistic basis, and application of the MTS model. Students are introduced to critical competencies such as crystal structure, dislocations, thermodynamics of slip, dislocation–obstacle interactions, deformation kinetics, and hardening through dislocation accumulation. The model described in the book facilitates readers' understanding of integrated computational materials engineering (ICME), presenting context for the transition between length scales characterizing the mesoscale (mechanistic) and the macroscopic. Presenting readers a model buttressed by detailed examples and applications, along with end-of-chapter exercises, the textbook is ideal for students, practitioners, and materials researchers.



Metallurgy in Space: Recent Results from ISS

Editors: Hans-Jörg Fecht and Markus Mohr

This book presents experimental work conducted on the International Space Station (ISS) in order to characterize metals and alloys in the liquid state. The internationally recognized

authors present and discuss experiments performed in microgravity that enabled the study of the relevant volume and surface-related properties free of the restrictions of a gravity-based environment. The collection also serves as a handbook of space experiments using electromagnetic levitation techniques. A summary of recent results provides an overview of the wealth of space experiment data, which will ignite further research activities and inspire academics and industrial research departments for their continuous development.

Metallurgy in Space summarizes the most exciting results of the physical property measurements in the ISS, providing benchmark data; demonstrates the entire chain of crucial developments from the atomic structure to related macroscopic properties; and illustrates international research and cooperation on board the ISS.

ADDITIONAL CONTENT AVAILABLE TO TMS MEMBERS

In addition to discounts on publications, TMS members receive free access to online member libraries and electronic journals as part of their annual memberships. Log in to the members.tms.org website to access the following content at no charge:

Online Libraries

- **TMS Member Library:** Access more than 3,700 technical articles from TMS publications.
- **AIME Digital Library:** Access more than 550 technical documents from the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) archive, including the journal *AIME Transactions*.
- **Superalloys Conference Proceedings Archive:** Search more than 1,000 technical articles that encompass the history of these important materials. (Access is free to both members and nonmembers.)

Journals

- **JOM**, the TMS member publication featuring both magazine and journal content
 - **Integrating Materials and Manufacturing Innovation**, focusing on the tools, methods, and impact of digitally enabled materials engineering
 - **Journal of Electronic Materials**, reporting on the science and technology of electronic materials and examining new applications
 - **Journal of Sustainable Metallurgy**, presenting metallurgical processes and related research aimed at improving the sustainability of metal-producing industries
 - **Metallurgical and Materials Transactions A**, focusing on physical metallurgy and materials science
 - **Metallurgical and Materials Transactions B**, focusing on process metallurgy and materials processing science
- Plus 20 Additional Journals Published by Springer! Find the full list at www.tms.org/Journals and log in for access.

TMS MEETING HEADLINES

Meeting information is current as of July 30, 2024. For the most recent updates on TMS-sponsored events, visit www.tms.org/Meetings.

TMS 2025 Annual Meeting & Exhibition (TMS2025)



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

Join Your Colleagues

TMS2025 will feature six honorary symposia for distinguished TMS members who have contributed to all aspects of minerals, metals, and materials science and engineering. Those members are David Bourell, Diana Farkas, Fiona Doyle, Anthony Rollett, Dipanker Banerjee, and Rainer Schmid-Fetzer.

www.tms.org/TMS2025

TMS Specialty Congress 2025



June 15–19, 2025
Anaheim, California,
USA

Abstract Submission Deadline: October 30, 2024

The 8th World Congress on Integrated Computational Materials Engineering will be one of the co-located meetings featured at TMS Specialty Congress 2025. The event will convene stakeholders 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/SpecialtyCongress2025

TMS Fall Meeting 2025 at Materials Science & Technology (MS&T25)



September 28–
October 1, 2025
Columbus, Ohio,
USA

Make Plans to Attend

TMS Fall Meeting 2025 will present robust programming, networking and social activities, and professional development events tailored to TMS members' interests within the broader structure of the MS&T conference series, providing an opportunity to experience both their TMS community and the resources of all the MS&T partnering societies.

www.tms.org/TMSFall2025

OTHER MEETINGS OF NOTE



Extraction 2025 Meeting & Exhibition (Extraction 2025)

November 16–22, 2025
Phoenix, Arizona, USA

www.extractionmeeting.org/Extraction2025



TMS 2026 Annual Meeting & Exhibition (TMS2026)

March 15–19, 2026
San Diego, California, USA

www.tms.org/TMS2026



TMS Specialty Congress 2026

June 21–25, 2026
Anaheim, California, USA

www.tms.org/SpecialtyCongress2026



TMS Fall Meeting 2026 at Materials Science & Technology (MS&T26)

October 4–7, 2026
Pittsburgh, Pennsylvania, USA

www.tms.org/TMSFall2026

CO-SPONSORED MEETINGS

Offshore Technology Conference (OTC) 2025

May 5–8, 2025
Houston, Texas, USA
Co-sponsored by TMS

OTC Brasil 2025

October 28–30, 2025
Rio de Janeiro, Brazil
Co-sponsored by TMS



6th International Symposium on
NICKEL AND COBALT

November 16–22, 2025
Sheraton Grand at Wild Horse Pass
Phoenix, Arizona, USA
#NiCo2025

The 6th International Symposium on
Nickel And Cobalt, part of Extraction 2025, is
organized by:



SUBMIT AN ABSTRACT

BY NOVEMBER 1, 2024

Ni-Co 2025—the largest technical conference series on the extraction and processing of nickel and cobalt—will feature operators, engineers, and researchers who will share information about all aspects of current processing technologies, as well as emerging technologies for both metals. Learn about the latest developments in this growing field with renewed focus on circular economy and battery materials at this must-attend event, co-located with the Extraction 2025 Meeting & Exhibition. Specific focus areas of the conference include mineral processing, metallurgy of nickel and cobalt ores, battery materials, recycling, recovery of valuable by-products, and sulphide and laterite processing.

PLANNED KEY TOPICS:

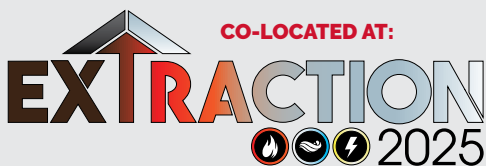
- Mineral Processing
- Hydrometallurgy
- Pyrometallurgy
- Recycling

KEY THEMES:

- Recovery of Valuable By-Products (PGMs, Sc, etc.)
- Environmental Improvements
- Process Optimization
- Operational Improvements
- Process Technology Development

Submit an abstract by November 1, 2024, to be part of this robust conference.

www.ExtractionMeeting.org/NiCo2025



ALSO FEATURING:

12th International
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THE WORLD COMES HERE.

TMS 2025

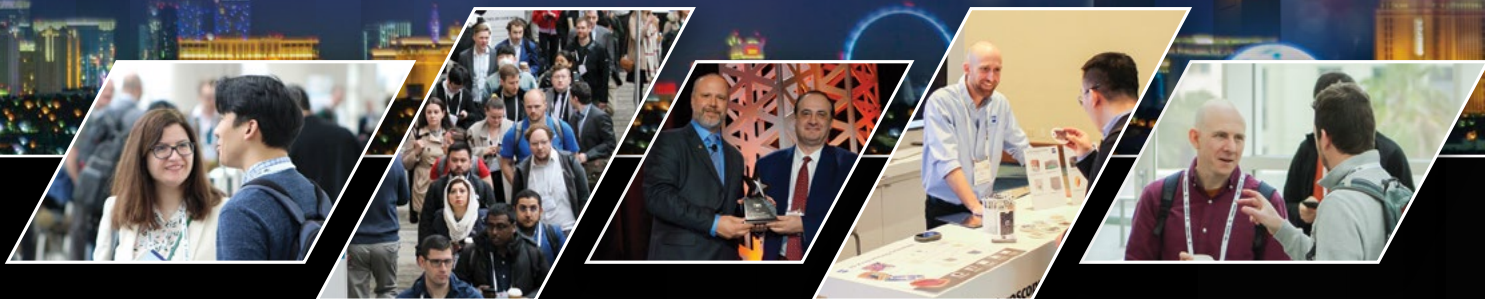
154th Annual Meeting & Exhibition

March 23–27, 2025

MGM Grand Las Vegas Hotel & Casino

Las Vegas, Nevada, USA

#TMSAnnualMeeting | www.tms.org/TMS2025



BOOK YOUR ROOM

Reserve your room at the MGM Grand Las Vegas Hotel & Casino, the venue for all technical sessions, exhibits, networking events, and other activities at the TMS 2025 Annual Meeting & Exhibition.

REQUEST YOUR TRAVEL VISA

If you require a visa to travel to TMS2025, please begin the application process now. You can request a visa invitation letter through the TMS2025 website.

MARK YOUR CALENDAR

October 2024: Registration Opens
March 23–27: Conference Dates
March 24–26: Exhibit Dates

Scan the QR code or visit:
www.tms.org/TMS2025



**FEATURING
CO-LOCATED
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