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An official publication of The Minerals, Metals & Materials Society

JOM TALKS WITH TOM BATTLE: A Look at His Year as President



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About the Cover

"Production Strategy for Manufacturing Large-Scale AlSi10Mg Components by Laser Powder Bed Fusion" by Federico Bosio et al. discusses platform temperatures to prevent cracks and distortions, and investigates in situ aging behavior for samples under various platform temperatures and holding times. The cover image shows a microstructure along building direction of a sample built with 53 h of printing time above a platform heated at 150°C.

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March 2021 Guest Editors Characterization of Additive

Manufactured Materials Materials Characterization Committee Rajiv Soman, Eurofins EAG Materials Science Yunus Eren Kalay, Middle East Technical University Zhiwei Peng, Central South University

Powder Materials for Energy

Powder Materials Committee Kathy Lu, Virginia Polytechnic Institute and State University David Yan, San Jose State University

About JOM:

The scope of *JOM* (ISSN 1047-4838) encompasses publicizing news about TMS and its members and stakeholder communities while publishing meaningful peer-reviewed materials science and engineering content. That content includes groundbreaking laboratory discoveries, the effective transition of science into technology, innovative industrial and manufacturing developments, resource and supply chain issues, improvement and innovation in processing and fabrication, and life-cycle and sustainability practices. In fulfilling this scope, *JOM* strives to balance the interests of the laboratory and the marketplace by reporting academic, industrial, and government-sponsored work from around the world.

About TMS:

The Minerals, Metals & Materials Society (TMS) is a professional organization that encompasses the entire range of materials and engineering, from minerals processing and primary metals production to basic research and the advanced applications of materials.

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Thermodynamic Optimization of Critical Metals Processing and Recovery

Process Technology and Modeling Committee; Recycling and Environmental Technologies Committee

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in the final analysis

"As I was motorvatin' over the hill—I saw Maybellene in a Coupe de Ville— A Cadillac a-rollin' on the open road—Nothin' will outrun my V8 Ford—The Cadillac doin' about ninety-five—She's bumper to bumper, rollin' side by side."

--- "Maybellene," Chuck Berry

I'll posit that, after romance, songs about cars and driving are the beating heart of rock 'n' roll. You've heard them time and again: "Little Deuce Coupe" (The Beach Boys), "Drive My Car" (The Beatles), "Highway Star" (Deep Purple), Mercedes Benz (Janis Joplin), "Pink Cadillac," (Bruce Springsteen and the E Street Band), "I Can't Drive 55" (Sammy Hagar), "Little Red Corvette" (Prince), . . . the list rolls on and on and on because we've "got fuel to burn and roads to drive" ("Rockin' in the Free World," Neil Young). With no exception that I can summon, our most stalwart driving songs are exclusively products of our high-octane passion for the vrooming of internal combustion engines. No one is having fun, fun, fun until daddy takes their *electric* T-bird away (with apologies to the Beach Boys).

That's sure to change, however, as the data tell us that the day is coming when increasingly aspirated V8s, V6s, V4s, and V3s will be largely replaced with pure electric and plug-in hybrid vehicles. Gasoline has fueled more than half-a-dozen generations of drivers. That fossil fuel seems ready to stand down as the new power supply will be *metal*, particularly in the form of lithium batteries. (I know, I know, they have to be charged by something.)

According to Deloitte, the sales of battery electric and plug-in hybrid electric vehicles tipped over the two-million-vehicle mark for the first time in 2019 worldwide. That's a bit less than 3% of the total car and light-vehicle market, but that's up from basically 0% just ten years earlier. By 2030, that share is expected to grow to about 30%. In terms of sheer number of vehicles, China accounts for half of all electric and plug-in vehicle sales. On a percentage basis, varied trade association data tell us that Norway led the world in 2019 with 56% of all new car sales comprising plug-in electric vehicles. The numbers will grow.

According to Bloomberg, growth in the electric vehicle market is about to drive acceleration in the consumption of some of our favorite TMS metals. Nickel, aluminum, phosphorus, iron, copper, graphite, and lithium are all expected to see increases in demand anywhere from 9–14 times (!) by 2030, as compared to 2019. (Did I read that right?!) More modestly, the demand for copper and manganese is expected to merely triple during the same period. If anywhere close to true, perhaps the TMS Extraction & Processing Division and Light Metals Division should prepare to process a lot more abstracts and paper submissions on primary metals as folks working with lightweighting, integrated computational materials engineering, batteries, and other vehicle-oriented technologies are going to be very, very busy. We'll need to work even harder to fill the STEM pipeline with qualified young people as well.

This demand won't just impact research and production. It will have a heavy influence on investment decisions, too. Want an example? How is the gold standard of electric vehicle makers doing? According to *The Wall Street Journal*, Tesla during 2020 grew roughly 700% in value to about \$622 billion and joined the S&P500, immediately becoming the sixth largest company in the index. As a byproduct, Tesla Chief Executive Officer Elon Musk became the world's richest person, surpassing Amazon Founder Jeff Bezos. Elon is a colorful fellow and was a Stanford Ph.D. candidate in applied physics and materials science for a few days. No surprise, as materials attract exceptionally bright people. Oh yeah, Tesla produced half a million electric vehicles in 2020.

The secret to Elon's success? Many things. One could be that his significant other is a rock artist (Grimes). Another is that he benefits from having made a video guest appearance during the all-conference plenary at TMS2018 in Phoenix. You never know how much attending a TMS meeting will help electrify your career.



Number 3

March 2021



James J. Robinson Executive Director

<u>@JJRofTMS</u>

"Nickel, aluminum, phosphorus, iron, copper, graphite, and lithium are all expected to see exponential increases in demand anywhere from 9–14 times (!) by 2030, as compared to 2019."

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member news

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

TMS Members Receive AAAS Fellow Distinction; Welcome New Members

Eight TMS Members Honored by AAAS

Congratulations to the following TMS members for being honored by the American Association for the Advancement of Science (AAAS) as 2020 Fellows. According to AAAS, "Fellows are a distinguished cadre of scientists, engineers, and innovators who have been recognized for their achievements across disciplines." They were elected in October 2020 and chosen out of 489 individuals worldwide, in 24 different AAAS section affiliations.

Section on Chemistry

Paul V. Braun University of Illinois at Urbana-Champaign *TMS member since 2013*

Jiaxing Huang Northwestern University TMS member since 2012

Section on Engineering

L. Catherine Brinson Duke University TMS member since 2002

Kristen P. Constant Iowa State University TMS member since 2015

Ju Li Massachusetts Institute of Technology TMS member since 2003

Uday B. Pal

Boston University TMS member since 1992, recipient of the 2015 Extraction & Processing Division Distinguished Lecture Award, and co-editor-in-chief of the Journal of Sustainable Metallurgy

Robert O. Ritchie

University of California, Berkeley TMS member since 1976, recipient of the 2020 William D. Nix Award, 2017 Morris Cohen Award, 2010 Institute of Metals/ Robert Franklin Mehl Award, and 2004 TMS Fellow

Section on Societal Impacts of Science and Engineering

Oladele (Dele) A. Ogunseitan University of California, Irvine, *TMS member since 2005*



Paul V. Braun



Ju Li



Jiaxing Huang



Uday B. Pal



L. Catherine Brinson



Robert O. Ritchie



Kristen P. Constant



Oladele (Dele) A. Ogunseitan



TMS Members Receive AAAS Fellow Distinction; Welcome New Members

TMS Welcomes New Members

The TMS Board of Directors approved professional membership for the following individuals at its December 2020 meeting. Please join us in congratulating and welcoming them to all the privileges and benefits of TMS membership.

- Aceves, Maureen; Oxford University, United Kingdom
- Al-Lehyani, Ibrahim; King Abdulaziz University, Saudi Arabia
- Amini, Shahram; Pulse Technologies Inc., United States
- Andermann, Lawrence J.; Suez, United States

Apena, Azeez; United States

- Arai, Noriaki; QuesTek Innovations LLC, United States
- Beach, Elvin; The Ohio State University, United States
- Birnbaum, Peter; Chemnitz University of Technology, Germany
- Brueck, Ekkes; Delft University of Technology, Netherlands
- Chan, Andrew; ALD Vacuum Technologies North America Inc., United States
- Chen, Yi-Sheng; The University of Sydney, Australia
- Choi, Hongseok; Clemson University, United States
- Colpitts, Tanner D.; United States
- Cristante, Angelo; United States
- D'Abreu, Jose Carlos; Catholic University, Brazil
- Dos Santos, Igor Cuzzuol; AMG Brasil, Brazil

Dowdle, John; Old Hickory Clay Company, United States Fu, Wentao; United States

Fuerst, Jacob D.; United States

Gagnon, Jessie; Laval University, Canada

Gupta, Ankur; Indian Institute of Technology Jodhpur, India

Holota, Radek; University of West Bohemia, Czech Republic

House, Stephen D.; University of Pittsburgh, United States

Hunert, Daniela; Germany

Jacobsohn, Luiz G.; Clemson University, United States

Jain, Vipin; National Physical Laboratory, India

Kapoor, Monica; Novelis, United States

Khalaj, Omid; University of West Bohemia, Czech Republic

Klenam, Desmond E.P.; South Africa

Kolel-Veetil, Manoj; Naval Research Laboratory, United States

Korotov, Anne-Sophie; United Kingdom

- Koucky, Vaclav; University of West Bohemia, Czech Republic
- Kua, Harn-wei; National University of Singapore, Singapore
- Lin, Jeffrey D.; QuesTek Innovations LLC, United States
- Macha, John; United States

Massie, Grant Nicol; Gates Power Transmission Ltd., United Kingdom Meng, Fan; QuesTek Innovations LLC, United States

Porter, Eric I.; University of Alberta, Canada

Romani, Nadia; Rio Tinto, Canada

Santala, Melissa K.; Oregon State University, United States

Schaadt, Steven T.; Howmet Aerospace, United States

Sharma, Prince; India

Shu, Wenya; Virginia Polytechnic Institute and State University, United States

Skala, Jiri; University of West Bohemia, Czech Republic

- Sobotova, Lenka; University of West Bohemia, Czech Republic
- Sohrabi, Sajad; Islamic Republic of Iran
- Sorkin Samuel; QuesTek Innovations LLC, United States

Souza, Flavio; United States

Stadler, Ctibor; University of West Bohemia, Czech Republic

Thamizhirai, Selvan; United Kingdom

- Unruh, Bryan L.; NuWay Solutions LLC, United States
- Wilkinson, Mark; United Kingdom
- Yu, XiaoXiang; Novelis Inc., United States

*Membership grade recommendations are based on a review of credentials provided by the individuals. These credentials are taken on the honor system and not independently verified, except by exception.

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Do you have business or industry news of interest to the minerals, metals, and materials community? Submit your announcement or press release to Kaitlin Calva, JOM Magazine Managing Editor, at kcalva@tms.org for consideration.

In Case You Missed It: Business News from the Field

Lockheed Martin Buys Aerospace Manufacturer

Bethesda, Maryland, USA: Lockheed Martin Corporation agreed to acquire Aerojet Rocketdyne Holdings Inc. for an all-cash transaction valued at \$4.4 billion. Aerojet Rocketdyne operates 14 rocket development facilities that span the nation. Its facility in Redmond, Washington, has built thruster systems for virtually every interplanetary mission since the Apollo era. Lockheed Martin's space division has its hand in wideranging programs ranging from the Orion and Mars missions to its work on national security satellites. The transaction is expected to close in the second half of 2021.

Invitalia and ArcelorMittal Reach Deal

Milan, Italy: Invitalia, an Italian state-owned company, reached a deal with ArcelorMittal S.A. to run the ILVA steel plant in Taranto. Invitalia will pay initially €400 million for joint control of ArcelorMittal vehicle AM Investco. In a second step, Invitalia will invest up to €680 million by May 2022 to raise its stake to 60%. A new industrial plan between the partners envisions reaching 8 million metric tons of production by 2025 and investment in process technology.



Pittsburgh, Pennsylvania, USA: American researchers created the first fullsize human heart model using 3D printing technology. The model was made with a specially developed 3D printer that uses biomaterials to produce a structure and tissues similar to a real human heart. The model heart can be a useful tool to train medical professionals in heart-related operations. It could also be used as a basis for new research on ways to use 3D printing technology to produce fully operating hearts to replace in people. (Image courtesy Carnegie Mellon University/ACS Publications via YouTube.)

Rio Tinto and Nippon Steel Partner to Lower Emissions

Melbourne, Australia: Rio Tinto, a global mining company, and Nippon Steel Corporation, Japan's largest steelmaker, inked an agreement to jointly explore, develop, and demonstrate technologies to transition to low-carbon emissions within the steel value chain. The memorandum of understanding will allow them to pursue new technologies over the long term, starting with carbon dioxide reduction scenarios with goals set for 2030 and 2050. The companies plan to explore technologies for decarbonization of the entire steel value chain.

VanGold Acquires El Cubo Mine

Vancouver, Canada: VanGold Mining Corporation signed an agreement with Endeavor Silver Corporation to acquire the El Cubo Complex, a mine and mill located close to its El Pinguico silvergold project near the city of Guanajuato, Mexico. The El Cubo Complex includes two operating underground silver-gold mines with a rated capacity of 1,500 tonnes per day and a flotation plant. VanGold intends to restart the mill at approximately 750 tonnes per day using mineralized material from its surface and underground stockpiles at its El Pinguico project as a significant portion of its estimated throughput for the first 36 months of operation.

GM's 3D Print Shop Delivers Value

Detroit, Michigan, USA: General Motors Company increased its use of 3D printing across more production vehicles. A new Additive Industrialization Center located at GM's Global Technical Center in Warren, Michigan, will use 3D printing to make more production and car parts that will save the automaker money and speed up vehicle development. GM recently pivoted to using 3D printing on production vehicles and for tools in manufacturing plants, after using it largely for vehicle prototypes for 30 years. JOM, Vol. 73, No. 3, 2021 https://doi.org/10.1007/s11837-021-04576-3 © 2021 The Minerals, Metals & Materials Society

JOM Talks with 2020 TMS President Thomas Battle

Kelly Zappas



Tom Battle

Editor's Note: Tom Battle will complete his term as 2020 TMS President at the TMS 2021 Virtual Annual Meeting & Exhibition (TMS2021 Virtual), March 15–18, 2021. In this conversation with *JOM*, Battle reflects on the experience of being president during a truly challenging year and discusses his hopes for the future of the Society.

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JOM: Your term as TMS president included more challenges than most. How do you think TMS has evolved to meet the changing needs of our community over the past year? How do you think this will impact the Society going forward?



Battle was installed as 2020 TMS President during the TMS-AIME (American Institute of Mining, Metallurgical, and Petroleum Engineers) Awards Ceremony at TMS2020.

Battle: At the TMS 2020 Annual Meeting & Exhibition, which took place February 23-27, 2020, the leadership of TMS held many discussions, both formal and informal, on the state of the Society and what we could do to improve the organization going forward. This led to various more-or-less formulated plans for advancing the Society. Within two weeks of the end of the conference, all of those plans vanished when the world changed. Staff and volunteers did an amazing job of discarding our planning for the world as it was and adapting to the world as it was becoming. The shape of the future for organizations such as ours is still not clear, but we are at the forefront of professional societies in exploring future options.

JOM: In your inaugural speech in February last year, you talked about what a great time it was for members to become more involved with the Society. Do you think this message is still relevant? What can members do to get more involved with TMS at this time?

Battle: The need for involvement in the organization is *more* relevant as we find ourselves hindered in exchanging technical information in an era where social distancing may not go away anytime soon. We are realizing how important the in-person conferences and courses were. In addition, while many of us are forced to work from home or in a sparsely inhabited environment, we miss the interactions with fellow employees at our home organizations.

TMS is learning to adapt and has

"Speaking up to support the framework of our outreach to all people, mainstream or marginalized, is necessary for us to move above and beyond perhaps hallowed-but not really inclusivetraditions."



Battle virtually introduces the TMS/ASM Joint Distinguished Lectureship in Materials and Society during the Materials Science & Technology 2020 Virtual conference in November 2020.

MS&T20 VIRTUAL

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Technical Meeting and Exhibition

developed a COVID-19 Materials Needs Exchange that may be a model for future endeavors by the Society. We have created more webinars to foster the exchange of knowledge. We are learning to conduct virtual meetings. None of these would be successful without the assistance of dedicated volunteers to coordinate and lead these new initiatives-or without participants to attend and critique our efforts.

JOM: In the past year, TMS has issued position statements and letters to



Battle delivers his Presidential Address at the TMS-AIME Awards Ceremony at TMS2020.

government leaders on issues relevant to our communities, including social justice and diversity, equity, and inclusion. Why was it important to speak up on the issues that we addressed?

Battle: It would have been the easy route for us to just focus on the pandemic and its effect on our membership and Society operation. But these other events may, in the long term, have even more impact on our Society. It has been apparent for many years that we cannot function in a diverse, pluralistic world by continuing to act in a monolithic manner, implicitly or explicitly assuming that running the Society in the traditional way is appropriate for the world as it is (or as it should be). Speaking up to support the framework of our outreach to all people, mainstream or marginalized, is necessary for us to move above and beyond perhaps hallowed-but not really inclusive-traditions.

JOM: What do you consider to be your greatest contribution as TMS President?

Battle: That I carefully listened to staff, thought about ideas on my own, then approved their recommendations! Although I brought up useful ideas here and there, most of the changes came from staff members and volunteers concerned about our Society and how it needs to adapt to survive and thrive. I worked to keep my mind open to these new ideas. I tried to respect tradition, but also accept



JOM Talks with 2020 TMS President Thomas Battle



In a video to TMS members and prospective TMS2021 Virtual attendees, Battle talked about what a virtual annual meeting experience will look like and shared that he is most looking forward to interactions with colleagues and discussions on technical topics.

new ways of doing things as the Society's business model seemingly vanished in the course of a few weeks. (The model I'm thinking about, of course, is bringing together a diverse group of people from around the world to exchange information and build relationships—the opposite of social distancing!)

JOM: What have you found most fulfilling about serving as president?

Battle: That we're still above water, solvent, and have a plan to stay that way. That we have managed to keep Society staff gainfully employed. That we have kept most of our volunteers engaged and have plans in place to not only keep them interested and involved in the organization, but to bring in more volunteers.

JOM: What lessons are you taking with you from your presidential experience?

Battle: When I give advice to science or engineering students, I often tell them that the most important trait they can have is flexibility. You don't know what will come up tomorrow. You may think, for example, that your future will be the particular area you've become an expert in during your studies, or as a result of a research

project. But opportunities can come from the most unexpected places, and you need to assess them as they come along, and pivot as necessary. Well, the entire TMS organization, members, volunteers, and staff have had to pivot in the last year so often, it's a wonder we're not dizzy. But we have accomplished a lot, together, and we have plans for the upcoming year—or until the next pivot!

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

Battle: Simply that there's no way we could have gotten through the last year without the benefit of our past expertise, specifically the accumulated experiences of staff and membership and the availability of a "rainy day fund" (which handled well what turned out to be a monsoon). But that alone would not have gotten us through the year. It was building on this knowledge and turning in directions that will make our enterprise more sustainable, more inclusive of the diverse skills and abilities of all in our field that have helped us through this challenging year. Now, we are more prepared to interact with the world as it is and is becoming, and not just the world we came from, not all that long ago.



"...opportunities can come from the most unexpected places, and you need to assess them as they come along, and pivot as necessary."



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A Scientist in Service to Society: Announcing the New Sadoway Award

Ashley-Anne Bohnert



Donald R. Sadoway

The newest award to be offered by TMS honors a giant within the materials science community and member of the 2020 TMS Class of Fellows, Donald R. Sadoway. **The Sadoway Materials Innovation and Advocacy Award** is aimed at fostering the participation of TMS members in public advocacy for sustainable materials solutions while celebrating Sadoway's own commitment to sustainable solutions in materials processing, and his legacy of teaching and advocacy in public fora.

It will recognize a mid-career member with impactful and broad materials science and engineering achievements and a unique ability to champion their work and the materials science and engineering field through education, public advocacy, or entrepreneurship, particularly in areas related to sustainability.

The award was endowed by Sadoway's students, friends, and colleagues through the TMS Foundation to honor his influence on them, the Massachusetts Institute

About the Sadoway Materials Innovation and Advocacy Award

Recognizes: This award was established to honor and recognize the innovative achievements of Donald R. Sadoway in materials science, his commitment to sustainable solutions in materials processing, and his legacy of teaching and advocacy in public forums.

Criteria: Recipients must have an established record of innovative achievements in materials science or innovations that use and/or involve materials science as a core enabler. They must also have a record of outstanding communications, as evidenced by teaching, public advocacy, or entrepreneurship. Additionally, recipients must be current professional members of TMS and have been members for at least three consecutive years. Finally, they may not reach their 50th birthday by December 31 of the year in which the initial nomination is made.

Award: Award piece, \$3,500 cash prize.

Nominations: Award nominations will be due April 1 of each year. Visit awards.tms.org for details and the nomination form. For questions or additional information, contact Deborah Hixon, TMS Awards Program Administrator, at hixon@tms.org.

of Technology (MIT) Department of Materials Science and Engineering, and the global materials science community. The first recipient will be honored at the TMS-AIME Awards Ceremony held during the TMS 2022 Annual Meeting & Exhibition in Anaheim, California. All nominations must be received by **April 1, 2021.** Visit the TMS Honors and Awards website at awards.tms.org for further details.

Jim Yurko, an MIT alumnus and one of the two original proposers of the award, noted that, "Sadoway's enthusiasm for materials science and engineering, evident in both his ability to masterfully teach the subject as well as apply it to challenging societal problems, has influenced students and colleagues at MIT for more than 40 years. With the dawn of the internet age, Don's reach has expanded globally, giving him a platform to advocate for the use of materials chemistry and innovative solutions for a variety of sustainability challenges. This award comes at the perfect time to honor Don's legacy, but more importantly celebrate emerging people in our field who focus on impactful problems while harnessing his unique spirit."

"I was energized to work with Jim Yurko to create this award because it was an opportunity to provide recognition for midcareer individuals with passion and unique skills at championing their work and our field in broader public policy forums. To me, this award should recognize those who have been advocates for all of us working in materials science and engineering," noted 2017 TMS President, David DeYoung. "I have known Don Sadoway since my time as a graduate student at MIT and was delighted to help honor his legacy as a superb teacher and developer of sustainable materials processes."

Donald R. Sadoway is the John F. Elliott Professor of Materials Chemistry in the Department of Materials Science and Engineering at MIT and, over the course of his career, has authored over 170 scientific papers and has been listed as inventor on 32 U.S. patents. Much of his research is on environmentally sound metals extraction technologies and on batteries for grid-scale storage and electric vehicles.

Sadoway earned his B.A.Sc. in engineering as well as his M.A.Sc. and Ph.D. in chemical metallurgy from the University of Toronto. He won a NATO Postdoctoral Fellowship which took him to MIT where he worked under Julian Szekely. Before the fellowship year was up, Sadoway was hired as an assistant professor and gave his first conference presentation as a new faculty member at the TMS 1979 Annual Meeting & Exhibition and found it to be, "a huge boost to meet so many people who work in the same field and engage in faceto-face conversations. The networking was so critical in a time before internet and smartphones." He maintained his involvement with TMS and notes that, "over time I rose through the ranks of TMS here in Boston, while at the national level I was active in light metals and reactive metals. No question that my connection with TMS was beneficial to my career."

By 1990, he had distinguished himself as a hands-on experimentalist who imported techniques to the study of the fundamental processes at the heart of electrolytic production of metals. By adopting a holistic approach to materials selection, he conceived of a complete set of anode material, electrolyte, and electrical operating envelope which then led to his conceptualization of molten oxide electrolysis which today is being commercially deployed by Boston Metal. To complement his inventions in hightemperature electrochemical processing, he turned his attention to the largely neglected medium of liquefied gases. This gave birth to cryoelectrodeposition and, eventually, his work on high-Tc superconducting materials.

In the early 1990s, Sadoway turned his attention to another branch of electrochemistry: batteries. Shortly after came the invention of a solid polymer electrolyte which not only obviated the safety risk of the volatile, flammable liquid electrolyte still used today, but also allowed electrode. This meant a safe battery with exceptionally high energy density. Then, in the 2000s came the jump to grid-scale storage and the invention of the liquid metal battery. The work of Sadoway and his team led to the creation of the company Ambri, which is working to bring liquid metal batteries to the market.

If these accomplishments were not enough, Sadoway also found the time to demonstrate to NASA that electrolysis of lunar regolith was a feasible solution to producing oxygen on the moon. The by-product of this process was molten metal, an outcome that led to an even more interesting application: greenhouse gas (GHG)-free steelmaking on Earth. Sadoway received funding from the U.S. Department of Energy to continue his work on GHG-free steel and, in 2011, his team at MIT discovered a practical inert anode that would make the process more

lecture for the Introduction to Solid State Chemistry class on December 7, 2010.

"To me, this award should recognize those who have been advocates for all of us working in materials science and engineering." -David DeYoung

Sadoway delivers his last for the use of lithium metal as the negative

In October 2012, Sadoway appeared on The Colbert Report to discuss his team's work on liquid metal batteries.





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Sadoway (front row, far right) is pictured with his liquid metal battery team of students and postdocs at MIT, "Group Sadoway," in July 2011.

"I've always tried to practice science in service to society." -Donald Sadoway feasible. This led to the founding of the company Boston Metal, which is working to commercialize the process.

Among the many accomplishments in his distinguished career, Sadoway takes the most pride in those that have had a wide impact: "I've always tried to practice science in service to society. When you fold that in with decarbonization of industry this is a rich area for our brand of engineers. I am proud of two inventions that resulted in the creation of companies: the liquid metal battery leading to Ambri and molten oxide electrolysis leading to Boston Metal." In many ways however, his widest



In 2012, Sadoway was named one of TIME magazine's 100 Most Influential People in the World and delivered a TED talk that has since received over two million views.

impact is through the students and postdocs he mentored. Amidst all of his research, Sadoway remained preoccupied with teaching students to have a visceral understanding of the subject matter and developing a mastery of it. He notes that, "I'm also proud of my record of teaching and the web streaming of my lectures that extended my influence far beyond the walls of the lecture hall." Over the years at MIT, he has taught graduate classes in kinetics and in electrochemistry and undergraduate subjects in general chemistry and chemical metallurgy. His series of general chemistry lectures was disseminated online by MIT OpenCourseWare and has accumulated more than two million total views to date. His 2012 TED talk also gathered an additional two million views and brought liquid metal batteries, and a greater focus on the process of mentorship, to an even wider audience-including Bill Gates, who became one of Sadoway's most ardent admirers after watching his lectures.

When asked about the new Sadoway Materials Innovation and Advocacy Award, Sadoway's answer is true to the focus on the greater good demonstrated throughout his career: "It is my hope that this award will inspire young people to steer their careers in such a way as to align scientific accomplishment with societal benefit-science in service to society."



Donations continue to build for this award fund. If you would like to join his students, colleagues, and friends in honoring Donald Sadoway, you can make a contribution by visiting www.tms.org/SadowayAward and clicking on the "Sadoway Materials Innovations and Advocacy Award Fund" link in the award description. This award is funded through the TMS Foundation.



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CELEBRATING OUR COMMON LEGACY: 150 YEARS OF AIME AND TMS

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Kaitlin Calva

Above: Attendees and guests of the AIME 50th Anniversary Celebration, held at the Institute's September 1921 meeting in Wilkes-Barre, Pennsylvania.

Many JOM readers have seen the story before: on May 16, 1871, 22 mining engineers gathered to discuss technical papers in Wilkes-Barre, Pennsylvania, to form the American Institute of Mining Engineers, which would eventually become the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) that we all know today. But in 2021—the Institute's 150th year—this story bears repeating. In several articles to be published over the course of the next year, TMS and JOM will celebrate our shared history with AIME; our common legacy.

While much has changed in the last 150 years—within

Technology (AIST); the Society for Mining, Metallurgy, and Exploration (SME); and the Society of Petroleum Engineers (SPE).

If you are unfamiliar with our history, you may be wondering, "Why exactly does TMS celebrate the anniversary of AIME?" TMS's roots date back to 1918 as the Institute of Metals Division of AIME, which later became the separately incorporated Society that we all know today—but more on that later.

In those formative years, the Institute operated under two main purposes: "First, the more economical production of useful minerals and metals. Second, the greater safety



Help Us Celebrate Virtually

As the TMS 2021 Annual Meeting & Exhibition (TMS2021) has become TMS2021 Virtual, so has our AIME 150th Anniversary Celebration. While we are still planning some in-person elements for TMS2022, as well as the annual meetings of the other AIME member societies, here are a few ways you can celebrate and connect during our anniversary year:

- Visit the TMS History Timeline online, where you can read about major milestones and view photos from our shared history.
- Download the digital AIME History Walk companion booklet.
- Keep reading JOM all year long for more articles celebrating the history of TMS.
- Explore the AIME Oral Histories, many of which feature prominent TMS members.

You can access all of these activities and more on the Our History page of the TMS website: www.tms.org/OurHistory

our Society, the professions, and the world—one thing remains the same. Those 22 engineers formed AIME for a single purpose: to gather. To collaborate. Connecting may look a lot different these days, but this purpose still drives us forward at TMS, AIME, and the three other member societies, the Association for Iron and Steel and welfare of those employed in these industries."¹ At that first meeting in Wilkes-Barre, members presented technical papers, visited local mines and metallurgical works, and established rules and requirements for membership and electing officers. These activities laid the groundwork for AIME to flourish and set the precedent for the way Pictured here is the Wyoming Valley Hotel, where AIME was founded at its first meeting in Wilkes-Barre, Pennsylvania. (Photo credit: AIME)

that TMS still functions today, as organizing professional meetings is a cornerstone of who we are as a Society.



Pictured here is Rossiter W. Raymond, a leader of the Institute who ensured excellence in the *AIME Transactions*, first published in 1873. (Photo credit: AIME)

Shortly after this initial gathering, AIME began a tradition of excellence that continues to this day through its member societies: the publication of technical papers. In 1873, the first volume of AIME Transactions was published, covering topics such as geology, metal mining, ore dressing, and nonferrous metallurgy. Under the 40-year leadership of Rossiter W. Raymond (a founding member, 1873-1875 President, and 27-year Secretary of AIME) the Transactions volumes acquired an esteemed reputation, known "not only for their excellent physical format and outstanding

editorial standards but for the superior quality of their content."² Though the frequency and formats may have transformed over the years, TMS currently publishes six technical journals, in addition to a number of conference proceedings, textbooks, studies, and other publications.

The Institute experienced exponential growth in its membership over the next decades, expanding its geographic reach, founding the Women's Auxiliary to AIME in 1917, and witnessing the diversification of engineering technologies and professions. In 1911, AIME recognized the need to establish local sections, starting with New York, Boston, and Spokane. This allowed for "more frequent meetings, enabling technical exchange and social contact for all members, no matter how remote their location."¹

These local sections paved the way for technical committees, beginning with the

formation of the Iron & Steel Committee in 1912, which laid the foundation for professional divisions. In 1918, AIME invited the American Institute of Metals (AIM) to combine organizations which created the Institute of Metals Division, AIME's first professional division. In light of this merger, the organization approved a name change to the American Institute of Mining and Metallurgical Engineers (keeping the abbreviation AIME) at its February 1919 Annual Meeting.

The next 30-odd years saw AIME continue to evolve, with the addition of new divisions, student and junior membership categories, awards and honors for professional excellence, new journals, and more meetings. After World



This plaque honors the merger of AIM, the American Institute of Metals, with AIME, creating the Institute of Metals Division. (Photo credit: AIME)



CELEBRATING OUR COMMON LEGACY: 150 YEARS OF AIME AND TMS

War II, members began to call for a reorganization of the Institute to more closely align with their interests and needs; Joe Alford noted in his *AIME Centennial Volume* that, "a viable organization cannot remain static, however, and the time came for AIME when the central Institute with various professional Divisions and Committees [were] no longer adequate to serve properly the diversity of technical interests of AIME members."¹

Responding to its members, the AIME Board formed a number of special committees to explore issues relating to greater autonomy for the divisions; publications; income, dues, and expenditures; and others. At first, it was decided to organize into three branches (Mining, Metals, and Petroleum) that would encompass the various existing divisions of the Institute. This, however, presented administrative issues which led to the creation of the Long-Range Planning Committee in 1955. After a thorough investigation, the AIME Board of Directors approved a number of the committee's recommendations at its February 24, 1957, meeting. The two most significant were:

- 1. Renaming the Institute the American Institute of Mining, Metallurgical, and Petroleum Engineers (again, keeping the AIME abbreviation)
- 2. Creating three Constituent Societies in place of the previously established branches:
 - The Society of Mining Engineers of AIME
 - The Metallurgical Society of AIME
 - The Society of Petroleum Engineers of AIME





What About JOM?

Along with the reorganization into three separate branches in the late 1940s, the AIME Board established new monthly magazines for each branch. In January 1949, the Metals Branch published its first issue of the *Journal of Metals*. Initially, papers from the Metals Branch of AIME were published in a separate section of the *Journal of Metals*, but in November 1957 the Board approved a change to this model. Papers from *Transactions* would be published bi-monthly as a new journal: *Transactions of the Metallurgical Society of AIME*. (A precursor to today's *Metallurgical and Materials Transactions family of journals.*) In January 1989, the *Journal of Metals* was renamed *JOM*.

The cover for the first issue of the *Journal of Metals*, published by the Metals Branch of AIME, featured pure ductile titanium rods.

Calva



John C. Kinnear Jr., 1957 President, The Metallurgical Society of AIME (Photo credit: AIME)

John C. Kinnear Jr. became the first President of The Metallurgical Society, having just served as the AIME Extractive Metallurgy Division Chair. In a July 1989 *JOM* member profile, Kinnear reflected on his term as president, during that crucial first year: "our first challenge was to establish order and direction. The next and biggest challenge was to establish some common interest and purpose which would be embraced by each of the Society's divisions. Finding funding for our publishing initiatives was a problem as well. Fortunately, we were able to manage these issues through useful exchange and cooperation."³

In 1974, a fourth Constituent Society, the Iron & Steel Society, was established as the AIME Board of Directors took action to "respond to the needs and wishes of its members as they change[d] with time."⁴

Over the next decade, there was another call within the Constituent Societies for even further autonomy from AIME in an effort to reflect the changing



needs and requirements of the professions and industries that the Societies served. In October 1983, the AIME Board approved a plan for decentralization, and at the 1984 Annual Meeting, the Board approved the separate incorporation of the Constituent Societies. The change was described in an issue of "TMS News" as follows: "By

What About the TMS Foundation?

In 1993, the TMS Board of Directors established the TMS Foundation "to engage the finest young minds in pursuit of the design, development, and applications of materials for sustainable global prosperity by stimulating the dynamic evolution of our educational and professional infrastructures." The first fundraising goals of the TMS Foundation centered around providing scholarships, leadership development programs, and education for students and young professionals. Over the years the Foundation has seen both peaks and valleys, undergoing a revitalization period beginning in 2013 to provide direction and re-establish a culture of giving within TMS.

Today, the TMS Foundation remains devoted to these original goals. It echoes the AIME commitment to developing the next generation of engineers and ensuring a legacy much larger than itself by supporting students and young professionals with meaningful financial assistance and impactful career-building experiences. Learn more about the TMS Foundation at www.TMSFoundation.org or by reading the May 2018 *JOM* article, "The History of the TMS Foundation."









CELEBRATING OUR COMMON LEGACY: 150 YEARS OF AIME AND TMS

becoming a separate legal body, TMS will not be severing ties with AIME. On the contrary, TMS will continue to support and sponsor AIME programs and activities. This support will be in recognition of the founding role that AIME has played in establishing TMS as a professional engineering society."⁵

This change established AIME as a Federation comprised of four Member Societies. AIME embraced its new role of supporting Board-level activities as defined by each of the Societies, ensuring its position as a leading engineering organization in the United States. Today, AIME builds on the important work of supporting its four Member Societies through facilitating information exchange and encouraging collaboration between the Societies and other engineering organizations.

Within TMS, separate incorporation presented new challenges, which were addressed by a new Long-Range



Planning Committee (LRPC) task force. Harold Paxton, 1982 TMS President and head of the LRPC task force, explained that, "The Society has not moved decisively to assume its role in materials technology and applications...For TMS to remain a central society in the materials field, it must reassess and restructure its strategic objectives according to changes now occurring in metallurgy and

materials."⁶ Among the LRPC's recommendations were to broaden the technical range of materials coverage through two major changes: a name change and a new mission statement. The TMS Board approved the changes, finally becoming The Minerals, Metals & Materials Society. The new mission statement read:

TMS is a leading professional society dedicated to the development and dissemination of the scientific and engineering knowledge base for materials-centered technology. The Society will maintain its interest in minerals and metals while extending its interests into materials and materials-centered technologies. The focus for the Society is on the science and engineering association with the economics, extraction, processing, and fabrication, and the relationships between the structure and properties of materials. TMS disseminates information through regional, national, and international meetings, through publications, and through continuing education programs.⁷

While our mission statement today ("The mission of TMS is to promote the global science and engineering professions concerned with minerals, metals, and materials.") has been simplified from its predecessor

In Their Own Words

While looking back at TMS's history with AIME, JOM asked two longtime leaders in the TMS community about their experiences with the Society. Here's what they told us:



Alex R. Scott 1973–2008 TMS Executive Director, 2008 AIME Presidential Citation Award Recipient

JOM: How did you first get involved in AIME or TMS? Scott: I got involved with AIME when I was hired in 1969 as the meetings manager to plan for its 100th Anniversary Annual Meeting in 1971 in New York City. JOM: What's one early and/or favorite memory associated with AIME or TMS?

Scott: Working with several member volunteer committees to plan the 100th Annual Meeting and learning of their commitment to AIME and the value of membership organizations.

JOM: What was the Society like when you first started your employment? What has changed or remained the same?

Scott: AIME in 1970 was a centralized organization with three of the Member Societies located in New York City with SPE in Dallas, and all four Member Societies had a technical program at the combined Annual Meeting. AIME embarked on its decentralization plan the year or so after, with the Societies moving out of New York City by 1978.
JOM: Is there anything else that you would like to add?
Scott: I think people need to know the great value organizations like AIME bring to the welfare of our country and the betterment of the professions it serves for all its individual members.





Shown here is the official ballot from the November 1987 *Journal of Metals* on which TMS members voted to change the Society's name and adopt a new mission statement, as approved by the Board of Directors in 1988.⁷

above, neither are that far off from the early goals of those 22 mining engineers. So much has changed in 150 years. Yet, TMS still organizes meetings, supports education, publishes journals, and encourages excellence within the minerals, metals, and materials professions.

So please, join TMS and *JOM* during our 150th anniversary year, as we journey through this truly shared history to learn, understand, and celebrate our common legacy.

End Notes

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In Their Own Words...



Rob Wagoner

1997 TMS President, 2003 AIME President, 2003 TMS Fellow, 2007 AIME Presidential Citation Award Recipient, Former Chair, TMS Foundation Board of Trustees

JOM: How did you first get involved in AIME or TMS? **Wagoner:** First in a student chapter at The Ohio State University as an undergraduate, but more importantly and long-lasting, as a venue for my first professional talk outside of the university, at a Fall or Annual Meeting around 1975 in Cincinnati. It was fantastic to meet the greats from our profession that I had only heard of before. Scared to death to present to them, but also highly exciting!

JOM: What's one early and/or favorite memory associated with AIME or TMS?

Wagoner: Too many to choose from! In the 1980s there were memorable meetings in New York and New Orleans, with lots of dancing and socializing with professionals and also with TMS staff. It is this informality within the TMS family that I think is its most valuable asset.

JOM: What has changed or remained the same about the Society since you first became a member? Wagoner: A gradual change that I applaud is the election of younger and more energetic board members and presidents. That made a great difference in the tone of the whole Society from the formal and staid to more casual and flexible. One big change: the student mixer. For some years it dragged, but it has become highly enjoyable and an annual draw.

JOM: Is there anything else that you would like to add?

Wagoner: In recent years, I have been involved in volunteer service and governance, which is very rewarding and fun on its own. But some of the best and most memorable experiences are as a member and attendee.



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Celebrating Over Five Decades of Technical Excellence in Light Metals Research

Alan Tomsett





Alan Tomsett

"The 7,300 papers that have been published since 1971 cover fundamental research on new and improved processes and products, through to practical applications of technology in industry." In 2021, we are celebrating the 50th birthday of the aluminum-related symposia at the TMS Annual Meeting & Exhibition and the associated proceedings—*Light Metals*. Since 1971, *Light Metals* has provided a repository for the combined knowledge of researchers and industry practitioners and today remains the pre-eminent reference work for the aluminum industry with a global reach for contributors and readers.

The concept of *Light Metals* was initiated in an AIME International Symposium on the Extractive Metallurgy of Aluminum held in New York in 1962. This symposium was notable for its high level of global industry participation. Many of the papers from the symposium (published in 1963) covered the fundamentals of the Hall-Héroult and Bayer processes and remain relevant today.

The Light Metals symposia and proceedings became a regular feature at the AIME-TMS Annual Meetings beginning in 1971. The symposia now cover all major technical areas related to aluminum bauxite and alumina, aluminum reduction, cast house technology, anode and cathode technology, aluminum processing, and aluminum alloy development. From the beginning, *Light Metals* has provided an important record of the research, development, and innovation in these technical areas.

Despite the many changes in the industry

over the past 50 years, the Light Metals symposia continue to attract 150–250 papers each year. The 7,300 papers that have been published since 1971 cover fundamental research on new and improved processes and products, through to practical applications of technology in industry. This broad range of topics attracts participation from both industry and academia. The global nature of the aluminum industry is reflected in the contributors and meeting attendees. Authors from over 60 countries have published their work in the book.

The early years of the symposia were a period of important technical development for the aluminum industry. Most of the major aluminum producers had their own research and development facilities and were willing to share technical developments. This set the scene for the strong industry participation in the Light Metals symposia which continues today. With the addition of the exhibition in 1987, the TMS Annual Meeting became the most important global gathering of aluminum industry representatives. In addition to the strong technical program, there continues to be countless technical and commercial meetings between attendees.

Despite the challenges of supporting an industry which perennially goes through tough financial times, the TMS Annual Meeting continues to provide opportunities for students and early-career engineers to present work and get feedback from global

"Our aim is to keep Light Metals relevant for the next 50 years and to maintain its position as **the** place to publish and present aluminum technology developments." experts. It also allows attendees to develop long-standing professional relationships through discussions at the author coffees, exhibition, and social activities, as well as in the technical sessions. (Editor's Note: See the sidebar, "Experiences from Annual Meetings and *Light Metals* Publications from an Early Career Professional," for a TMS Young Leader perspective.)

The symposia are sponsored by the TMS Aluminum Committee and the Light Metals Division (LMD). To maintain broad relevance, the role of *Light Metals* editor is rotated through each technical area, with a strong focus on industry experience. The 1962 meeting was organized by industry representatives from Kaiser Aluminum (Gary Gerard) and Alcoa (Phillip Stroup). In the last 50 years, over 80% of the editors have been employed industry participants.

The ongoing importance of *Light Metals* as a reference series has been further enhanced by the availability of the *Essential Reading in Light Metals* compilation of the best papers published in *Light Metals* between 1963 and 2011, and also the Light Metals Digital Library, an online collection of over 5,200 *Light Metals* papers published between 1971 and 2010. Over 50,000 individual papers from the *Essential Readings* compilation have been downloaded in the last five years.

The Aluminum Committee is continuing to support the Light Metals symposia at the TMS Annual Meeting & Exhibition and providing training opportunities for new and experienced technolgists through regular professional development courses. We are also sponsoring an additional paper covering more details of the history of Light Metals from some of our longterm attendees, as well as providing recommendations on how Light Metals can continue to evolve and add value to future technologists. Look out for this article in a future issue of JOM later this year. Our aim is to keep Light Metals relevant for the next 50 years and to maintain its position as the place to publish and present aluminum technology developments.

Alan Tomsett is technical manager at Rio Tinto Pacific Operations. He is the current TMS Aluminum Committee Chair and editor of Light Metals 2020 and Essential Readings in Light Metals, Volume 4, Electrode Technology for Aluminum Production.

TMS Inaugurates Annual Exhibition

During the Annual Meeting in Denver, the first TMS Exhibition premiered in grand opening style. Before the official kick off, crowds patiently gathered outside the Denver Convention Complex while exhibitors made their final preparations and waited for the doors to open. As the starting time arrived, curious attendees were invited in to partake of the cocktail reception which ran concurrently with the exhibition opening.

As the latest addition to the society's

Annual Meeting forum, the exhibition was deemed a success by both the organizers and participants alike. Cosponsored by the Society of Mining Engineers, the exhibition hosted over 130 display booths and more than 115 participating organizations. Reflecting the global nature of the modern metals and materials fields, exhibitors included companies from throughout the U.S., Canada, and several European nations.

Designed to complement the meet-

ing's technical programming, the exhibition offered a broad spectrum of displays related to minerals, metals and materials technologies. Visitors devoted hours to exploring the vast array of products and services—from handson trials with interactive software to updates on innovative advances in applied technology. Other displays included operational equipment models and systems; publications and reference information on mining, metallurgy and materials science; various software packages

A May 1987 *JOM* News article announces the introduction of the successful annual exhibition, held at the TMS 1987 Annual Meeting in Denver, Colorado.



Celebrating Over Five Decades of Technical Excellence in Light Metals Research

Experiences from Annual Meetings and *Light Metals* Publications from an Early Career Professional

Julien Lauzon-Gauthier

This personal reflection is intended to share how the TMS Annual Meeting & Exhibition, the *Light Metals* publications, and *JOM* have impacted my career so far. I would like to discuss two aspects: the technical knowledge available and professional development activities. But first, how did it all start for me?

When I started my master's degree in 2009 with the team at Université Laval involved in the R&D partnership with Alcoa,¹ the most prestigious international event that a student could attend in our field of research was the TMS Annual Meeting & Exhibition. This is where the industrial and other academic players would meet to present some of their most recent work. I got the opportunity to attend my first annual meeting in 2011 to present the results from my M.Sc. project, and again in 2013 and 2014 to present other results from my graduate studies work.

The *Light Metals* publications were very important early on in my academic journey. No less than 24 *Light Metals* references appear in my M.Sc. thesis and 20 in my Ph.D. thesis. *JOM* and other TMS journals were also important; they were my main source of information on the anode manufacturing process and quality parameters. Later, TMS journals became a good place for me to publish my own work. So far, I have been able to publish three conference articles, with another one accepted for *Light Metals 2021*, as well as two *JOM* articles as first author. I have also collaborated on three other *Light Metals* publications.



Julien Lauzon-Gauthier (left) receives the LMD Young Leaders Professional Development Award at the TMS 2020 Annual Meeting & Exhibition from LMD Chair Eric Nyberg. I realize now that attending annual meetings during my graduate studies provided a lot of exposure for my work, but most importantly for myself. It was a good way to connect with the technical people from Alcoa and other companies while I was still a graduate student. It contributed in building my confidence and presentation skills, as well as my English language proficiency which is now important for my work, as French is my native language. However, at that time, I was not aware of all the activities and committees sponsored by TMS except for the annual meetings and technical publications.

This academic period was followed by the opportunity to start my career with Alcoa in different process engineering roles at different smelters in Canada, where my focus was on daily process optimization. At the end of 2018, I changed roles within Alcoa and joined the Center of Excellence's Technology Development Group as a research engineer, which led to my first TMS Annual Meeting participation as a professional in 2019. Around this time, I was made aware of the TMS Young Leaders Professional Development Award. Receiving this award not only gave me the opportunity to attend TMS2020, but more importantly, gave me good insight into all the TMS activities that I had never been aware of before. This was a lot to explore in one short event, but it was a great experience. It is still early to measure the impact of this award on my personal and professional development, but I see it as a recognition of my efforts to participate in the technical development of the aluminium sector.

From now on, I plan to get involved in committees and technical sessions when I can. I also hope that I will be able to continue contributing to the technical knowledge base through TMS's publications. I have already started with TMS2021 Virtual as a session chair to help organize and review the technical papers for the Electrode Technology for Aluminum Production sessions.

TMS events and publications have allowed me to share my work in *JOM* and the *Light Metals* proceedings. Attending the annual meetings has also allowed me to interact with other researchers, colleagues, and suppliers that helped to broaden my knowledge and my network. I realize now that this is very valuable in my role as a research engineer and it will also help me in my professional development in the future.

End Note

 J. Tessier, J. Lauzon-Gauthier, M. Fafard, H. Alamdari, C. Duchesne, and L. Gosselin, "10 Years of Anode Research and Development: Alcoa and Universite Laval Experience," *Light Metals 2020*, (2020).

Julien Lauzon-Gauthier currently works at Alcoa Corporation, Continuous Improvement Smelting Technology. He is the 2020 recipient of the TMS Light Metals Division Young Leaders Professional Development Award.





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TMS meeting headlines

Meeting dates and locations are current as of January 13, 2021. For the most up-to-date list of TMS-sponsored events, visit www.tms.org/Meetings.

Other Meetings of Note

European Metallurgical Conference (EMC 2021) June 27–30, 2021 Salzburg, Austria

5th International Congress on 3D Materials Science (3DMS 2021) June 29–July 2, 2021 Washington, D.C., USA

13th International Conference on the Technology of Plasticity (ICTP 2021) July 25–30, 2021 Columbus, Ohio, USA

14th International Symposium on Superalloys (Superalloys 2021) September 12–16, 2021 Seven Springs, Pennsylvania, USA

Liquid Metal Processing & Casting Conference (LMPC 2021) September 19–22, 2021 Philadelphia, Pennsylvania

Philadelphia, Pennsylvania, USA

Materials in Nuclear Energy Systems (MiNES 2021) September 19–23, 2021 Pittsburgh, Pennsylvania, USA

TMS 2022 Annual Meeting & Exhibition (TMS2022) February 27–March 3, 2022 Anaheim, California, USA

Additive Manufacturing Benchmarks 2022 (AM-Bench 2022) August 15–18, 2022 Bethesda, Maryland, USA For the most up-to-date list of TMS-spons TMS 2021 150th Annual Meeting & Exhibition March 15–18, 2021 Virtual Event Register Today!

www.tms.org/TMS2021

• Experience the TMS Annual Meeting & Exhibition virtually! Registration is still open for TMS2021 Virtual, and comes with access to recorded presentations through May 31, 2021.



June 15–18, 2021 Virtual Event

Discount Registration Deadline: April 30, 2021 www.tms.org/Mg2021

• The 12th International Conference on Magnesium Alloys and their Applications (Mg 2021) is a fully virtual event. The conference will cover the breadth of magnesium research and development, from primary production to applications to end-of-life management.



October 17–21, 2021 Columbus, Ohio, USA Share Your Work!

 www.matscitech.org/MST21
 Abstracts for Materials Science & Technology 2021 (MS&T21) are being accepted now on topics including, but not limited to, additive manufacturing, artificial intelligence, ceramic and glass materials, iron and steel, nanomaterials, processing and manufacturing, and more. See the full list of topics and symposia and submit your work today.



November 14–18, 2021 Hyatt Regency Lake Tahoe Lake Tahoe, Nevada, USA New Abstract Submission Deadline: April 16, 2021 www.tms.org/ICME2021

- Date change! The 6th World Congress on Integrated Computational Materials Engineering (ICME 2021) has been rescheduled to November 14–18, 2021. A call for abstracts has reopened—visit the congress website for technical program details.
- ICME 2021 is the only congress dedicated to bringing all stakeholders together from across nations, disciplines, and organizations to focus on integration priorities and gaps that need to be addressed in order to advance the field.
- Enjoy the best rates by booking a room now at the Hyatt Regency Lake Tahoe.



December 5–8, 2021 Hilton Charlotte University Place Charlotte, North Carolina, USA Abstract Submission Deadline: April 16, 2021 www.tms.org/HEA2021

- The 2nd World Congress on High Entropy Alloys (HEA 2021) will feature highly focused technical talks on topics that include, but are not limited to, fundamental theory of alloy design, computational modeling and simulation, properties, processing, and applications of high entropy alloys.
- Abstracts are being accepted now. Visit the HEA 2021 website for information and to share your work today.



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call for papers

JOM is seeking contributions on the following topics for 2021. For the full Editorial Calendar, along with author instructions, visit www.tms.org/EditorialCalendar.



September 2021 Manuscript Deadline: April 1, 2021

Topic: Computational Modeling in Pyrometallurgy Scope: Pyrometallurgical furnace operations are typically very complex in nature and may involve tightly coupled interactions between phenomena from heat transfer, fluid flow, electromagnetics, thermochemistry, phase change, granular media, and more. Exacerbating the difficulties in understanding such phenomena are the extraordinary challenges inherent in performing measurements on pyrometallurgical processes (e.g., extreme conditions limit direct measurements). This topic will aim to cover a variety of contemporary applications of computational modeling in pyrometallurgical science and engineering.

Editors: Quinn Reynolds and M. Akbar Rhamdhani **Sponsor:** Pyrometallurgy Committee

Topic: Recovery, Sorting, and Processing of Secondary Aluminum

Scope: This topic covers recycling of aluminum and its alloys, with a specific focus on managing recovery, sorting, and processing for secondary aluminum production. This may include advances in sorting technologies, pre-treatment steps, and various re-melting techniques together with, or in addition to, recovery of by-products from these techniques. Also, holistic approaches for secondary aluminum production are welcomed. **Editor:** Anne Kvithyld

Sponsors: Aluminum Committee and Recycling and Environmental Technologies Committee

October 2021 Manuscript Deadline: May 1, 2021 Topic: Corrosion in Heavy Liquid Metals for Energy Systems

Scope: This topic invites papers on studies related to heavy liquid metal (HLM) such as Pb and lead bismuth eutectic compatibility with structural materials including corrosion and liquid metal embrittlement. In addition, technological aspects of HLM technology including chemistry control methods, filtering, in-situ characterization techniques, forced and natural convection methods, and flow measurements are also included in this topic.

Editors: Osman Anderoglu, Alessandro Marino, and Peter Hosemann

Sponsors: Corrosion and Environmental Effects Committee and Nuclear Materials Committee

Topic: Informatics-Enabled Design of Structural Materials

Scope: Informatics-enabled design is a paradigm shift for materials engineering, and has led to many breakthroughs within the last decade. For structural materials, an array of challenges persist due to the need for quantitative evaluation of competing performance metrics across many time and length-scales. This special topic aims at capturing the needs and limitations of informatics toolsets for design of structural materials. We invite articles that highlight recent advances and set the scope for future. **Editors:** Jennifer L.W. Carter and Amit K. Verma **Sponsor:** Mechanical Behavior of Materials Committee

Topic: Materials for Small Nuclear Reactors and Micro Reactors, including Space Reactors

Scope: Small nuclear reactors, including micro-reactors, small modular reactors, space reactors, and off-grid reactors rely on different materials and manufacturing processes than those in large-scale power plants: molten salts as coolants and fuels, heat-pipes for heat removal, metal hydrides as high-temperature moderators, fuels for higher burnup and accident tolerance, etc. They also require novel structural materials and understanding of material interactions. This special topic focuses on materials research and experimental and modeling/ simulation for small nuclear reactors. Editors: Sven C. Vogel, Raluca O. Scarlat, Aditya P. Shivprasad, and Marisa Monreal Sponsor: Nuclear Materials Committee

November 2021 Manuscript Deadline: June 1, 2021

Topic: Advanced High-Strength Steels

Scope: Advanced high-strength steels (AHSS) have been widely used in commercial vehicles for decades. New AHSS are being actively researched in academia and industry. This special topic focuses on the latest developments in AHSS, including high-strength lowalloy (HSLA), dual-phase (DP), transformation-induced plasticity (TRIP), complex phase (CP), martensitic, quenched & partitioned (Q&P), medium manganese, TRIPassisted bainitic ferrite (TBF), press-hardened steel (PHS), twinning-induced plasticity (TWIP), and low density steels. **Editors:** M.X. Huang and Ana Araujo **Sponsor:** Steels Committee

Topic: Advances in Multi-modal Characterization of Structural Materials

Scope: Progress in the development of instrumentation and workflows that enable the collection of various data modalities have provided novel insights into material behavior. This special topic will focus on the application of varied characterization approaches in both 2D and 3D, across multiple length scales and/or imaging modalities, for structural materials. Papers that focus on the development and application of advanced segmentation and data fusion approaches for quantitative data analysis are also invited. **Editors:** Andrew T. Polonsky and Amit Pandey **Sponsor:** Advanced Characterization, Testing, and Simulation Committee

Topic: Latest Developments in Manufacturing and Recycling of Refractory Materials

Scope: Renowned for their unique properties, refractory materials have widespread applications in electronic, nuclear, and defense industries. Although powder metallurgy is still the only route for major commercial production, manufacturing and recycling technologies have made great strides in processing of refractory materials. The focus of this special topic includes recent advances in overcoming process challenges or improving material performances. Manuscripts covering the latest experimental and theoretical studies especially focusing on recycling of refractory metals are invited.

Editors: Chai Ren and Ravi Enneti **Sponsor:** Refractory Metals and Materials Committee

Topic: Silicon Technologies

Scope: This topic covers silicon production from quartz and carbon to the most important feedstock for crystalline solar cells. Characterization of singlecrystalline silicon, silicon defects, and behavior of impurities are included, as well as the use of silicon as a storage material, and use of silicon melt to store and generate energy. Recycling of silicon compounds, solar cells, electronic components, and life-cycle of siliconrelated technologies are also covered. **Editors:** Shadia Ikhmayies

Sponsors: Recycling and Environmental Technologies Committee and Materials Characterization Committee

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