JOM

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An official publication of The Minerals, Metals & Materials Society

A FIRST IN 150 YEARS: HIGHLIGHTS FROM A HISTORIC MEETING

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Pandat Software

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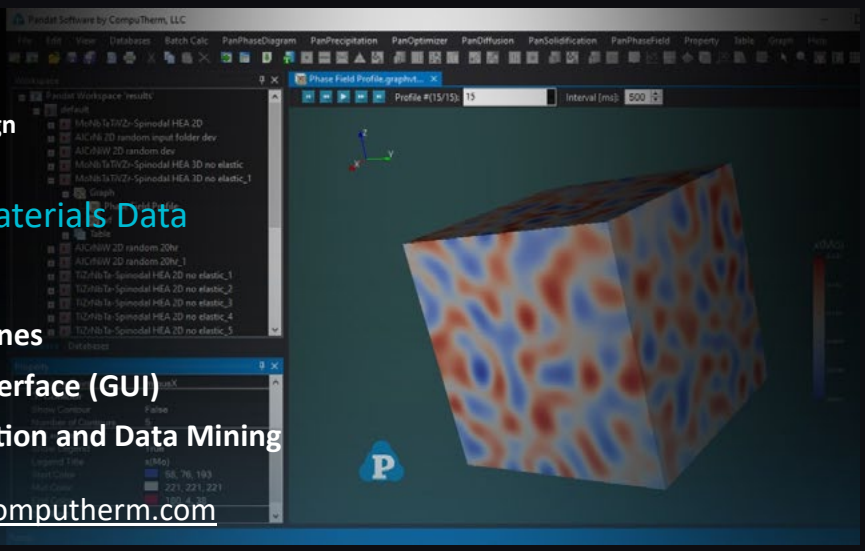

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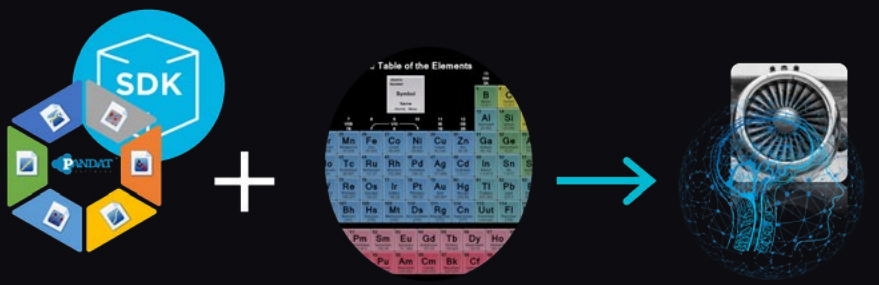

Pandat Software + PanDatabases → ICME & MGI Applications

- Al – based alloys
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- Cu – based alloys
- Fe – based alloys
- Mg – based alloys
- Ni – based alloys
- Ti – based alloys
- TiAl – based alloys
- Refractory alloys
- High-entropy alloys
- More…

Pandat Software Modules

Pandat Software adopts modular design and enables users to easily switch between modules and perform various types of simulations in the same workspace.

PanPhaseDiagram

- stable and meta-stable diagrams
- property contour diagrams
- thermodynamic properties
- chemical driving force

PanPrecipitation

- concurrent nucle-ation, growth and coarsening
- particle size and size distribution
- multi-phase co-precipitation

PanDiffusion

- diffusion couple
- homogenization
- carburization and decarburization
- particle dissolu-tion

PanSolidification

- solidification path
- back-diffusion in the solid
- dendrite arm coarsening
- micro-segregation

PanPhaseField

- direct coupling with CALPHAD
- feasible for multi-component alloys
- open architecture for user's model plugin

JOM

5700 Corporate Drive
Suite 750
Pittsburgh, PA 15237
USA

Phone: 1-724-776-9000
Web: jom.tms.org
E-Mail: membership@tms.org

Publisher for TMS
James J. Robinson,
Executive Director

Operations Management
Matt Baker,
Department Head, Content

JOM: The Journal
Justin Scott,
Principal Editor; Department Head, Research, Engagement, Data, and Information

Maureen Byko,
Editor

Kelly Markel,
Publications Coordinator

JOM: The Magazine
Lynne Robinson,
Department Head, Strategic Communications and Outreach

Kaitlin Calva,
Magazine Managing Editor

Cheryl M. Geier,
Senior Graphic Designer

Contributing Writers
Ashley-Anne Bohnert,
Outreach and External Communications Lead

Megan Enright,
Promotions and Editorial Assistant

Ann Ritchie,
Technical Communications Specialist

Kelly Zappas,
Membership News and Communications Lead

Graphics Support
David Rasel,
Media Manager

Bob Demmler,
Graphic Designer

Advertising
Contact sales@tms.org
for information.

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About the Cover

The cover image for this issue depicts a collage of screenshots taken from technical presentations, networking events, and awards ceremonies held during the TMS 2021 Virtual Annual Meeting & Exhibition (TMS2021 Virtual), held March 15-18, 2021. Three articles in this issue present just some of the many highlights of this historic meeting—the first fully virtual installment of the TMS annual meeting and the 150th anniversary meeting of TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), TMS's parent organization.

June 2021 Guest Editors

100 Years of the Griffith Fracture Criteria
Nanomechanical Materials Behavior; Mechanical Behavior of Materials Committee
Megan Cordill, Erich Schmid Institute of Materials Science
Jennifer Carter, Case Western Reserve University

Advances in Process Metallurgy
Hydrometallurgy and Electrometallurgy Committee
Hong (Marco) Peng, University of Queensland
Kerstin Forsberg, KTH Royal Institute of Technology

Multiscale Experiments and Modeling in Biomaterials and Biological Materials
Biomaterials Committee
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Dinesh Katti, North Dakota State University
Hendrik Heinz, University of Colorado Boulder

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Titanium Committee
Rongpei Shi, Lawrence Livermore National Laboratory
Michael Gram, Titanium Metals Corporation
Yufeng Zheng, University of Nevada-Reno

Pyrometallurgical Processing of Secondary Resources
Pyrometallurgy Committee
M Akbar Rhamdhani, Swinburne University of Technology
Stuart Nicol, Glencore Technology

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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in the final analysis

JOM
Volume 73
Number 6
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"When I'm on the couch, I usually have the TV on and my MacBook Air nearby. And sometimes, when my ADD is really kicking in, I have my iPad too. And my iPhone. And a magazine that I haven't gotten to. And a book under the pillow to my left."

— Aubrey Plaza

James J. Robinson
Executive Director
@JJRofTMS

Print or digital, we love to read, but the way that we read has changed a lot over the 37 years since I was hired by TMS to work on the *Journal of Metals.* A lot about *JOM* has changed as well . . . we had a name change, we migrated from analog to digital production, we designed a content-rich website for the journal and then modernized, re-modernized, and re-modernized that site, we ceased in-house publishing and partnered with Springer to put every issue of *JOM* within a few-clicks of every corner of the planet, and we went from monthly mailings of issues with an average of 72 pages to issues with an average of a few hundred pages. *JOM* has gone from a feature-rich newsstand magazine format to a predominantly scholarly journal format. This shift of focus over time is partially attributable to our partnership with Springer, to the growing necessity in the professional community to publish, to the hard work of countless volunteer editorial advisors to grow quality, and to the efforts of a seasoned staff editorial team.

JOM has evolved into a very desirable journal in which to publish. It brings both prestige and revenue to TMS, but I grant that the heavy shift to a focus on technical papers means that *JOM* may not have as much flavor, eccentricity, engageability, or je ne sais quoi as it used to. Volunteer leadership and staff see an opportunity to continue *JOM's* evolution. So, starting with next month's July 2021 issue, we will begin a six-month transition in publishing formats designed to help us retain the benefits of the current publication while providing members a "touch of TMS" via a revamped publication format and delivery model. We believe that members will find the changes both practical and engaging. There are two "scoops" to this story.

Scoop One: As of next month's issue, we are no longer printing and mailing copies of *JOM* as a member benefit. Wow! That sounds like big news, but it is not. Really. Only about 23% of TMS members eligible to have *JOM* mailed to them are actually receiving print copies. The great majority of members are "opting out" of receiving the print mailing with the vast majority of accesses to *JOM* being either through SpringerLink access or through the TMS website. Why the diminishing interest in print? Lots of reasons, notably we are becoming a community of e-readers and downloaders. Compound that with *JOM's* tendency to land in mailboxes with the heft and subtlety of a cement block. The average issue has about 40 technical papers. Printing and mailing these issues is neither reader nor carbon friendly. Objectively, papers are available earlier online than in print, are searchable as PDFs, and are easy to find via the SpringerLink search box. Subjectively, hundreds of pages of technical papers also mean that the 40 or so pages of compelling TMS member news and features contained within the "Magazine" section are easy to overlook. So, . . .

Scoop Two: While the full *JOM* (the "Magazine" and the "Journal") will continue to be presented in its monthly entirety on SpringerLink, in January 2022 we will start print delivery to all professional members of *JOM*: The Magazine. This excerpt from the larger journal will continue to showcase Society news, activities, and members while providing features on how materials are advancing and improving our world. I believe that TMS members will find the *JOM*: The Magazine mailing to be properly sized and engagingly crafted. Most importantly, it will help keep members connected and involved with our unique TMS membership network and culture. We are much more than a series of impact factors and transactions.

Is printing and mailing *JOM*: The Magazine a retro move? I don't think so. I sense that actress Aubrey Plaza has it right by characterizing herself, and us by extension, as media omnivores. There's a place for *JOM* on the couch via your tablet, your laptop, your phone, and as a magazine sitting on your cushion waiting to be opened. There is no favored solution, only every solution.

"Volunteer leadership and staff see an opportunity to continue JOM's *evolution. So, starting with next month's July 2021 issue, we will begin . . . "*

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Material Advantage Member Receives Georgia Tech Honors; Discover Member Benefits from TMS; Welcome New Members

Lily Tursaski Awarded Engineering Cup from Georgia Tech

Lily Turaski

Material Advantage member Lily Turaski, a senior at the Georgia Institute of Technology (Georgia Tech), was awarded the Davidson Family Tau Beta Pi Senior Engineering Cup, the highest honor bestowed by Georgia Tech's College of Engineering. The Cup, which recognizes academic excellence, leadership, and service, is supported by the family of Narl Davidson, past associate dean at the College of Engineering, and Tau Beta Pi, a national honor society for engineers.

At Georgia Tech, Turaski is a Stamps President's Scholar and received the 2019 Goldwater Scholarship. She created two student groups at Georgia Tech, Women in Materials Science and Engineering (MSE) and MSE Peer Partners Organization, and further participates in various outreach programs and activities to get local K–12 students interested in science, technology, engineering, and math (STEM). Upon graduating, Turaski will begin her Ph.D. in materials science engineering at Stanford University, with funding by a fellowship from the National Science Foundation.

Turaski has been a member of Material Advantage since 2017, recently serving as her chapter's vice president. In 2021, she received the TMS Functional Materials Division Gilbert Chin Scholarship as well as first place in the TMS Best Paper Contest – Undergraduate.

Explore Your Member Benefits

Your TMS membership is a great way to stay connected—with your colleagues around the world, with the latest developments in your field, and with topics of current interest to your community. Log in to members.tms.org and spend a few minutes testing out a member benefit you have not tried before, such as:

- **Membership Directory:** There are plenty of TMS members you've never met—find ones who share your technical interest and introduce yourself.
- **Webinar Library:** Sign up for a live, upcoming webinar or view past offerings at your leisure—all free to members.
- **Journals:** As a TMS member, you have electronic access to more than 20 technical journals from TMS and our publishing partner Springer. Log in to start reading.
- **Online Libraries:** Explore more than 4,500 technical articles and documents through the TMS Member Library, the AIME Digital Library, and the Superalloys Conference series archive.

Members can access any of these resources by logging in to the Access Member Benefits section of the TMS website at members.tms.org. While there, remember to update your member profile with any changes to contact information or technical interests.

Just for Students

If you are about to graduate or have graduated in the last year, take advantage of the TMS Recent Graduate membership program. Designed to make TMS membership affordable during the early years of your career, one year of professional membership after graduation is free. For the second and third years after graduation, the cost of membership is just $60, half the cost of professional member dues. To apply, fill out the recent graduate membership form found on the Recent Graduate link at **www.tms.org/Membership**. Forms can be returned to **members@tms.org**.

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.

Make a Commitment to Safety in June

Did you know that June is National Safety Month, as dedicated by the U.S. National Safety Council? Make a plan to attend the first Congress on Safety in Engineering and Industry (Safety Congress 2021) in honor of this month-long awareness event. Safety Congress 2021 is scheduled for November 1–3, in Fort Worth, Texas. Advance registration rates are available through September 20.

Geared toward leaders, managers, and safety professionals seeking to expand their skill sets and gain cutting-edge knowledge, attendees will learn best practices through dozens of experts, five plenary sessions, and 18 interactive breakout sessions. The program will cover areas such as: Operational, Process, and Project Safety; Safety Management; System Design and Implementation; Effective Use of Data Metrics; and more.

"I believe that a challenge for most industries and companies may be how to effectively learn from the past," said Roland Moreau, program chair for Safety Congress 2021, in a January 2020 *JOM* preview article about the meeting. "I am hoping that this event will allow participants to equally share successes and challenges with the objective of everyone collaborating and partnering to make the work environment safer, including at the university level."

Additionally, two professional development offerings are planned for October 31—Process Safety in Engineering and Industry Course and Certified Mine Safety Professional (CMSP) Examination. Learn more about these programs and register today at www.safetycongress.org.

Safety Congress 2021 is the first combined effort of eight professional societies and the National Academies to collaborate on safety successes and challenges. The United Engineering Foundation, the McElhattan Foundation, and the National Academies' Gulf Research Program have also provided support for the event.

TMS Welcomes New Members

The TMS Board of Directors approved professional membership for the following individuals at its March 2021 meeting. Please join us in congratulating and welcoming them to all the privileges and benefits of TMS membership.

Abu-Zahra, Nidal H.; University of Wisconsin-Milwaukee, United States

Adams, Thomas; Naval Surface Warfare Center, United States

Ajantiwalay, Tanvi; United States

Alarifi, Ibrahim M.; Majmaah University, Saudi Arabia

Ali, Yahia; University of Queensland, Australia

Bair, Jacob; Oklahoma State University, United States

Balachandran, Anusha; United States

Balazsi, Katalin; Hungarian Academy of Sciences, Hungary

Balila, Nagamani Jaya; Max Planck Institut für Eisenforschung, India

Bao, Sarina; SINTEF Materials & Chemistry, Norway

Bartles, Dean L.; Manufacturing Technology Deployment Group, United States

Bates, Jeffrey S.; University of Utah, United States

Belen-Cordero, Daphne S.; Naval Nuclear Laboratory, United States

Bolen, Janice; Hatch Ltd., Canada

Bruns, Edward; United States

Burciaga-Diaz, Oswaldo; Instituto Tecnológico de Saltillo, Mexico

Burke, Michael; Electric Power Research Institute, United States

Campbell, Jeff; Materion, United States

Carden, Sean; Vesuvius, United Kingdom

Chava, Venkata S.N.; United States

Chen, Jiang; Australian National University, Australia

Choi, Jungwoo; Samsung Electronics, South Korea

Choi, Sungyeol; KAIST, South Korea

Colligan, Grant T.; United States

Coudert, Lucie; Universite du Quebec en Abitibi-Temiscamingue, Canada

Dandekar, Yogesh; Cummins College of Engineering for Women Nagpur, India

Davis, Robert F.; Carnegie Mellon University, United States

De Luca, Anthony; EMPA, Switzerland

Dechent, Matthias; Trimet Aluminium SE, Germany

Dietrich, Rob; United States

Dion-Martin, Olivier; Dynamic Concept, Canada

Dou, Zhihe; Northeastern University, China

Durandet, Yvonne C.; Swinburne University of Technology, Australia

Ekstroem, Kai Erik; Norwegian University of Science and Technology, Norway

Elmustafa, Abdelmageed A.; Old Dominion University, United States

Etter, Thomas; Lincotek, Switzerland

Ferreira Cardoso, Alice; SENAI Innovation Institute for Mineral Technologies, Brazil

Field, Daniel; CCDC Army Research Laboratory, United States

Franco, Thiago; Companhia Brasileira de Alumínio (CBA), Brazil

Fulton, Lisa; United States

Garrett, Lee; United States

Geng, Xiaoxiao; University of Science and Technology Beijing, China

Gevaudan, Juan Pablo; Pennsylvania State University, United States

Glodowski, Robert J.; RJG Metallurgical LLC, United States

Glover, Alexandra; Los Alamos National Laboratory, United States

Gordon, Jerard; University of Michigan, United States

Goswami, Arindom; United States

Greytak, Andrew B.; University of South Carolina, United States

Gu, Wendy; Stanford University, United States

Haselhuhn, Amberlee; General Motors R&D, United States

Hayamizu, Yuhei; Tokyo Institute of Technology, Japan

Holanda, Roseanne Barata; SENAI Innovation Institute for Mineral Technologies, Brazil

Holland, Sharniece; Washington University in St. Louis, United States

Hong, Jae-Keun; Korea Institute of Materials Science, South Korea

Huxel, Justin; United States

Jacobs, Taylor Roth; Los Alamos National Laboratory, United States

Jain, Nupur; Brown University, United States

Jha, Rajesh; India

Jiang, Quanxin; Delft University of Technology, Netherlands

Kaczmarek, Peter; NSWC Carderock, United States

Kang, Pilgyu; George Mason University, United States

Kelley, Matthew L.; University of South Carolina, United States

Khan, Zuhair; National University of Science & Technology, Pakistan

Khanikar, Prasenjit; Indian Institute of Technology Guwahati, India

Kim, Hyosim; Los Alamos National Laboratory, United States

Kim, Jai-woh; U.S. Department of Energy, United States

Kojima, Takayuki; Shinshu University

Krutz, Nicholas; GE Aviation, United States

Kumar, Anil; Los Alamos National Laboratory, United States

Labukas, Jospeh P.; U.S. Army Research Laboratory, United States

LaLonde, Aaron D.; U.S. Army Combat Capabilities Development Command, United States

Lam, Stephen; University of Massachusetts Lowell, United States

Laurencin, Cato T.; University of Connecticut, United States

Le Beau, Stephen E.; nanoMAG LLC, United States

Lee, Keunho; Agency for Defense Development, South Korea

Lee, Kyungtae; United States

Li, Longfei; University of Science and Technology Beijing, China

Li, Ling; Virginia Polytechnic Institute and State University, United States

Li, Maxwell P.; Carnegie Mellon University, United States

Li, Meimei; Argonne National Laboratory, United States

Lindvall, Mikael; AFRY, Sweden

Litrel, Joseph; General Dynamics Electric Boat, United States

Long, Alexander; Los Alamos National Securities, United States

Lopez Anton, Ricardo; Universidad de Castilla-La Mancha, Spain

LoVecchio, Paul; United States

Lu, Shenglu; RMIT University, Australia

Lv, Chao; Northeastern University, China

Ma, Guang; Global Energy Internet Research Institute Co. Ltd., China

Ma, Jie; Shanghai Jiao Tong University, China

Maddalena, Roger; Thermo Fisher Scientific, United States

Magalhaes Pereira Silva, Patricia F.; SENAI Innovation Institute for Mineral Technology, Brazil

Mahdi, Mahdi; Hatch Ltd., Canada

Marin-Alvarado, Tanai L.; XPS, Canada

Mathew, James; WMG, University of Warwick, United Kingdom

McCarley, Joshua; Illinois Institute of Technology, United States

McDonald, Stuart; University of Queensland, Australia

McDonnell, Martin M.; U.S. Army-TARDEC, United States

McKellar, Michael; University of Idaho, United States

Melia, Michael A.; Sandia National Laboratories, United States

Menon, Nalini C.; Sandia National Laboratories, United States

Metcalfe, Darryl; Hatch Ltd., United States

Milovanov, Mikhail; Australia

Moran, Peter D.; Michigan Technological University, United States

Mostaghel, Sina; SNC-Lavalin, Canada

Nakajima, Hideo; Osaka University, Japan

Nell, Johannes; Tronox, United States

Nienaber, Maria; Helmholtz-Zentrum Geesthacht, Germany

Niu, Xinrui; City University of Hong Kong, Hong Kong

Nolet, Isabelle; Hatch Ltd., South Africa

Nomoto, Akiyoshi; Central Research Institute of Electric Power Industry, Japan

Nowell, Matthew M.; TexSem Laboratories Inc., United States

Okur, Serdal; Structured Materials Industries Inc., United States

Ouyang, Bin; United States

Pambianchi, Michael Scott; Industrion, United States

Panetta, Paul; Applied Research Associates, United States

Pascucci, Marina R.; CeraNova Corporation, United States

Patki, Priyam; University of Michigan, United States

Peters, David; United States

Phanikumar, Gandham; Indian Institute of Technology Madras, India

Pikul, James H.; University of Pennsylvania, United States

Pol, Vilas; Purdue University, United States

Poulin, Eric; Laval University, Canada

Remy, Guillaume; University of Warwick, United Kingdom

Rezaei, Seyed Emad; University of Virginia, United States

Rheinheimer, Wolfgang; Julich Research Center, Germany

Rojas, Jessika V.; Virginia Commonwealth University, United States

Russell, Richard W.; NASA Kennedy Space Center, United States

Sagapuram, Dinakar; Texas A&M University, United States

Salloum, Maher; Sandia National Laboratories, United States

Sanders, John W.; California State University Fullerton, United States

Sapochak, Linda S.; National Science Foundation, United States

Sayer, Aaron B.; Materion Brush Beryllium and Composites, United States

Schultz, Bradley M.; TE Connectivity, United States

Secord, Mick; Polyonics Inc., United States

Serafeim, Alexandros; RWTH, Germany

Shigeyama, Haruhisa; Central Research Institute of Electric Power Industry, Japan

Singh, Sudhanshu Shekhar; Indian Institute of Technology Kanpur, India

Singh Gaur, Raj Pal; SH Chemicals, United States

Slater, J.E.; United States

Smith, Timothy; NASA Glenn Research Center, United States

So, Lily Lai Chi; Hatch Ltd., Canada

Sokalski, Vincent M.; Carnegie Mellon University, United States

Solis-Ramos, Euripides; United States

Sundqvist, Olle; Sandvik Materials Technology, Sweden

Taller, Stephen; United States

Tompa, Gary S.; Structured Materials Industries Inc., United States

Ukeje, Chukwudike Chukwunenye; Nigeria

Ullah, Asad; Karakoram International University, Pakistan

Uno, Masayoshi; University of Fukui, Japan

Vilaca do Carmo, Andre Luiz; SENAI Innovation Institute for Mineral Technologies, Brazil

Vubangsi, Mercel; The University of Bamenda, Cameroon

Wakabayashi, Hideki; Japan

Walters, Carey; Delft University of Technology, Netherlands

Wang, Shuai; Southern University of Science and Technology, China

Wang, Hao; University of Science and Technology Beijing, China

Westraadt, Johan; Nelson Mandela University, South Africa

Wiesner, Valerie L.; NASA Langley Research Center, United States

Williams, Mark A.; University of Warwick, United Kingdom

Wilson, Paul; The Boeing Company, United States

Wroblewski, Krzysztof P.; Wroblewski Consulting, United States

Xia, Zhenhai; University of North Texas, United States

Xiang, Song; Guizhou University, China

Xie, Yi; Purdue University, United States

Xin, Hongliang; Virginia Polytechnic Institute and State University, United States

Xue, Weihua; Liaoning Technical University, China

Yacoubian, Araz; LER Technologies Inc.; United States

Yadav, Shwetabh; Texas A&M University, United States

Yang, Junjie; New Jersey Institute of Technology, United States

Yang, Shu; University of Pennsylvania, United States

Yoo, Yung Suk; University of Michigan, United States

Yu, Dawei; Central South University, China

Zell, Elizabeth; Idaho National Laboratory, United States

Zhang, Jianjing; Capitech Venture Capital Co. Ltd., China

Zhao, Qiuyue; Northeast University, China

***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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JOM themagazine

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

Rio Tinto Adds Utah Plant

London, U.K.: Rio Tinto is building a new plant to recover tellurium from copper refining at its Kennecott integrated copper mining operation near Salt Lake City, Utah. A $2.9 million investment will equip the plant to recover tellurium as a by-product of copper smelting through extraction from waste streams. Operations will begin in the fourth quarter of 2021 at the new plant, which will have around 20 tonnes of annual production capacity.

Zeiss Finishes New Californian Site

Oberkochen, Germany: Carl Zeiss AG, a leading global optics and optoelectronics technology company, has completed construction of its new R&D, production, sales, and customer service site in Dublin, California, in the San Francisco Bay Area. The $180 million investment in the new Zeiss Innovation Center is part of the company's efforts to expand close to research centers and growth markets. The center's focus on digital solutions and scientific and industry partnerships spanning disciplines and technologies are key drivers behind the company's selection of a site in the Bay Area.

Adelaide, Australia: Core Lithium confirmed the production of battery-grade lithium at its Finniss Lithium Project in Australia's Northern Territory. Two samples of blended concentrate showed over 95% lithium in separate tests. The Finnish Lithium Project is the first lithium site to be approved outside Western Australia and is the first new mine of significant scale to be approved in the Northern Territory since 2013. Australia leads the world in lithium production. (Photo credit Core Lithium.)

Solvay's Tubing Advances Lightweighting

Brussels, Belgium: Solvay and Maincor Rohrsysteme GmbH & Co. KG pioneered a technique to manufacture a highly flexible, extruded corrugated tubing with varying wall thicknesses and diameters. The manufacturer's advancement will help automobile makers meet new thermal management design challenges stemming from combining internal combustion engine and e-mobility technologies including batteries, e-motors, and power electronics.

Pioneer Buys Permian's DoublePoint Energy

Houston, Texas, USA: Pioneer Natural Resources Company is acquiring DoublePoint Energy LLC for $6.4 billion. Pioneer will gain more than 100,000 acres in the core of the Permian basin, which are currently producing nearly 100,000 barrels per day. The acreage, in the Midland basin portion of the greater Permian basin, is contiguous with much of Pioneer's existing holdings, enabling Pioneer to engineer longer horizontal wells from fewer drilling pads, utilizing the existing pipeline and water systems. The deal is comprised of approximately 27.2 million shares of Pioneer common stock, $1 billion of cash, and assumption of approximately $900 million of debt and liabilities.

U.S. Steel Acquires Patents and Trademarks

Pittsburgh, Pennsylvania, USA: U.S. Steel Corporation purchased the flat-rolled sheet patents and trademarks to advanced, high-strength steel made by The NanoSteel Co. Inc. in Providence, Rhode Island. The patented proprietary alloys have a nanoscale microstructure, which creates a unique combination of extreme strength and enhanced formability that is normally only found in low-strength mild steels. The NanoSteel grades can be rolled thicker than other high-strength grades and are designed for automotive and heavy industrial applications where higher strength-to-weight ratios are needed.

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TMS2021 VIRTUAL: A First After 150 Years

Kelly Zappas

A virtual conference would have been an unfathomable concept in 1871, the year that TMS's parent society, The American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), held its first annual gathering.

For 149 years, TMS carried on the tradition of that first in-person conference where research and ideas could be shared among like-minded professionals. At the TMS 2021 Virtual Annual Meeting & Exhibition (TMS2021 Virtual), the 150th anniversary meeting, the Society demonstrated that the spirit of that first event would continue—even if the format had to change.

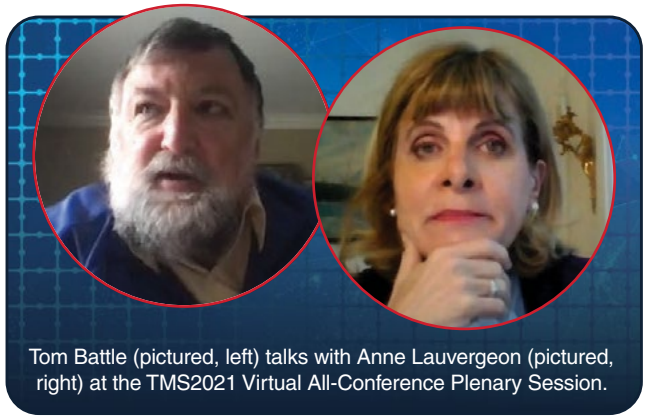
On March 15–18, TMS2021 Virtual marked the first fully online installment of the TMS Annual Meeting & Exhibition. In many ways, the Society kept with the tradition of previous years by offering scientists and engineers a recognized forum for sharing their work, a broad selection of technical symposia and presentations to view, and opportunities to initiate conversations and make connections with others working in their field.

There were some necessary changes, of course. In place of cocktail receptions in conference meeting rooms, TMS2021 Virtual featured smaller gatherings in virtual networking spaces. Instead of stepping up to the microphone to ask questions of distinguished speakers, attendees engaged in live online Q&A sessions with presenters. In the exhibit hall, conversations shifted from bustling show floors to one-on-one screen chats. Despite all these changes, TMS2021 Virtual remained a place that brought people together.

"Despite all these changes, TMS2021 Virtual remained a place that brought people together."

Throughout this article—and in two other articles published in the June 2021 issue of *JOM*—you'll gain a glimpse of this year's meeting through key statistics and event summaries that show how TMS2021 Virtual retained the key elements of a TMS Annual Meeting & Exhibition. Then look forward to TMS2022 and beyond to see where we'll be meeting once we can all gather in person again.

All-Conference Plenary Session



Tom Battle (pictured, left) talks with Anne Lauvergeon (pictured, right) at the TMS2021 Virtual All-Conference Plenary Session.

More than 200 attendees from around the world tuned in live to hear Anne Lauvergeon deliver the TMS2021 All-Conference Plenary, "New Methodologies: Producing High-Quality Metal from Low-Grade Ores," on Wednesday, March 17.

2020 TMS President Tom Battle introduced Lauvergeon, describing her as a person known for her leadership in pushing the boundaries of technology and innovating business practice in her field. She is founder/CEO of ALP; chair, École des Mines de Nancy; and former CEO of Areva S.A. She is also board chair of the start-up company IB2, which is pioneering an alumina production method that Lauvergeon called a potential revolutionary innovation with far-reaching implications.

The traditional way to produce alumina from bauxite, she explained, is the Bayer process, which results in significant waste known as red mud. It also requires transporting high-quality ores over long distances to refinery sites.

She described the IB2 technology, which can produce high-quality alumina from low-grade bauxite, as a green solution that addresses these problems. "What was considered mine waste using the normal process can be considered ore with this technology," she said.

During a Q&A session with Battle following her presentation, she explained that this technology can be added on to the traditional Bayer process. "You have nothing to change to the existing facility or installation," Lauvergeon said.

After piloting the process at two locations, Lauvergeon said the technology is now ready to commercialize.

TMS2021 VIRTUAL

By the Numbers:

2,967
Total Number of Attendees Registered for TMS2021 Virtual (as of March 31, 2021)

20
Number of Companies that Displayed Booths in the Virtual Exhibit Hall

2021 AWARDS

192
Individuals Honored with 77 Awards Presented During TMS2021 Virtual

Learn more about these awards and their recipients at awards.tms.org.

Ni-Co 2021 at TMS2021 Virtual

The Fifth International Symposium on Nickel and Cobalt (Ni-Co 2021) was held as part of TMS2021 Virtual. This special four-day symposium convened operators, engineers, and researchers to exchange information about all aspects of current processing technologies for nickel and cobalt, as well as emerging technologies for both metals.

The symposium opened with the Ni-Co 2021 plenary session on Monday, March 15, featuring invited presentations from five speakers. (For a closer look at the plenary session, see the article, "Keynotes and Featured Talks at TMS2021 Virtual," in the June 2021 issue of *JOM*.) Additional sessions were held on the topics of batteries; hydrometallurgy; pyrometallurgy; and market, materials, and mineral processing.

Ni-Co 2021 was organized by TMS, with sponsorship from the TMS Extraction & Processing Division, the TMS Pyrometallurgy Committee, and the TMS Hydrometallurgy and Electrometallurgy Committee. It was co-organized by the Metallurgy & Materials Society of the Canadian Institute of Mining, Metallurgy and Petroleum. The Ni-Co 2021 Organizing Committee was led by Corby Anderson, Colorado School of Mines.

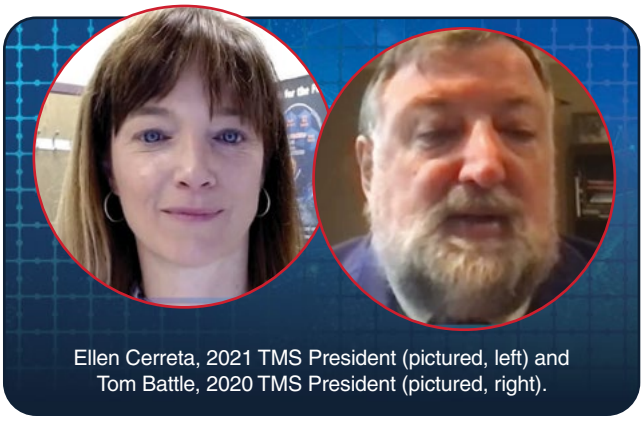
TMS2021 Proceedings

Eleven proceedings volumes, including *Ni-Co 2021: The 5th International Symposium on Nickel and Cobalt*, are now available for purchase through the TMS Bookstore in both hard copy and electronic formats. *Light Metals 2021* and *Magnesium Technology 2021*, the latest editions in TMS's long-running proceedings series, are also available, along with collections from six additional symposia.

The final volume in the collection, the *TMS 2021 150th Annual Meeting & Exhibition Supplemental Proceedings*, features a compilation of papers gathered from a variety of TMS2021 Virtual symposia.

Visit www.tms.org/Bookstore to view a full listing of available TMS2021 Virtual publications. TMS members should log in to receive a 40% discount off hard copy purchases.

TMS Installs New Leadership



Ellen Cerreta, 2021 TMS President (pictured, left) and Tom Battle, 2020 TMS President (pictured, right).

Each year, the TMS Annual Meeting & Exhibition marks the transition to the new year's TMS president. At this time, several members of the TMS Board of Directors end their leadership terms and new directors begin their cycles.

Tom Battle began his term as TMS President on February 27, 2020—the final day of the TMS 2020 Annual Meeting & Exhibition in San Diego, California, which brought together more than 4,600 attendees.

"Less than two weeks after the end of the conference, our world changed. New terms were introduced such as social distancing—rather the opposite of the business model that had been so successful in San Diego," he reflected, in a speech at the 2021 TMS-AIME Awards Ceremony, held on Wednesday, March 17. Looking back on his year as TMS President, Battle noted the unique challenges the Society encountered, but also the way the community stood together, even while staying apart. "It has been an honor and privilege to lead TMS through the most extraordinary of years," he concluded.

As Battle's presidential term came to an end, Ellen Cerreta of Los Alamos National Laboratory began her term as 2021 TMS President during TMS2021 Virtual. Cerreta also gave an address at the awards ceremony that acknowledged the challenges of the previous year and looked ahead to a brighter future.

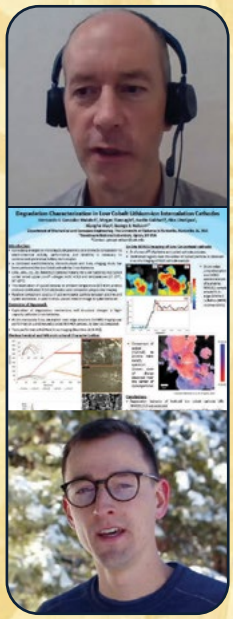
"What has transpired since our last in-person TMS Annual Meeting in 2020 shouldn't be allowed to change what we are doing as a Society for the profession, even if it is likely—perhaps more than likely—to change the how, the implementation of that vision," Cerreta said, reminding listeners of the strategic goals laid out in the TMS Aspires plan and how these will serve the profession well as the Society moves forward.

This change in leadership also included Jud Ready, Georgia Institute of Technology, moving into the role of 2021 Vice President. Ready will serve as TMS President beginning at the TMS 2022 Annual Meeting & Exhibition. Timothy Rupert, University of California, Irvine, also joined the TMS Board of Directors at TMS2021 Virtual, moving into the position of Programming Director.

TECHNICAL SESSIONS

and Proceedings

440
Technical Sessions Held at 83 Symposia in 13 Topic Areas



2,493
Presentations Given, including:

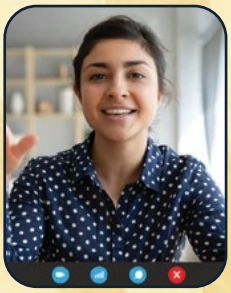
273
Poster Presentations

583
Student Presentations

480
Manuscripts Published in 11 Collected Proceedings Volumes

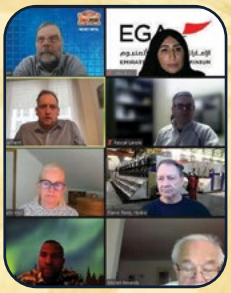
ATTENDEE ENGAGEMENT

at TMS2021 Virtual



90,035

Total Views of On Demand Sessions (as of March 31, 2021)



1,082

Attendees Participated in Live Q&A Sessions and Networking Events

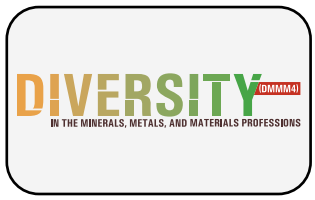
1,883

Direct Messages Sent Between Conference Participants

Future Annual Meeting Dates and Venues

For 149 years, the TMS Annual Meeting & Exhibition operated in-person meetings, and we plan to return to that model in future years. Mark your calendars now and plan to join us at these future venues:

Plans are already underway for the **TMS 2022 Annual Meeting & Exhibition,** which is now accepting abstracts for symposia planned by all five TMS technical divisions. TMS2022 will feature two co-located events: **Diversity in the Minerals, Metals, and Materials Professions 4 (DMMM4)** and the **REWAS 2022** Symposium, which will focus on the theme of Developing Tomorrow's Technical Cycles. In addition, TMS2022 will feature the popular **Bladesmithing Competition** and continue the celebration of the Society's **150th Anniversary Year**.



Visit **www.tms.org/TMS2022** to learn more and to submit your abstract by July 1.

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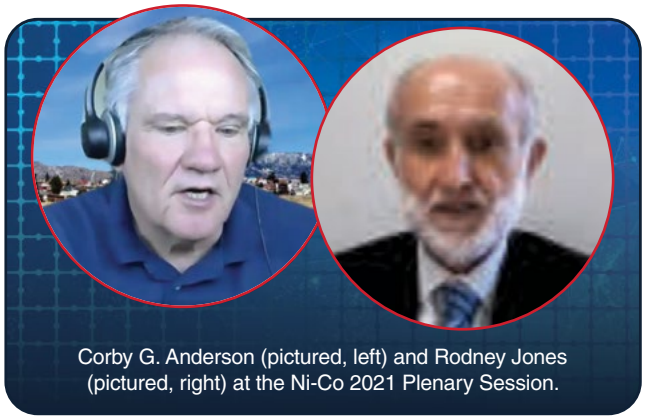
Nearly 2,500 oral and poster presentations at 83 symposia in 13 technical tracks were delivered over the course of four days at the TMS 2021 Virtual Annual Meeting & Exhibition (TMS2021 Virtual), March 15-18, 2021.

Among these were keynote sessions on high-interest topics, award lectures delivered by leaders in the field, and talks and sessions from young professionals on emerging technology areas. What follows is a look at some of these featured sessions and talks from TMS2021 Virtual.

PLENARY AND KEYNOTE SESSIONS

Ni-Co 2021 Plenary



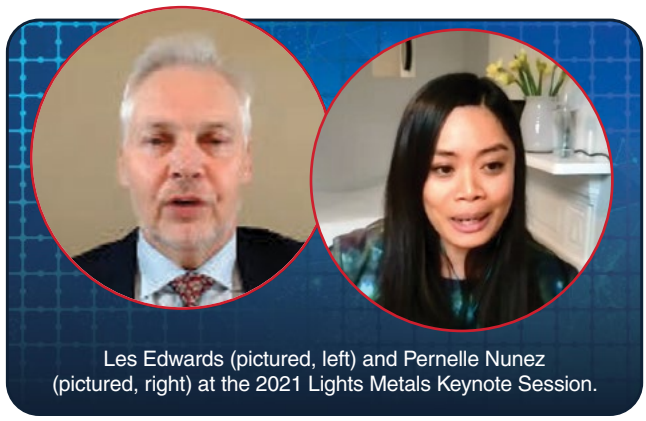
Corby G. Anderson (pictured, left) and Rodney Jones (pictured, right) at the Ni-Co 2021 Plenary Session.

The Fifth International Symposium on Nickel and Cobalt (Ni-Co 2021) opened with a plenary session that featured five invited speakers, including the 2021 TMS Extraction & Processing Division (EPD) Distinguished Lecturer, Rodney Jones, Mintek. Ahead of the technical presentations, lead Ni-Co 2021 organizer, Corby G. Anderson, Colorado School of Mines, welcomed attendees to the session and thanked the authors and speakers as well as his co-organizers of the symposium. "We labored through the challenges of the global pandemic and actually this whole symposium, even though it's gone virtual, has come to fruition," he said.

Jones kicked off the plenary session, delivering the presentation, "Ferronickel–Thermodynamics, Chemistry, and Economics," in which he noted that "nickel is an essential metal in our modern world." Though current nickel demand is dominated by stainless steel, there is growth anticipated in batteries over the next decade. "We are living in an exciting time of new developments and have the opportunity to shape the world for the better," Jones said. "The contributions that nickel, stainless steel materials, and batteries can make to a cleaner and kinder world are very significant."

Later in the session, Anthony Warner, Worley, provided an overview of key developments in nickel pyrometallurgy since 1970—many of which he and his co-authors, Philip Mackey and Ahmed Vahed, experienced first-hand throughout their careers—with his talk, "A Review of Nickel Pyrometallurgy over the Past 50 Years with Special Reference to the Former INCO Ltd. and Falconbridge Ltd." "Nickel is an essential metal to modern society, primarily through its use as an important ingredient in stainless steel," he noted. "More recently and in the future, electric vehicles are becoming a key nickel demand driver for nickel products to meet this application."

2021 Lights Metals Keynote Session



Les Edwards (pictured, left) and Pernelle Nunez (pictured, right) at the 2021 Lights Metals Keynote Session.

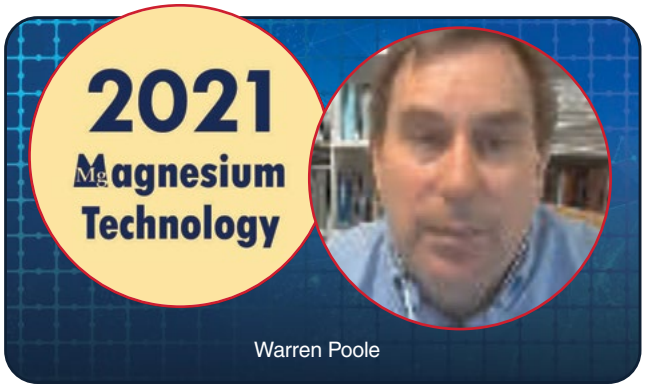
Sustainability in the Aluminum Supply Chain was the focus of the 2021 Light Metals Keynote Session, which was organized by Les Edwards, Rain Carbon Inc., and sponsored by the Aluminum Committee of the TMS Light Metals Division. The idea for the session came about, Edwards said, after he attended a presentation at TMS2020 that highlighted the sustainability challenges faced by the aluminum industry in meeting climate change targets.

"Since that time, there's been a growing focus around the world on sustainability issues," said Edwards, who organized a lineup of seven speakers to both explore the industry's sustainability challenges and discuss how companies and organizations are taking innovative steps to meet them.

Pernelle Nunez, International Aluminium Association, opened the session with her talk, "Long-Term Sustainability of the Aluminium Sector," which offered an overview of the challenges and opportunities for a sustainable aluminum industry. "Aluminium has a key role to play as an enabling material in sustainable development," she said. "Because of that, demand for aluminum products will increase and the industry will need to address its sustainability challenges as it grows. Collaboration, innovation, and investment will be essential for the industry's long-term sustainability."

In all, the session included seven talks, many of which were among the most-watched presentations delivered at TMS2021 Virtual. (For a look at some of the most highly viewed talks, see the sidebar, "Highly Viewed Presentations at TMS2021 Virtual," in this article.) The slides for these presentations can now be accessed through the TMS 2021 Virtual website at www.tms.org/TMS2021/LightMetalsKeynote.

Magnesium Technology 2021 Keynote



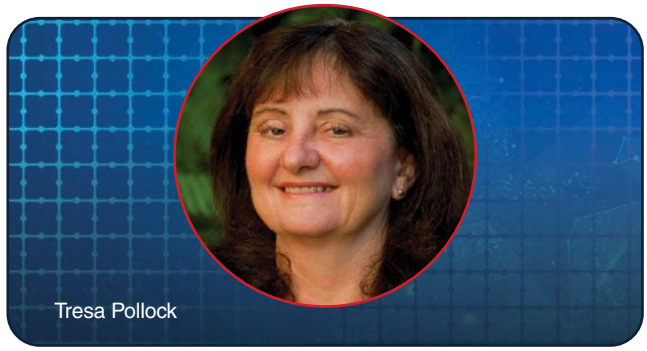
The Magnesium Technology 2021 symposium opened with a keynote presentation by Warren Poole, University of British Columbia (UBC), presenting, "Measurement of the Critical Resolved Shear Stress for Slip in Magnesium Alloys Using Instrumented Indentation."

The competition between different deformation modes and how this changes with temperature is a critical challenge for the plasticity and fracture of magnesium and its alloys, Poole explained, but instrumented indentation tests offer advantages. His presentation walked through a set of instrumented indentation experiments performed on magnesium alloys, and the evidence collected the depth of indents changed.

Poole's complete paper was published in the *Magnesium Technology 2021* proceedings volume, available at www.tms.org/Bookstore. In total, five Magnesium Technology 2021 sessions were held over the course of three days at TMS2021 Virtual.

AWARD LECTURES

2021 Institute of Metals/Robert Franklin Mehl Award Lecturee



Tresa Pollock, University of California, Santa Barbara, presented, "New Superalloys in the Co-Ni Design Space", as the 2021 Institute of Metals/Robert Franklin Mehl Award recipient.

The presentation started with a brief overview on superalloys, looking at conventional cobalt and nickel alloys, as well as newer high-temperature cobalt alloys. It wasn't until 2006, when a rediscovery and mechanical experiments revealed that "strength at very high temperatures of cobalt alloys might be better than nickel alloys," which "kicked off a worldwide effort to better understand what is possible in a cobalt-based system."

She offered final thoughts on the topic, noting that new ICME tools can continue to enhance our understanding and that more understanding is needed in phase equilibria and stability of the L12 phase and the fault energies. "Achieving a balanced set of properties remains as an interesting challenge, and I think there's still much interest and research to be done."

Hume-Rothery Award Lecture

Ji-Cheng (JC) Zhao, University of Maryland, delivered the William Hume-Rothery Award Lecture, "High-Throughput Measurements of Composition-Dependent Properties of Alloy Phases for Accelerated Alloy Design."

Zhao's presentation offered an introduction to the diffusion multiple approach and discussed the possibilities

of new computational tools and models that can help speed up the experimentation process. Holistic integration of computational, experimental, and data science approaches will be needed, he said, to efficiently build thermodynamic databases.

"Holistic integration is basically ICME," he said. "Every experiment is an ICME concern." The field is ready, he concluded, to build an all-encompassing diffusion database for solid solutions, where we can have all the computed data for each element of each phase structure.

Highly Viewed Presentations at TMS2021 VIRTUAL:

Some of the most highly viewed presentations included:

- "Designing Ductility in BCC High Entropy Alloys?" **William Curtin**, EPFL
- "Pushing Structural Performance of Materials by Combining Alloy Design with Disruptive Manufacturing Technologies," **Rajiv Mishra**, University of North Texas
- "Long Term Sustainability of the Aluminium Sector," **Pernelle Nunez**, International Aluminium Institute
- "Aluminium Production: A Pathway to Zero Carbon by 2050," **Mark Dorreen**, EnPot Ltd.
- "Additive Manufacturing and Characterization of High-density Materials for Aerospace Applications," **Kristyn Kadala**, Lockheed Martin
- "Development of a Rapid Alloy Selection Tool for Rapid Solidification Processing Conditions," **Emma White**, Ames Laboratory
- "Mechanical Behavior of Induced Lack of Fusion Flaws in AlSi10Mg," **John Lewandowski**, Case Western Reserve University
- "Near Zero-waste and Near Break-Even: A Path towards Sustainable Bauxite Processing," **Efthymios Balomenos**, Mytilineos SA
- "Review of Sustainability in the Carbon Supply Chain," **Les Edwards**, Rain Carbon Inc.
- "Hydro's New Karmøy Technology Pilot: Start-up and Early Operation," **Pierre Reny**, Hydro Aluminium

ACTA MATERIALIA SYMPOSIUM

Acta Materialia Awards Session

The TMS2021 Acta Materialia Symposium featured lectures by four recipients of this year's Acta Materialia awards.

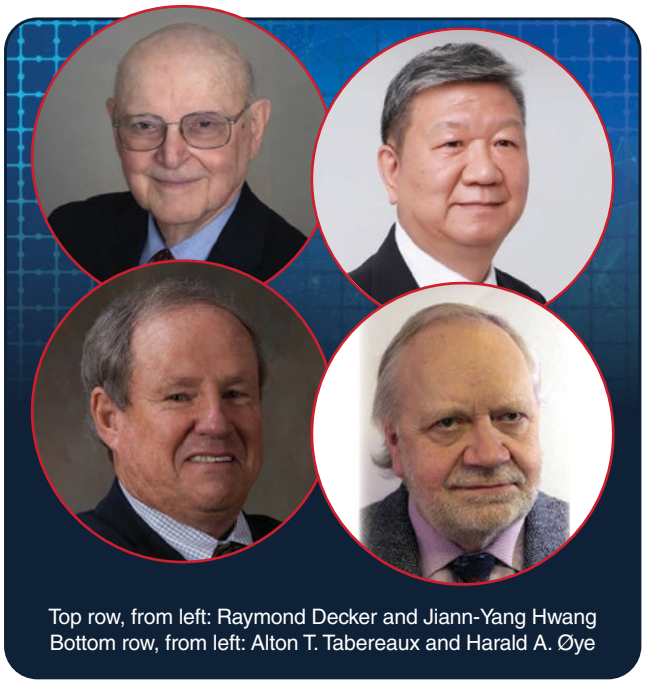
Günter Gottstein, RWTH Aachen University, gave the talk, "Modelling Microstructure Complexity for Better Property Predictions," as the Gold Medal Lecturer. Gottstein, who has been a TMS member for more than 30 years, received the award for his demonstrated ability and leadership in materials research. During his talk, he discussed research efforts and materials design projects that allow us to make better predictions of material properties from the knowledge of microstructure and physical metallurgy research.

Katalin Balázsi, Hungarian Academy of Sciences, was honored as the first recipient of the Mary Fortune Global Diversity Medal, a newly established award for outstanding contributions to the field of materials but also for contributions to the diversity of researchers in the field. In her talk, "STEM Mentor Programs and New Opportunities for Women and Other Under-represented Groups in Materials Science," Balázsi discussed her work to establish and grow the Association for Hungarian Women in Science (NATE) in 2008. It has grown into a national organization involving 13,500 girls, 800 teachers, 190 educational and research organizations, and four regional centers. "In the new post-COVID world, it is more important than ever to upskill and reskill people for the jobs of the future," Balázsi said.

Julie Cairney, University of Sydney, delivered the Silver Medal Lecture, awarded for scientific contributions and leadership in the midst of the researcher's career, and Qingjie Zhang, Wuhan University of Technology, received the Holloman Award in Materials and Society, recognizing demonstrated leadership in promoting the understanding of the interactions between materials technology and societal interests and needs. The session was chaired by the University of Waterloo's Carolyn Hansson, who serves as Acta Materialia's executive secretary.

HONORARY SYMPOSIA

Four distinguished TMS members were celebrated at three honorary symposia during TMS2021 Virtual.



Top row, from left: Raymond Decker and Jiann-Yang Hwang
Bottom row, from left: Alton T. Tabereaux and Harald A. Øye

Raymond Decker

The TMS Light Metals Division held Greater Than the Sum of Its Parts—Concurrent Alloy Design and Processing Science, a symposium in honor of Raymond Decker's 90th birthday. Decker, who has been a member of TMS for 70 years, celebrated this milestone by looking back at a century of evolution in alloy design and application, from 1921 to 2021. He presented six successful case histories of alloy design and applications, from the Inconel Alloy 600 in 1921 to maraging stainless steel for additive manufacturing at QuesTek in 2021 using ICME. Drawing on his experience of more than 70 years, Decker offered a closer look at each example and looked at trends that have developed in the field during that time.

After looking at a century of examples, Decker stated, "The best in alloy design is yet to come."

He then offered his own recipe for alloy design and applications: Good basic research + ICME software + lab confirmation (observing) + The Princes Serendip [known for making unexpected discoveries and inspiring the term serendipity] + the library + the technical societies + *ab initio* market development. The last step of the recipe? Stir vigorously with partners.

Jiann-Yang Hwang

Jiann-Yang Hwang, Michigan Technological University, shared his experiences and gave many examples of successes in materials processing for the session titled Materials Engineering—From Ideas to Practice: An EPD Symposium in Honor of Jiann-Yang Hwang: Mineral and Material Processing.

Hwang's research interests cover the entire cycle of materials, from raw material acquisition and bulk processing, to manufacturing and transport, to use and storage, to recycling and disposal. In the cycle, each process involves a sequence of unit of operations. He stressed the importance of viewing the whole cycle when presented with a problem. A problem could occur at any point in the process, involving the input, processing, output, cost, quality, and environment. "In the whole material cycle, ideas can be generated in each unit operation. The more areas of knowledge you learned, the more operation boxes can be put together, and you can probably get the more practical solution," Hwang said.

Hwang expressed gratitude for the opportunity to speak at TMS2021 Virtual. "I'm deeply touched to have this symposium sponsored by TMS that honors my lifelong contributions to the society, education, and industry," he said.

Alton T. Tabereaux and Harald A. Øye

The final TMS2021 Virtual honorary symposium, also sponsored by the TMS Light Metals Division, honored two recipients in separate sessions: Alton T. Tabereaux and Harald A. Øye.

Xiangwen Wang, Alcoa, described Tabereaux as a world aluminum smelting icon in his talk, "Alton Tabereaux: A Humble Individual Who Dedicates His Lifetime to Aluminum—An Aluminum Legend of Our Time." Tabereaux retired from Alcoa in 2007, but, Wang stated, "he's never quit the industry." Instead, he said, he has spent his time solving world problems in smelting, advancing reduction technology, and serving and strengthening the aluminum community.

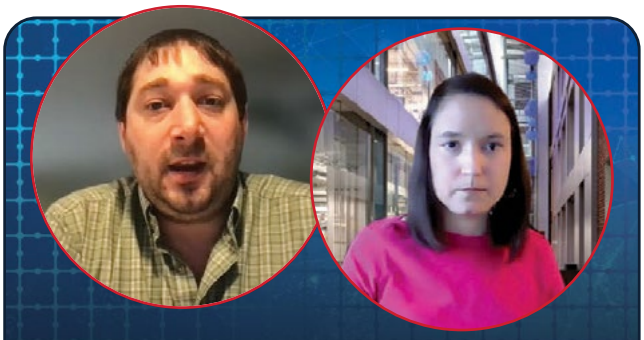
One of the most important of Tabereaux's many contributions to the field, according to Wang, is greenhouse gas initiatives. During the symposium, Tabereaux himself delivered a talk titled, "Awakening of the Al Industry to PFC Emissions and Global Warming," which offered an historic overview of the discovery of PFCs and highlighted some of the first investigators in the journey to understand, measure, account for, and reduce emissions of this potent greenhouse gas.

Kristian Etienne Einarsrud, Norwegian University of Science and Technology, introduced the Øye session of the Aluminum Reduction Technology Across the Decades symposium. "For 50 years, he has played a key role in the modernization of the Norwegian aluminum industry," Einarsrud said of Øye. "He's had a strong international impact and has an extensive network around the world."

Five presentations looked at various aspects of Øye's career and research, including the talk, "Forty Years of Trondheim International Course on Process Metallurgy of Aluminium," which provided an overview of the influential course Øye has organized since 1981.

YOUNG PROFESSIONAL LECTURES

Additive Manufacturing Award Lecture



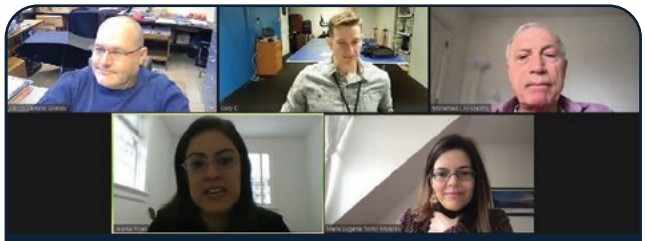
Michael Kirka (pictured, left), Oak Ridge National Laboratory, talks with Allison Beese (pictured, right), Pennsylvania State University, during the Q&A Session following Kirka's lecture.

As the recipient of the 2021 Young Innovator in the Materials Science of Additive Manufacturing Award, Michael Kirka, Oak Ridge National Laboratory, gave the talk, "Additive Manufacturing of High Temperature Metals: Present and Future Opportunities," where he discussed how the maturation of additive manufacturing (AM) technologies presents new processing options for high-temperature materials and is opening the door to materials innovations and design opportunities.

"There's a lot of opportunities out there for high-temperature metals added. A lot of it can be tied back to the classical works that occur in the 50s and 60s, when they looked at these things but they were not fruitful at the time," Kirka said. He encouraged participants to learn about past research, using examples of foundational works in AM for nickel-based superalloys. He showed how leveraging processing science can help to drive materials development.

The lecture concluded with a question-and-answer session where Kirka elaborated on concepts discussed in his presentation. He emphasized a need to design alloys for AM: "In additive manufacturing, there are ideas of what people want to be able to process—with the properties and the end application in mind—but it's not processable today. So how do you engineer it to get there, rather than going from the application-side down?"

Frontiers of Materials Award Symposia



The Radiation Processing of Materials symposium included a live Q&A session with the speakers. Clockwise from top left: Carlos Castano, Missouri University of Science and Technology; Cory Cress, U.S. Naval Research Laboratory; Jessika Rojas, Virginia Commonwealth University; María Eugenia Toimil-Molares, GSI Helmholtz Center; and Mohammed Al-Sheikhly, University of Maryland.

One of the goals of the TMS Frontiers of Materials Award is to bring technical programming in topic areas that are novel, exciting, and not typically captured in existing programming to the TMS annual meeting. At TMS2021 Virtual, early-career professionals, selected through a competitive awards process, organized Frontiers of Materials Awards symposia on three such topics.

"We want to talk to you about the fascinating opportunities that ionizing radiation has in the field of materials science," Jessika Rojas, Virginia Commonwealth University, said when she introduced her session, Radiation Processing of Materials. "We can use ionizing radiation to manufacture materials at different length scales. We can also use ionizing radiation to modify materials properties so that we can potentially enhance their performance for different applications."

Deep Jariwala, University of Pennsylvania, brought the topic of Low-Dimensional Materials and Interfaces for Next Generation Computing to the TMS audience. "The major motivation behind this is the energy forecast and the consumption of power and energy that is required for modern-day computing, data transmission, and internet usage activities," he said. "Producing technology that can compute and store data with much better efficiency is extremely important." His symposium focused on the materials, devices, and architecture that will help enable these efficiencies.

Huanyu Cheng, Penn State University, discussed the development of stretchable sensors that can be worn on the skin in his keynote talk, "Wearable Gas Sensors with Wireless Communication and RF Energy Harvesting Capabilities." This was part of his session of invited talks, 2021 Functional Nanomaterials: Translating Innovation into Pioneering Technologies.

"I hope that it will be a valuable experience for us to receive guidance and advice from the leading experts in these next-generation devices in biomedical sciences," said Cheng.

Young Professional Tutorial Lecture

James Pikul (pictured, left) and Wei Xiong (pictured, right)

The Young Professional Tutorial Lecture featured presentations from the two 2021 Early Career Faculty Fellows: James Pikul, University of Pennsylvania, and Wei Xiong, University of Pittsburgh.

Pikul began, "Electrochemical Healing of Metals: A New Way to Repair Additive and Cellular Metals at Room Temperature," with an introduction to technologies applied to the Opportunity and Spirit rovers on Mars. Opportunity operated for 15 years on Mars, while Spirit lasted only five years due to a fractured wheel. "Wouldn't it be nice if it could regrow metal and repair metal, like self-healing bone?" Pikul said.

Pikul's research described how electrochemistry enables transport-mediated healing in cellular metals and was able to show rapid, effective, low-energy, room-temperature healing of cellular metals. "Further developments can revolutionize how we design metal parts in aerospace vehicles and robots," Pikul said.

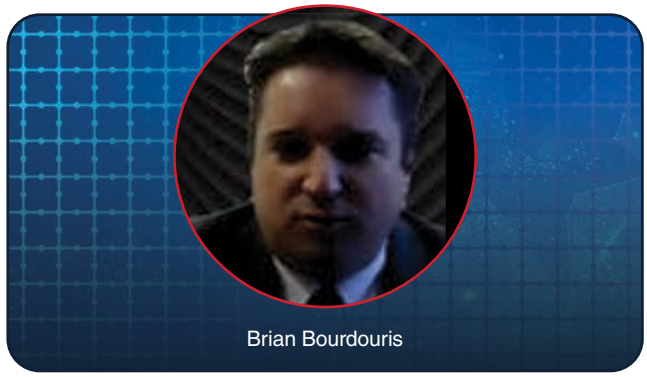
Xiong presented, "Integrated Computational Materials Design for Alloy Additive Manufacturing," to describe how the integrated computational materials design (ICMD) method can accelerate the new alloy development and processing optimization. The method integrates multiscale microstructure engineering approaches, and especially uses the CALPHAD-based ICME approach as a guide tool, to reveal the process-structure-property relationships.

"We are scientists, similar to a chef doing the cooking. We need the 'rice' or the 'meat,' which is the data, and the ICME model is the recipe. The question is, can we get a better model?" Xiong said.

2021 TMS STUDENT-LED SYMPOSIUM

Design and Manufacturing Approaches for the Next Generation of Sustainable Materials

When asked to organize a symposium for a TMS annual meeting, Colorado School of Mines students Mary Dougherty, Christopher Finfrock, Casey Gilliams, Brady McBride, Desmond Mills, and Jaden Zymbaluk felt up to the task. "We accepted the challenge, because we want to elevate the voices of key materials science innovators and stimulate a discussion that inspires the current and future generations of materials science students and young professionals," said Zymbaluk. Their chosen topic became the 2021 TMS Student-Led Symposium, Design and Manufacturing Approaches for the Next Generation of Sustainable Materials.



Brian Bourdouris

Brian Bourdouris, National Science Foundation (NSF), opened the Challenges in Sustainable Materials: Novel Processing and Recycling session with his talk, "Research with a Sustainable Materials Science and Engineering Approach." Bourdouris described how sustainable materials science and engineering is covered by many different sectors and at many different levels throughout the NSF, from projects with a single principal investigator to large centers with entire teams.

"Sustainable materials and manufacturing are really one of the key opportunities of the day and addressing the basic and applied research problems in this field is something that can really help move society, both here in the United States and across the globe, forward in a very impactful manner," Bourdouris said, providing a variety of examples of research projects supported by the NSF, both fundamental and applied, and even into education and training of future researchers.

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Though they looked different this year, networking events, student activities, and awards ceremonies were still a key part of the TMS 2021 Virtual Annual Meeting & Exhibition (TMS2021 Virtual). The following pages offer a look at some these key events held throughout the week of March 15–18 at TMS2021 Virtual.

TMS-AIME Awards Ceremony

Several members of the 2021 TMS Class of Fellows accept their awards at the TMS-AIME Awards Ceremony. Pictured are, from top left to bottom right, Dipankar Banerjee, Fiona Doyle, Somnath Ghosh, and Hani Henein.

At the TMS-AIME Awards Ceremony, TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) recognized distinguished achievements by leaders in their field, early career professionals, and students.

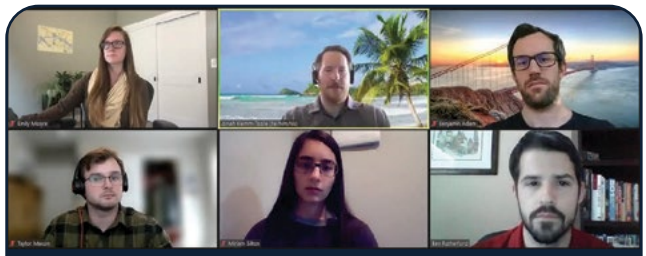
Among the awards presented was the highest honor the Society can bestow: the TMS Fellow Award. Eight new members were inducted into the 2021 Class of TMS Fellows and several of these inductees delivered acceptance speeches by video.

"Being honored by TMS is particularly meaningful to me because this Society has been singularly influential in my career success," said Fiona Doyle, University of California, in her speech. "Almost 40 years ago, I found a community of hydrometallurgists and others who mentored me, befriended me, and didn't squash my wild and crazy ideas.…At a time when other women in engineering were struggling with gaining acceptance by their male colleagues, I felt that TMS was fully supportive of me and other women."

In addition to Doyle, new Fellows included Dipankar Banerjee, Raymond Decker, David DeYoung, Somnath Ghosh, Hani Henein, Donald Sadoway, and Julie Schoenung.

The full ceremony, which also included speeches by 2020 TMS President Tom Battle and 2021 TMS President Ellen Cerreta, is now available as a series of videos through Channel TMS on YouTube at www.youtube.com/user/ChannelTMS.

Student Career Forum



Pictured from top left to bottom right: The Student Career Forum was moderated by Emily Moore, Lawrence Livermore National Laboratory. Panelists included Jonah Klemm-Toole, Colorado School of Mines; Benjamin Adam, Portland State University; Taylor Mason, Pacific Northwest National Laboratory; Miriam Silton, W.L. Gore & Associates; and Ben Rutherford, Army Corps of Engineers.

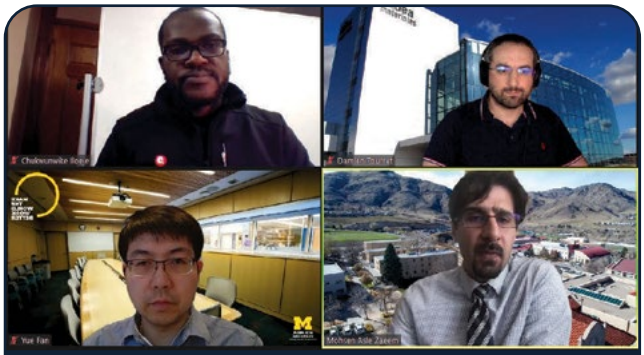
Six early career professionals shared insights on potential career paths, gave a preview of what to expect during the job search process, and offered useful career advice and encouragement at the Student Career Forum, held on Tuesday, March 16.

Panelist Miriam Silton, W.L. Gore & Associates, encouraged students to try out different opportunities within their field now, while they have more flexibility and freedom. "It's a lot easier to try out smaller-scale, temporary commitments as a student, than it is as a working professional," she said.

Jonah Klemm-Toole, Colorado School of Mines, advised students to start participating in professional societies while they're still in school. "I wish I had participated earlier," he said. "I'd have 15-year relationships established by now." He also noted that professional societies are one of the best places to network for job opportunities.

Taylor Mason, Pacific Northwest National Laboratory, suggested seeking out researchers whose work you find interesting, particularly when attending conferences, as a way of networking. "People love talking about their research, so if you come with questions ready, they'll often be willing to sit and talk with you. Don't be afraid to approach them."

Preparing a Winning Resume Package Workshop



Panelists, clockwise from top left, were Chukwunwike Iloeje, Damien Tourret, Mohsen Asle Zaeem, and Yue Fan.

Determining what type of job is the right fit for you, writing a cover letter, preparing for interviews, and more topics were covered in the Preparing a Winning Resume Package Workshop for students.

The workshop was led by Mohsen Asle Zaeem, Colorado School of Mines, with contributions from panelists working in industrial, academic, and government sectors: Yue Fan, University of Michigan; Chukwunwike Iloeje, Argonne National Laboratory; and Damien Tourret, IMDEA Materials Institute.

Panelists fielded audience members' questions on a variety of topics related to job searches and preparing application materials and encouraged students to pursue the positions that best matched their interests.

For academic jobs in particular, Zaeem urged applicants to choose an institution that offered the right balance of research and teaching for them.

"Forget about status," Zaeem advised. "Status is something you need to throw out the window. You need to do what makes you happy."

It's Not All Zoom & Gloom

In place of the traditional Materials Bowl event typically held at the TMS annual meeting each year, a virtual trivia competition tested student participants' knowledge of materials and TMS with a series of 35 timed questions.

It's Not All Zoom & Gloom, the student trivia competition held at TMS2021 Virtual, resulted in two ties that ended with a final tie-breaking question. Purdue University students took the three top spots in the final standings:

- **First Place:** Thomas Mann (331 points), Purdue University – $250 prize
- **Second Place:** Hannah DeBoer (331 points), Purdue University – $150 prize
- **Third Place:** Ethan Mann (291 points), Purdue University – $100 prize
- **Honorable Mention:** Kevin Schmalbach (291 points), University of Minnesota – Bragging rights

Congratulations to all of the winners and thank you to everyone who participated in the trivia competition.

Diversity & Inclusion Table Talks

Pictured from right to left: Chelsey Hargather and Ashley Paz y Puente organized Diversity & Inclusion Table Talks at TMS2021 Virtual.

Attendees gathered for informal discussions at the TMS Diversity, Equity & Inclusion (DEI) Networking Table Talks event on Thursday, March 18, organized by Ashley Paz y Puente and Chelsey Hargather, members of the TMS DEI Committee.

Participants joined in small-group discussions on the following topics: Cultivating Inclusion in TMS; DEI Best Practices for Outreach; Managing Expectations in Workplace Interactions; Managing Mental Health During Physical, Social, and Emotional Isolation; Moving Beyond Imposter Syndrome; Overcoming Anxiety in the Workplace; Strategies for Ensuring Virtual Accessibility; and Working in a Virtual Reality.

The conversation will continue at the Fourth Summit on Diversity in the Minerals, Metals, and Materials Profession (DMMM4), which will be held March 2–3, 2022, as a co-located event at the TMS 2022 Annual Meeting & Exhibition in Anaheim, California.

DIVISION AWARD CEREMONIES AND SPECIAL LECTURES

The five TMS technical divisions celebrated award recipients and heard from invited speakers at three events during TMS2021 Virtual. Each event opened with the conferring of awards by the technical division chairs. **All of these award ceremonies can now be viewed through the Channel TMS on YouTube at www.youtube.com/user/ChannelTMS.**

SMD/FMD Lecture

Rajiv S. Mishra

At the Structural Materials Division (SMD)/Functional Materials Division (FMD) Awards Ceremony & Lecture, Rajiv S. Mishra, University of North Texas, gave the invited talk, "Pushing Structural Performance of Materials by Combining Alloy Design with Disruptive Manufacturing Technologies." The central question that his talk posed was: "How can we change what we get out of a material when we design the alloy for a specific manufacturing process?"

To take best advantage of materials, he said, we have to think about their attributes and how they synch with manufacturing technologies' attributes. This co-design of disruptive technologies and analog design can enable things that otherwise are not possible.

"That's how we can push the envelope more and more," he said. "The SMD is home to some of these discussions that we're engaged in."

LMD Lecture

Mark Easton

At the TMS Light Metals Division (LMD) Awards Ceremony & Special Lecture, one of the award recipients, LMD Scholar Zachary Wolff of the University of Nevada, Reno, gave a brief presentation on Lattice Confinement Fusion, which, he said, NASA scientists hope to use in power systems for space travel, exploration, and propulsion systems.

Mark Easton, RMIT University, then delivered the talk, "Near Net Manufacturing of Light Metal Alloys," discussing research that has been a theme throughout his career. He spoke about how some of the themes of the research can travel from one manufacturing technology to the next.

"Near net shape manufacturing is continuing to evolve from more traditional methods such as casting to more modern methods such as additive manufacturing," he said. Many of the challenges, such as microstructure control and defect formation, remain the same, but approaches used in more traditional technologies to dealing with these issues can also be used in additive.

EPD/MPMD Lecture

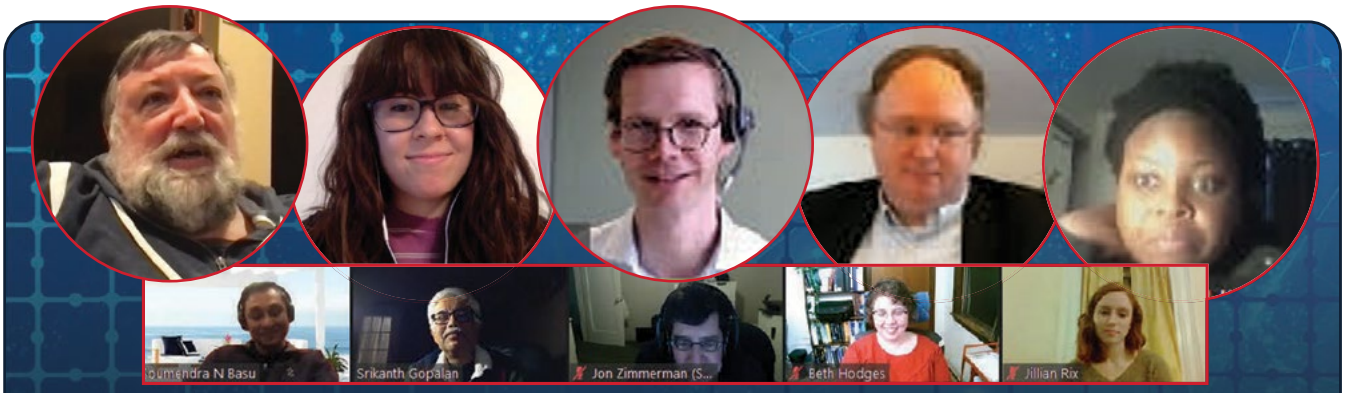
Richard Russell

At the Extraction & Processing Division (EPD)/ Materials Processing & Manufacturing Division (MPMD) Awards Ceremony & Special Lecture, Richard Russell, NASA Kennedy Space Center, presented, "Qualification and Certification Strategies for Additive Manufactured Parts for Manned Spaceflight," as the MPMD special lecturer.

"Additive manufacturing—it's always been touted as a thing of the future. Well, the future is now," Russell began. He first explained the motivation behind developing additive manufacturing (AM) standards, noting several examples of AM parts and applications already in use at NASA. Focusing on the particular challenges when manufacturing for deep space missions, Russell discussed the development, methodologies, and governing principles for NASA's current and upcoming AM standards. In summary, he noted, "control what you do; evaluate what you get."

Looking at future directions for AM in spaceflight, he talked briefly about the problem presented by non-destructive evaluation and the future in inspection: "You need to be able to understand the signals we can gather while making a part, be able to make adjustments, be able to know where your problems are, and then know how that relates back to properties."

Networking Sessions



Attendees met for small group discussions at five Networking Sessions held throughout the week at TMS2021 Virtual. Each session allowed individuals to join a moderated, virtual conversation on topics that aligned with the conference's 14 programming tracks.

TECHNICAL DIVISION STUDENT POSTER COMPETITION WINNERS

Several of the TMS Technical Divisions honored excellence in graduate and undergraduate student work at the 2021 Technical Division Student Poster Competition at TMS2021 Virtual. Each participant contributed a poster and a two-to-three-minute video presentation describing their work. The following posters took top honors:

Functional Materials Division (FMD)

Graduate: "Utilizing Advanced Manufacturing for the Development of Advanced In-pile Sensors and Instrumentation"

Kiyo Fujimoto, Boise State University and Idaho National Laboratory

Materials Processing & Manufacturing Division (MPMD)

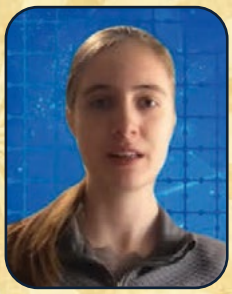
Graduate: "Comparison of Laser Diffraction and Image Analysis Techniques for Particle Size-Shape Characterization in Additive Manufacturing Applications"

Jack Grubbs, Worcester Polytechnic Institute

Structural Materials Division (SMD)

Graduate: "Prediction and Testing of Hot Cracking Susceptibility during Local Melting in Binary and Multi Component Aluminum Alloys"

Shubhra Jain, Iowa State University



Undergraduate: "First Principles Study of Sigma Phase Destabilization in Compositionally-complex Stainless Steel Alloys"

Anna Soper, Harvey Mudd College

TMS2021 VIRTUAL SYMPOSIUM AWARDS

A number of symposia at TMS2021 Virtual recognized quality poster and oral presentations. Congratulations to the following award recipients:

Advanced Materials for Energy Conversion and Storage VII Symposium Awards

First-Place Poster: "Probing Structural Changes of 2D Supercapacitor Electrode by Kelvin Probe Force Microscopy," *Kowsik Sambath Kumar,* Nitin Choudhary, Deepak Pandey, Yi Ding, Luis Hurtado, Laurene Tetard, Yeonwoong Jung, and Jayan Thomas, University of Central Florida; Hee-Suk Chung, Analytical Research Division, Korea Basic Science Institute

Second-Place Poster: "AgCl-decorated Ag Nanowire Catalysts to Maximize the Surface Effect in the Oxygen Reduction Reaction," *Suyeon Choi,* Youngtae Park, and Hyuck Mo Lee, Korea Advanced Institute of Science and Technology; Changsoo Lee, Korea Institute of Energy Research

Third-Place Poster: "Temperature-induced Successive Martensitic and Inter-Martensitic Phase Transformations of $Ni_{2.15}Mn_{0.85}Ga$ Heusler Alloy," Amila Madiligama, Penn State DuBois; *Pnina Ari-Gur* and James George, Western Michigan University; Yang Ren, Argonne National Laboratory; Vladimir Shavrov and Victor Koledov, Russian Academy of Sciences; Yanling Ge, Aalto University

Advanced Real Time Imaging Symposium Awards

First-Place Oral Presentation: "Atomic Scale Processes of Initial Oxidation of Cu and Cu-Ni Alloy Revealed by In Situ Environmental TEM," *Meng Li,* Matthew Curnan, Richard Garza, Stephen House, Wissam Saidi, and Judith Yang, University of Pittsburgh

Second-Place Oral Presentation: "An In Situ and Operando Additive Manufacturing Process Replicator for High Speed Optical, Infra-red and Synchrotron X-ray Imaging," *Sebastian Marussi,* Chu Lun Alex Leung, Samuel Clark, and Peter Lee, University College London; Leigh Stranger and Jon Willmott, The University of Sheffield; Robert Atwood, Diamond Light Source Ltd.; Veijo Honkimäki and Alexander Rack, European Synchrotron Radiation Facility; Mike Besston, Oxford Lasers Ltd.

Third-Place Oral Presentation: "Characterizing Laser-driven Metal Ejecta Interactions," *Alison Saunders,* Camelia Stan, Kyle Mackay, Suzanne Ali, Hye-Sook Park, Jon Eggert, Fady Najjar, Tomorr Haxhimali, Brandon Morgan, Jeremy Horwitz, and Yuan Ping, Lawrence Livermore National Laboratory; Hans Rinderknecht, Laboratory for Laser Energetics; Marcho Echeverria, University of Connecticut

First Place Oral Presentation, Student: "Local Shock Viscosity Measurement in Composites Using In-situ Time-gated Raman Spectroscopy," *Abhijeet Dhiman,* Ayotomi Olokun, Nolan Lewis, and Vikas Tomar, Purdue University

Second Place Oral Presentation, Student: "Dynamics of Abnormal Grain Growth in a Particle-containing System Uncovered by Multimodal Three-dimensional X-ray Imaging," *Jiwoong Kang,* Ning Lu, Nancy Senabulya, and Ashwin Shahani, University of Michigan; Nicolas Gueninchault, Carl Zeiss X-ray Microscopy Inc.

Third Place Oral Presentation, Student: "Quantifying Spatter in Powder Bed Fusion Processes with High-speed Video Observations and Machine Learning," *Christian Gobert,* Evan Diewald, and Jack Beuth, Carnegie Mellon University

Alloys and Compounds for Thermoelectric and Solar Cell Applications IX Symposium Awards

First Place Poster: "Ultra-low Thermal Conductivity for High-performance GeTe-based Thermoelectric Materials," *Yi-Fen Tsai* and Hsin-Jay Wu, National Chiao Tung University

Second Place Poster: "Using Neutrons to Probe the Influence of Processing on Temperature-dependent Strain in PbTe," *James Male,* Riley Hanus, and G. Jeffrey Snyder, Northwestern University; Raphael Hermann, Oak Ridge National Laboratory

Third Place Poster: "Ni/Pb-Te and Ni/Se-Sn Interfacial Reactions and Their Related Phase Diagrams," *Yohanes Hutabalian,* Zhi-kai Hu, Xu-hui Chen, and Sinn-wen Chen, National Tsing Hua University

Biological Materials Science Symposium Awards

First Place Poster: "A Novel Cardiac Patch for Treating Myocardial Infarction," *Juan Sebastian Rincon Tabares,* Juan Camilo Velasquez, Hayden Bilbo, Hai-Chao Han, and David Restrepo, The University of Texas at San Antonio

Second Place Poster: "Bone-Mimetic ß-TNTZ Alloy for Osteointegration and Antibacterial Property: A Rat Animal Model," *Ya-Ching Yu* and Ta-Jen Yen, National Tsing Hua University; Shih-Jie Lin, New Taipei Municipal TuCheng Hospital, Chang Gung Memorial Hospital

Third Place Poster: "Strain Field Mining of Steady-state Tearing Fields in Thin Film, Heterogeneous Fiber Networks," *Sarah Paluskiewicz* and Christopher Muhlstein, Georgia Institute of Technology

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A Multitude of Thanks for the TMS Foundation Donors

Kaitlin Calva

Although this year's TMS Foundation Donor Appreciation Event was virtual, it was no less a warm and welcoming environment for colleagues and friends of the TMS Foundation family to gather. Like the rest of the events and programming that were part of the TMS 2021 Virtual Annual Meeting & Exhibition (TMS2021 Virtual), this format was a first for those who signed in on Tuesday, March 16, for donor recogntion, informal networking, and a presentation from guest speaker Donald R. Sadoway.

Beginning with the usual introductions, TMS Foundation Board of Trustees Chair Garry W. Warren thanked the top donors who tuned in to the evening's festivities and reminisced about last year's in-person event held during TMS2020. "You are not only the premier donors to the TMS Foundation, but also stand as the top donors in a challenging year of disruption and coping with the global pandemic. Who would have thought last year sitting at our Donor Appreciation Dinner that it would be one of the last public events we would attend in 2020 and even into 2021?" Warren asked.

"You who are gathered here this evening are not only resilient in your own lives, but you also reached out to others in need in their lives with your financial generosity. Although the world changed, the need did not. The TMS Foundation and its many beneficiaries are deeply grateful to you."

Next, Warren recognized a special group of donors—the new inductees into the Foundation's Lifetime Giving Honorific Societies. "Your philanthropy expresses your personal values and shows your commitment to strengthening the future of the TMS family and the materials community," he said. The 2020 inductees are: **Silver Society:** Corbett C. Battaile; Brad L. Boyce; Ellen K. Cerreta; Amy K. and Kester D. Clarke; John Howarter;

Garry Warren, chair of the TMS Foundation Board of Trustees, greets prominent donors and guests and welcomes them to the virtual TMS Foundation Donor Appreciation Event.

Join Us Next Year

The TMS Foundation Donor Appreciation Event is held in conjunction with the TMS annual meeting to formally welcome new members to the TMS Foundation Lifetime Giving Honorific Societies and to thank all donors from the preceding year for their generosity and support. You can be a part of the next celebration at the TMS 2022 Annual Meeting & Exhibition (TMS2022), February 27–March 3, 2022, in Anaheim, California, by making a gift of $1,000 or more, or by increasing your lifetime giving to reach an Honorific Society.

To get special benefits as a TMS2022 attendee in addition to an invitation to the donor event, become a VIP donor with a contribution of $2,000 or more in 2021. Visit www.TMSFoundation.org for more details or to make a donation online today.

Cesar R. Inostroza; Paul R. Ohodnicki; Linda S. Schadler; and Olivia D. Underwood. **Titanium Society:** Viola L. Acoff; James C. Foley; George T. Gray III; Luis Ortiz; and Ray D. Peterson. **Gold Society:** Joseph D. Defilippi.

Another feature of this event was a special lecture by Donald R. Sadoway, the John F. Elliott Professor of Materials Chemistry at the Massachusetts Institute of Technology (MIT). Sadoway is a 2021 TMS Fellow and was recently honored with the new TMS Foundation named award, the Sadoway Materials Innovation and Advocacy Award. In his presentation, "Towards Profitable Sustainability via Liquid-Metal x Molten-Salt Electrochemistry," Sadoway detailed his career's work in emerging technologies for a sustainable future—specifically, the liquid metal battery and molten oxide electrolysis, both invented by his teams at MIT. To get to these innovations, however, Sadoway explained the paradigm shift that had to occur at the research level.

First, he started out by going to the "anti-experts"—his students—for help and inspiration. Sadoway was looking for "people who had no background in this area," he said. "All they wanted to do was change the world." Additionally, their path forward had to pose the right questions in order to achieve cost-informed discovery. With the liquid metal battery, for example, he instructed his team to confine the chemistry to Earth-abundant elements ("To make it dirt cheap, make it out of dirt!" he quipped), and make it easy to manufacture. Sadoway then discussed how these inventions made it to market through the creation of several startup companies and procurement of funding, and the exciting changes and possibilities in the future of the field. "It's a really good time to be an electrochemist, and it's a really great time for TMS."

Before the evening concluded with casual conversation between friends, Warren left attendees with a heartfelt parting note, thanking the Foundation's donors once again. "It's a simple word, donor. Five letters, but in it is a multitude of meaning—caring, generosity, diligence, and determination to make the present brighter for young people and the future secure for materials science. Thank you."

Donald Sadoway presents a special lecture entitled, "Towards Profitable Sustainability via Liquid-Metal x Molten-Salt Electrochemistry," during the 2021 TMS Foundation Donor Appreciation Event.

2020 Gold Society Inductee

Joseph Defilippi

2020 Titanium Society Inductees

Viola Acoff

James Foley

Rusty Gray

Luis Ortiz

Ray Peterson

2020 Silver Society Inductees

Corbett Battaile

Brad Boyce

Ellen Cerreta

Amy Clarke

Kester Clarke

John Howarter

Cesar Inostroza

Paul Ohodnicki

Linda Schadler

Olivia Underwood

JOM Vol. 73, No. 6, 2021
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JOM themagazine

TMS meeting headlines

TMS is committed to your safety during the pandemic. Meeting dates and locations are current as of April 20, 2021. For the most recent updates on TMS-sponsored events, visit www.tms.org/Meetings.

Other Meetings of Note

Offshore Technology Conference (OTC) 2021
August 16–19, 2021
Houston, Texas, USA

14th International Symposium on Superalloys (Superalloys 2021)
September 12–16, 2021
Virtual Event

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

Materials Science & Technology 2021 (MS&T21)
October 17–21, 2021
Columbus, Ohio, USA

Congress on Safety in Engineering and Industry 2021 (Safety Congress 2021)
November 1–3, 2021
Fort Worth, Texas, USA

TMS Materials Innovation Briefing: Focus on Pittsburgh
November 10, 2021
Cranberry Township, Pennsylvania, USA

2nd World Congress on High Entropy Alloys (HEA 2021)
December 5–8, 2021
Charlotte, North Carolina, USA

COPPER-COBRE 2022
November 13–17, 2022
Santiago, Chile

ICTP 2021

July 25–30, 2021
Virtual Event
Register Today!
www.tms.org/ICTP2021

- The 13th International Conference on the Technology of Plasticity (ICTP 2021) is dedicated to convening the breadth of the metal forming community to share their latest improvements and innovations in all aspects of metal forming science and technology.
- The in-depth program will feature eight plenary speakers, including Matthias Kleiner, Leibniz Association, and Pierre-Olivier Bouchard, Mines ParisTech, among others, and seven honorary symposia. Visit the website for details.

CELEBRATION AIME-TMS 150th TMS 2022 Annual Meeting & Exhibition SINCE 1871

February 27–March 3, 2022
Anaheim, California, USA
Submit Your Abstract by July 1!
www.tms.org/TMS2022

- The TMS 2022 Annual Meeting & Exhibition (TMS2022) is now accepting abstracts. Visit the website for a list of symposia plans and to share your work.
- TMS2022 will feature two co-located events:
  - The 7th installment of the REWAS conference series (REWAS 2022)
  - The Fourth Summit on Diversity in the Minerals, Metals, and Materials Profession (DMMM4)
- Join us for the continued celebration of the 150th Anniversary of TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) at TMS2022.

TMS AIM First World Congress on Artificial Intelligence in Materials & Manufacturing 2022

April 3–6, 2022
Pittsburgh, Pennsylvania, USA
Submit an Abstract by September 3, 2021
www.tms.org/AIM2022

- The inaugural TMS World Congress on Artificial Intelligence in Materials and Manufacturing (AIM 2022) is the first event of its kind to focus on the role of artificial intelligence in materials science and engineering and related manufacturing processes.
- AIM 2022 will convene stakeholders from academia, industry, and government to address key issues and identify future pathways.
- Abstracts are being considered now for inclusion in the technical program. Visit the website for submission instructions.

AM BENCH 2022 | ADDITIVE MANUFACTURING BENCHMARKS

August 15–18, 2022
Bethesda, Maryland, USA
Share Your Work by January 7, 2022
www.tms.org/AMBench2022

- The second Additive Manufacturing Benchmarks conference (AM-Bench 2022) provides a continuing series of controlled benchmark measurements, in conjunction with a conference series, with the primary goal of enabling modelers to test their simulations against rigorous, highly controlled additive manufacturing benchmark test data.
- Separate from the benchmark tests, the conference will also include technical sessions with a focus on additive manufacturing modeling, measurement, and characterization. Abstracts are due by January 7.

JOM Vol. 73, No. 6, 2021
https://doi.org/10.1007/s11837-021-04728-5

call for papers

***JOM* is seeking contributions on the following topics for 2021 and 2022. For the full Editorial Calendar, along with author instructions, visit www.tms.org/EditorialCalendar.**

December 2021

Manuscript Deadline: July 1, 2021

Topic: 2D Materials – Preparation, Properties & Applications

Scope: Since the discovery of graphene, interest in basic and applied research in 2D materials is on the rise. Challenges and opportunities continue to grow in the areas of process-property-performance correlations in 2D materials. Efforts to transfer technology from fundamental R&D to prototyping to manufacturing are being pursued rigorously on a global scale. Studies on carbon nanotubes, graphene, hexagonal boron nitride, perovskites, phosphorene, transition metal dichalcogenides, xenes (germanene, silicene, stanene) are of interest for this topic.
Editors: Nuggehalli M. Ravindra, Ramana Chintalapalle, Gerald Ferblantier, Sufian M. Abedrabbo, and Amber Shrivastava
Sponsor: Thin Films and Interfaces Committee

Topic: Advanced Casting and Melt Processing Technology for Light Alloys

Scope: This topic covers the newly developed or significantly improved casting and melt processing technologies applicable to light alloys. This may include advanced studies on the improvement of structure; optimization of phase composition, mitigation of casting defects as well as advances in casting and melt treatment technology. Also considered is the extension of the technology to recycled alloys. Both experimental and modelling studies will be considered, the latter requiring experimental validation.
Editor: Dmitry Eskin
Sponsor: Aluminum Committee

Topic: Advances in Processing, Manufacturing, and Applications of Magnetic Materials

Scope: We welcome the submission of papers on advances for synthesizing, processing, and characterization of magnetic materials including permanent and soft magnets, energy conversion, and multiferroic materials (such as magnetocaloric, magnetoelastic, magnetoelectric and magnetoresistive materials). Applications of interest include biological applications of magnetism, sensors and actuators, energy harvesting, motor-generators, transformers and inductors, and memory applications. Work on discovery, advanced manufacturing, processing and characterization techniques applied to the relevant magnetic materials and their applications, is strongly encouraged.
Editors: Scott McCall and Ikenna Nlebedim
Sponsors: Magnetic Materials Committee

Topic: Corrosion and Protection of Materials at High Temperatures

Scope: Papers on all aspects of high-temperature corrosion and protection of materials are invited. Examples of topics include oxidation in different atmospheres, molten salt corrosion, metal dusting, halogen attack, etc. Papers dealing with surface modification for high-temperature corrosion protection are also invited.
Editors: Vilupanur Ravi and Ramprashad Prabhakaran
Sponsor: Corrosion and Environmental Effects Committee

Topic: Surface Engineering for Improved Corrosion or Wear Resistance

Scope: Corrosion and wear are surface phenomena and therefore, surface engineering has been used to improve both properties. Coatings, surface alloying, gradient structures, nanocrystallization, and inhibitors have been applied to tailor the surfaces for improved corrosion and wear resistance. This special topic focuses on capturing recent advancements in: 1) surface engineering technologies to improve corrosion and/or wear resistance and 2) theoretical understanding of corrosion and/or wear behavior of the surfaces.
Editors: Tushar Borkar, Arif Mubarok, and Rajeev Gupta
Sponsor: Surface Engineering Committee

January 2022

Manuscript Deadline: August 1, 2021

Topic: New and Novel Laboratory and Pilot Techniques for Pyrometallurgy

Scope: Laboratory and pilot testing is critical for advancing our understanding of pyrometallurgical processes. Due to advances in analytical techniques and our understanding of pyrometallurgy, laboratory and pilot testing is advancing as well. This topic focuses on describing new and novel piloting and laboratory techniques, illustrating their use and the advances that have been made.
Editors: Stuart Nicol and Will Hanneman
Sponsor: Pyrometallurgy Committee

Topic: Technology Metals in the Circular Economy of Cities

Scope: The need for technology metals such as precious metals, rare earths, and minor metals (Sb, Co, etc.) will continue to increase. However, the recycling rate of these metals is inadequate. This special topic focuses on innovative recycling technologies that would improve recovery rate of these technology metals from municipal waste streams (MWSs). Manuscripts that address waste treatment and life cycle assessments pertaining to the (potential) recovery of technology metals from MWSs are welcome.
Editors: Fiseha Tesfaye, Joseph Hamuyuni, Chukwunwike Iloeje, and Alexandra Anderson
Sponsors: Recycling and Environmental Technologies Committee; Energy Committee; Process Technology and Modeling Committee

Topic: 4IR in Extractive Metallurgy

Scope: With the advent of the fourth industrial revolution, advanced digital technologies that facilitate engineering, design, optimization, and management are becoming increasingly pervasive across a wide range of industries. In extractive metallurgy, large processing plants often combine many unit operations together into highly complex and interdependent flowsheets, making them a rich field for potential application of 4IR technologies. This topic will explore past, present, and future research and development into the use of 4IR in the extractive metallurgy.
Editors: Chris Aldrich, Quinn Reynolds, and M. Akbar Rhamdhani
Sponsor: Pyrometallurgy Committee

February 2022

Manuscript Deadline: September 1, 2021

Topic: Characterization of Waste-Derived Materials

Scope: Papers are invited on the latest achievements in exploration of novel value-added materials derived from various wastes. In particular, papers on characterization and modification for those originated from mineral/metallurgical/material processing are welcome. Of interest are multifunctional slag/tailing-based materials with unique combinations of desirable thermo-mechanical-chemical performance for sustainable industrial and municipal applications.
Editors: Zhiwei Peng, Yunus Eren Kalay, Rajiv Soman, and Jian Li
Sponsor: Materials Characterization Committee

Topic: Artificial Intelligence and Machine Learning in Energy Storage and Conversion Materials

Scope: Artificial intelligence (AI) and machine learning (ML) have emerged as important tools for material scientists aimed at finding optimum solutions to complex scientific dilemmas. This special topic invites papers from industry, academia, and national labs that focus on AI and ML advances in field of materials design, characterization, and applications for energy storage and conversion.
Editors: Simona Hunyadi Murph and Surojit Gupta
Sponsor: Energy Conversion and Storage Committee

Topic: Bauxite to Aluminum: Automation, Data Analytics and New Processes

Scope: This topic covers automation and data analytics, fostered by developments and implementations of Industry 4.0, and also new processes or engineering technologies used throughout the primary aluminum production chain, from bauxite to aluminum. Papers are invited focusing on novel developments aiming to improve those processes, or on scientific/innovative approaches within these areas.
Editors: Jayson Tessier and Hong Peng
Sponsor: Aluminum Committee

Topic: Plasmonics in Nanocomposite Materials

Scope: Plasmonic nanocomposites are an emerging class of materials that integrate a plasmonic metallic nanoparticle with an assortment of other similar/dissimilar nanostructures leading to new multifunctional systems with improved functionalities and properties. This special topic will cover recent achievements in the design, fabrication, and application of plasmonic nanocomposites in different fields of science including material science, medicine, and industry, and it will cover their impact on global society.
Editors: Nasrin Hooshmand and Simona Hunyadi Murph
Sponsor: Composite Materials Committee

CALL FOR ABSTRACTS

AIME–TMS 150th CELEBRATION

TMS 2022
Annual Meeting & Exhibition

SINCE 1871

FEBRUARY 27-MARCH 3, 2022

ANAHEIM, CALIFORNIA, USA

#TMSAnnualMeeting

Join us next year in Anaheim, California, for the TMS 2022 Annual Meeting & Exhibition (TMS2022) and continue the celebration of the 150th Anniversary year of TMS and the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME).

TMS2022 WILL FEATURE:

DIVERSITY (DMMM4) IN THE MINERALS, METALS, AND MATERIALS PROFESSIONS

REWAS 2022
Developing Tomorrow's Technical Cycles

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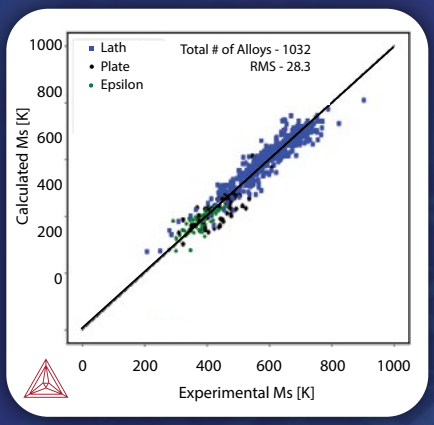
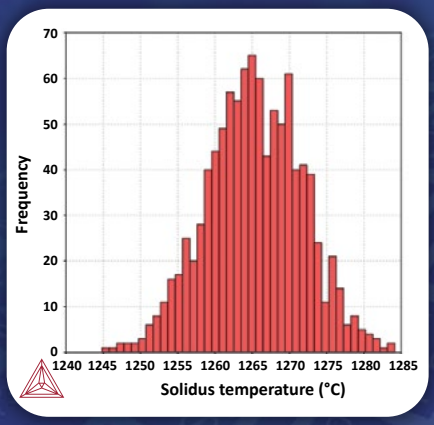


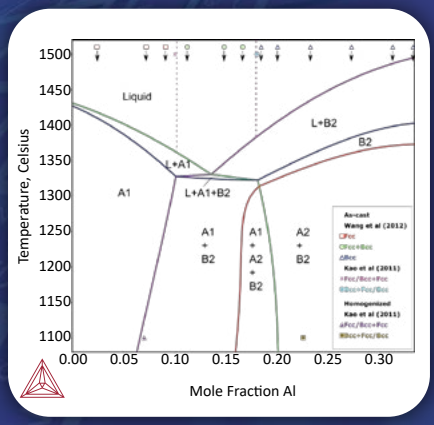
Comparison of calculated and experimental Ms temperatures for a wide range of steels

Nickel



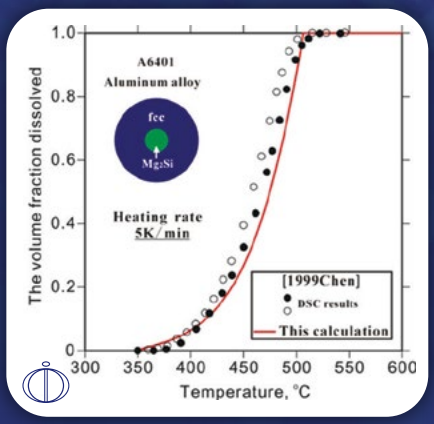
Variation in solidus temperature over 1000 compositions within alloy 718 specification

High Entropy Alloys



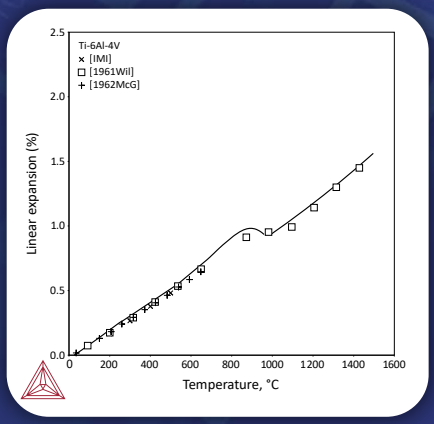
Calculated phase diagram along the composition line of CoCrFeNi-Al

Al Alloys



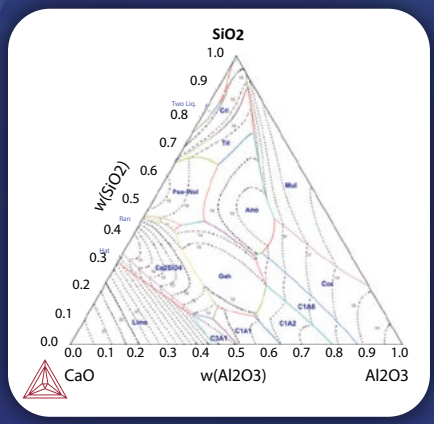
Dissolution of Mg2Si precipitate in Alloy A6401

Ti and TiAl Alloys



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

Oxides



Ternary liquidus projection in oxide systems

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